ATILIM UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF BUSINESS ADMINISTRATION
BUSINESS ADMINISTRATION MASTER'S PROGRAMME

MASS PRODUCTION EFFICIENCY & RESOURCE ALLOCATION: A MULTI-CRITERIA DECISION-MAKING STUDY IN AFRICA'S GARMENT INDUSTRY

Master's Thesis

Abdisamad ABUKAR OMAR

Ankara-2022

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Ankara-2022

ACCEPTANCE AND APPROVAL

This is to certify that this thesis titled "Mass production efficiency and resource allocation: A multi-criteria decision-making study of Africa's garment industry and prepared by Abdisamad Abukar Omar meets with the commitee's approval unanimously/by a majority vote as Master's Thesis in the field of Business Administration following its successful defense conducted on 29/12/2021.

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ETHICAL STATEMENT

I accept and acknowledge that I have prepared this thesis study, prepared in line with the Thesis Writing Guidelines of Atılım University Graduate School of Social Sciences;

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/ /2022

Abdisamad Abukar Omar

ÖZ

ABUKAR OMAR, Abdisamad. Seri Üretim Verimliliği ve Kaynak Tahsisi: Afrika'nın Hazır Giyim Endüstrisinde Çok Kriterli Bir Karar Verme Çalışması,Yüksek Lisans Tezi, Ankara, 2022.

Çalışmanın amacı, Afrika'nın hazır giyim endüstrisinde seri üretim ve kaynak tahsisinin verimliliğini incelemektir. Araştırmanın amacı, Afrika'nın hazır giyim endüstrisi için en verimli seri üretim ve kaynak tahsis yöntemini belirlemekti. Bu araştırmada, çok kriterli bir karar verme yaklaşımı, özellikle entegre bir AHP-TOPSIS modeli kullanılarak, seri üretim ve kaynak tahsisinin etkinliği çeşitli boyutlarda incelenmiştir.

Dört kriterler değerlendirildi: güvenilirlik, kabiliyet, uyarlana bilirlik ve son olarak, etkili kaynak yönetimi. Ayrıca 12 alt kriterler değerlendirildi: dağıtım oranı işlevsellik kalitesi, operasyonel makinelerin dayanıklılığı, üretile bilirlik derecesi, çalışan beceri düzeyi, pazarlanabilir bir meta yaratma yeteneği, esneklik, çok yönlülük, çalışan zamanını yönetme, tekrarlayan hataları düzeltme oranı, çalışan verimliliği ve son olarak, geri dönüşüm çabasının derecesidir.

Bu kriterler dört kalemi kapsamaktadır. Bunlar yalın üretim, yalın altı sigma, toplam kalite yönetimi ve çevik üretimdir. Ağırlıkları belirlemek için AHP ve söz konusu tüm kriterlere göre her bir alternatifin performansını derecelendirmek için TOPSIS kullanılmıştır. TOPSIS'in tüm hesaplamaları Microsoft Excel kullanılarak yapılmıştır.

Anahtar Sözcükler: AHP, TOPSIS, Çok kriterli karar verme, Seri üretim verimliliği, Uygun kaynak tahsisi.

ABSTRACT

ABUKAR OMAR, Abdisamad. Mass Production Efficiency & Resource Allocation: A Multi-Criteria Decision-Making Study in Africa's Garment Industry, Master Thesis, Ankara, 2022.

The study's objective is to examine the efficiency of mass production and resource allocation in Africa's garment industry. The purpose of the research was to determine the most efficient method of mass production and resource allocation for Africa's garment industry. The efficiency of mass production and resource allocation have been examined in various dimensions in this research, utilizing a multi-criteria decision-making approach, specifically an integrated AHP-TOPSIS model.

For the purposes of this study, to test the concept of increasing mass production efficiency and optimizing resource distribution in African apparel industries, Four criteria were evaluated: reliability, capability, adaptability, and finally, effective resource management and 12 sub-criterial, which included the rate of distribution, the quality of functionality, the durability of operational machines, the degree of manufacturability, employee skill level, the ability to create a marketable commodity, resilience, versatility, managing employee time, the rate of correcting recurrent errors, employee productivity, and finally, the degree of recycling effort.

There are four options: lean manufacturing, lean six sigma, total quality management, and agile manufacturing. AHP was used to determine weights, while TOPSIS was used to rate each alternative's performance against all of the criteria in question. All calculation of TOPSIS were done using Microsoft excel.

Keywords: AHP, TOPSIS, Multi-criteria decision making, Mass production efficiency, Proper resource allocation,

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INDEX OF ABBREVIATION

AGOA	**African growth and opportunity act**
AHP	**Analytical hierarchy process**
CEO	**Chief executive officer**
CFO	**Chief financial officer**
CI	**Consistency index**
DM	**Decision making**
GDP	**Gross domestic product**
JIT	**Just in time**
LM	**Lean manufacturing**
LP	**Lean Process**
LSS	**lean six sigma**
MADM	**Multi-attribute decision making**
MCDM	**Multi-criteria decision making**
MODM	**Multi-objective decision making**
OECD	**Organization for economic cooperation and development**
RCI	**Random consistency index**
SPSS	**Statistical package for social sciences**
TOPSIS	**The technique for order of preference by similarity to ideal solution**
TQM	**Total quality management**

INTRODUCTION

Background

Humans seldom consider the origins of their goods, and the majority of us are unaware that each and every man-made item we come into contact with is the result of countless hours of labor. It becomes even more frightening when we remember that prior to the advent of production, goods were handcrafted and could take days to complete. Manufacturing has a long history, and we have come a long way.

Manufacturing is evolving, from product design to the processes and tools used to create goods for use or sale. It dates all the way back to the Industrial Revolution of the nineteenth century, when raw materials were turned into finished goods. During this time period, artisans became wage earners as human labor was displaced by technology and industrial production processes (Corporate finance institute, 2015).

Manufacturing has traditionally been described as an industrial production process that transforms raw materials into finished goods for sale. Manufacturing is now viewed as an interconnected phenomenon at all stages, including machinery to manufacturing processes to the overall operation of a company (Esmaeilian, Behdad, & Wang, 2016).

The production of goods is vital to a country's economic health. The manufacturing industry has gone through many technological breakthroughs since its inception two centuries ago (Hu , 2013).

With the very first industrial revolution and industrialization, mass manufacturing began, the manufacture of the same uniform product offerings for an extended period is known as mass production.

It employs automation or assembly lines to enable the mass processing of related goods in enormous quantities. The incorporation of the concepts of productivity, division of work, and component optimization to the production of products is involved in this process of mass production.

Since its inception, the slogan of industrial production has been the integration of solitary machines and unskilled labor to manufacture uniform products. In general, mass manufacturing started in the first half of the twentieth century, when Henri Ford introduced the assembly line. Ford entered mass production by lowering the price of

the Model T automobile, which was launched in the fall of 1908. In 1908 and 1909, a fully fitted touring Model T cost about $950; seven years later, in 1916, the equivalent Model T cost $360 (Haslam , Williams , & Williams, 1992).The concept of interchangeable parts aided ford in his venture of mass producing.

The aim of large-scale production is to keep manufacturing costs low by producing uniform goods using standardized, repetitive processes.

The drastic decrease in material cost and processing time affected many sectors, such as the garment industry, and much has been published about the empirical essence of mass production. Not only did the transition from man to machine transform the manufacturing process, but it also shifted the market dramatically.

The importance of manufacturing is undeniable, and the continuous evolvement of mass production is one that has significantly contributed to the upward development of human lives albeit raising many eyebrows. This is in places like Africa today where the age of industrialization did not occur massively and manufacturing is not a strong hold, much research is arguing today that this majestic continent needs to do so in order to create jobs for its growing young population.

Garments have indeed been circling the globe for decades, collecting tales along the way. Most of these textiles originate in Africa, travel through it, or end up there. Cloth spreads through oceans, deserts, and so much more, it binds common people to wealthy markets, and it bridges innovations by incentivizing creativity, Fabrics are followed by a plethora of stories as they travel. Garment and clothes are highly recognizable and endlessly resilient, and they are deeply related to the people who wear them, so these representations are especially vivid. They leave their imprints on locations, individuals, and backgrounds, and they pick up new connections as they pass (Rovine, 2017).

For the vast majority of Africans, the question of jobs is much more about work quality than job availability. Low unemployment is often correlated with low-quality jobs, When an African worker finds employment, it is likely that it will be of inferior quality in terms of pay, benefits, and job security. Furthermore, Poverty in Africa is a bit of a conundrum Although individual state experiences differ. The mystery is that of all the emerging economies, Africa has the least responsive poverty to per capita income growth and the least responsive poverty to shifts in income distribution. We

know that the distribution of income affects the rate of poverty reduction with every rate of income growth (Why Industry Matters for Africa, 2016).

Africa has long been trying to stand on its own two feet, after independence most African countries were busy getting their political affairs in to order and so most basic issues were neglected or deferred, now off to a new millennium and Africa is desperate to get into the fold. Though Africa is trying to realize its potential, they are a few issues that need to be addressed. Primarily, the population dynamics of Africa is alarming, Sub-Saharan Africa's population is growing at a rate of 3% per year, the world's highest rate of growth. Half of Sub-Saharan Africans are under the age of 20, 20% are between the ages of 0 and 5.

These are the world's youngest populations in terms of proportion. Demographic trends and the need for population policies are becoming more commonly understood. Most African governments have now made a public effort to minimize fertility and/or provide family planning services. The African Development Bank acknowledged the need to slow population growth for the first time in 1992 (Segal, 1993).

Around 1950 to 1995, Africa's population expanded at a 2.6 percent annual rate, more than trebling to 561 million people. This rate of growth is unprecedented in the history of the world's major regions over comparable time periods. In contrast to Asia, much of Africa is sparsely populated, with an average population size of twenty-five inhabitants per square kilometer. Infrastructure projects such as road networks, telecommunications systems, port operations services, and urban sewerage appear to be more expensive when population sizes and rates of urbanization are low. They are thus significant considerations in the awfully harsh conditions of African infrastructure, in addition to low income (Bloom, Sachs, Collier , & Udry, 1998).

This further cement the argument of Manufacturing still being critical to Africa's systemic transformation. Despite previous failures to industrialize, a new timeframe could be opening. This is due to the emergence of the Fourth Industrial Revolution's due to emerging innovations and a revival of start-up entrepreneurship (International Labour Organization , 2020). Manufacturing jobs are generally of higher quality than agriculture or even service jobs around the world. This seems to be the case in Africa as well, as only 5.4 percent of the working poor worked in

manufacturing from 2002 to 2012, compared to 16.4 percent in the service sector and 78.2 percent in agriculture (International Labour Organization , 2020).

Uzor (2011) says, the growing pace of economic populism, helped by lower entry barriers to development, has placed pressure on countries to develop their manufacturing capabilities. Since the 1980s, the globalization process has intensified the growth of global imports and exports, as well as increased cross-border Foreign Direct Investment (FDI).

You see the very nature of industrialization and the ability to mass produce has strengthen the capabilities of nations economically and socially and thus Africa's apparent need to build opportunities.

International Labour Organization (2020), Significantly states that Africa's demographic is youthful and rapidly growing with more than one billion people already making it the second most populated region in the world after Asia. Africa's economic recovery has received a lot of praise for it. Despite the fact that the gap between Africa's Earning per ratio and the rest of the globe is decreasing, employment levels on the continent continue to be greater than elsewhere. Due to the fact that there are more individuals employed in some capacity in Africa than there are in any other region of the world, this is the case, the year before that had been.

Industrial development has the potential to change women's lives in addition to creating decent employment and driving poverty reduction. For a long time, manufacturing expansion has been linked to increased female labor force participation. This boosts household income and can improve women's self-confidence. Quite notably, research has been done that manufacturing benefits women employees in other respects. There is some evidence that factory workers raise the likelihood of girls staying in school and deferring marriage an issue that has become plague like to Africa by rising the educational attainment and raising the opportunity cost of marriage (Why Industry Matters for Africa, 2016).

The benefits of manufacturing or mass producing are numerous, and they deliver a foundation for hopefulness in Africa. There might be more space for Africa to succeed in the sector. To take advantage of the opportunity the area must first develop a foundation and proceed to conquer the expansionary policies of ubiquitous

nature especially in the garment industry. Given its late industrialization and excitement for mass production's promising prospects.

Africa still has the capacity to master all stages of the production process efficiently and to expand both vertically and horizontally in the global arena in just a few decades. African countries can easily be molded to become economies that excel in increasing the diversity and complexity of their products and services (The World Bank, 2014).

Factory jobs, on comparison, are higher than those in key sector for a plethora of purposes. The main factor is that they are concentrated in towns, where workers are better paying, monitored, and secured. Municipalities can have a variety of services that enhance people's standard of living, and production jobs allows individuals to work in towns. The African continent has recently recognized that it must move beyond exporting raw materials to foreign countries and instead has started to focus on expanding efficiency and competitiveness to meet the needs of Africans. Efforts to bring more manufacturing to Africa have already proven successful and yielded huge opportunities (International Labour Organization, 2020).

The notion of Africa becoming more industrialized is not fresh. After Africa achieved independence, rulers in former British, French, and Portuguese colonies held common views on the value of industrialization, which were influenced by an urge to modernize their predominantly agrarian economies and reduce their dependency on former colonial powers (Signé, 2018).

Post-independence politicians on the region, such as those in many emerging regions in the 1960s and 1970s, saw industrialization as the path to sustainable economic and social development change. Those ambitions have been minimally realized. Dating back to the late 1950s, newly installed regimes across Africa attempted to foster government industrial development (Industrialization Efforts and Outcomes, 2016).

Industrial mass production, in actuality, is increasingly funding significant advancement and employment in absolute numbers. Its contribution to The GDP has remained very stable in Africa than anywhere else, manufacturing adds to better labor productivity growth, and industrial jobs are of better caliber than those in many services and agriculture areas (International Labour Organization, 2020).

The general image of the African industry is that it is struggling and that the continent is de-industrializing. However, when the overall scale of manufacturing in Africa is considered, a different story emerges. For instance, rather than deteriorating, manufacturing's total value-added has nearly tripled since 1980, rising from US$ 66 billion to US$ 158 billion in 2015. Surprisingly, the majority of this rise occurred after the year 2000 (International Labour Organization , 2020).

Problem Statement and Motivation of the Study

Africa has a wealth of resources, and they account for a sizable portion of government revenues, and they have the potential to become much more important. But When corruption is widespread, and laws are not enforced, while people are left to fend for themselves, confidence in African governments and companies dilutes. Corruption is a major factor in the development of African resources, and it seems that there are no implications for it. Significant sums of money are often involved, many operations are inaccessible, most legal duties are confidential, and elected officials have unrestricted power over resources, all of which can inspire and facilitate these dishonest and immoral behaviors which led to fraud.

The majority of resource-rich African states lack specialized educational institutes for natural resource management. Human capital, on the other hand, is a critical component of economic development.

And is one of the conceptual pillars of both the African nations and its citizens. Perhaps more intriguing is the region's still-abundant future workers, Africa is home to over a billion people, the bulk of which are under the age of twenty.

With 30 percent of the world's estimated resource reserves and a rapidly increasing population, Africa's underdeveloped capacities and reliance on imported natural resource management capabilities is alarming (Nguegan, 2017).

African Garment industry has been no stranger to scrutiny in the past, issues like poor governance and corruption has been a recurrent theme in Africa as whole but such allegations have also been threatening Africa’s textile industry. While other threats like inefficiency of production, poor resource allocation and time mismanagement are not to be taken lightly either.

In an industry, resources should be well utilized for optimal success these resources include both the supplies needed to produce a merchandise and the employees needed. The problem in many African industries remains to be how to reach maximum efficiency and the proper allotment of resources to perfectly prosper (African Development Bank Group, 2019).

Research Questions

The fundamental problem of Africa's garment industry is fiercely contested, ranging from fierce competition to industry mismanagement to revenue misappropriation, fluctuating natural circumstances, and even some man-made disasters. In view of these concerns, this study will be planned to address the following questions.

1. How does the stimulus of mass production result in the push for industrial productivity today?
2. What is the most intelligent strategy for deciding the ideal mass production efficiency in Africa's garment industry?
3. What is the resource allocation scenario for Africa's garment industry?
4. What role does resource allocation policy play in production efficiency?
5. What approaches should be employed to enhance the effect of mass manufacturing while also competently allocating resources?

Research Objectives

The aim of this research is to figure out what role adequate resource allocation and successful mass production strategies play in the overall productivity of Africa's garment industry and how these strategies can be modified to affect the apparel industry's sales and growth maximization in Africa. As a result, the below objectives are the research's key targets and are categorized in to four.

1. To determine Africa's production performance in the garment industry
2. Selecting the most suitable way of distributing resources in Africa's garment industry for optimal performance.
3. To identify the priorities and requirements for peak productivity

4. To explore at multi-criteria decision-making strategies for improving output efficiency in Africa's garment industry.

Scope of the Study

This study is regulated to the African garment industry, and only data and from this industry will be considered, though other industries or similar industries in Africa or other parts of the world will be used as references to show progress or failure in some way related to our subject.

African countries which were afflicted by heavy conflicts were excluded although most were covered due to scarcity of such industries in one nation or a few nations in the continent.

The Hurdles to this master thesis subject can arise in a wide and diverse continent like Africa, and these hurdles can be the scarcity of data analyzed by experts employed in the garment industry sector.

Multiple-criteria decision-making, also known as multiple-criteria decision analysis, an operations research sub-discipline that looks at how to make decisions based on multiple conflicting criteria. Which in layperson terms refers to a variety of approaches that have been developed to help decision-makers make well-informed decisions will therefore be carried out in context of a hybrid or rather integrated Analytical hierarchy process (Ahp) and The Technique for Order of Preference by Similarity to Ideal Solution (Topsis) will be evaluated and analyzed to the precise requirement of examining Africa’s garment industry.

CHAPTER 1: LITERATURE REVIEW

1.1 Africa's Industrial Transformation Efforts

Figure 1: A map of Africa (king & Cole, 2018).

Following the year 2000, African countries pledged their support to mass producing by means of an industry as part of a wider initiative to consolidate their economies and build productive capacity in order to achieve high and sustainable economic growth, job creation, and significant poverty reduction. The expectation was that manufacturing would contribute to a growth of the export market. Although agriculture's share of total household spending declines as per capita manufacturing's share rises, according to one version of Engel's law. The inference is that

manufacturing provides substantial platform for conducting export markets and, as a result, could be a catalyst of product economic growth (Kapunda, 2017).

While Africa's labor force is rapidly expanding, employment in manufacturing and other high-value-added activities is slowing. This trend shows you how systemic change has some major consequences for job growth and poverty reduction. Furthermore, there is a chance that systemic reform in Africa will fizzle out. Ser vices have been absorbing jobs at a faster rate than the sector's productivity has increased (Why Industry Matters for Africa, 2016).

Among the most important recent developments in the area is China's expanded presence in Africa over the last decade. It seems to refute the notion of Africa's global disenfranchisement and has important economic implications (Tull, 2006). Whether these implications are of virtue or vice is yet to be determined, especially in the industrial sector. It is no secret that China is exploiting African resources to produce goods in Chinese industries the unanswered questions remain to be at what extent and at what cost.

Surprisingly China's continuous interest in Africa might even be a win-win situation for some of the African country's China are involved because of the Asian country's ambitious investing in infrastructure such as roads in countries like Kenya which they have built a superhighway that extends for kilometers and have spent billions of dollars (Vieira, 2019).

But what is happening to African resources? and this does not apply only to China, but also European nations who have been taking resources from Africa and manufacturing them in European industries for centuries.

Although today almost all African nations have the resources to establish a proper industry, rather many nations opt to sale their said resources to foreign nations, never the less countries like Ghana have paved the way for other African nations to follow whose president recently withheld resources to countries like Switzerland in order to force their hand in investing in his country rather than foreign countries buying African resources in bulk and manufacture them in European industries. By insisting to build industries in Africa and particularly in Ghana, his excellency president Nana Akufo-Addo is bringing jobs to his people, which will in turn help in the unemployment crisis in Africa and raise the standards of living, and as a nation, cities

will begin to urbanize and slowly but surely infrastructures will begin to adequately appear. Then throws Africa as a continent in the limelight and it motivates African leaders and to mimic Ghana's efforts to industrialize Africa whole heartedly with the intention of bringing jobs to their citizens and unanimously increasing the standards of living (Pilling, 2021).

If industries are built in Africa, it is just a slippery slope from there, a Pandora's box if you may like with each revelation in it much better and much significant than the other. A whole continent has been inspired simultaneously as if it was not an arbitrary matter to match its energy and majesty with its growth, to do so though it needs industries that are capable, and dependable. The demand for higher value at a lower price is growing, and apparel manufacturers must boost their operations and shorten their lead times to stay afloat (Shekar, Beloor, & Hegde, 2020).

Most Asian industries that are competitors to Africa's apparel industry are utilizing this ideology and hence a simple explanation for their undisputed success. you see price and quality are the two unspoken rules of any business, be it service based, or product based, getting low prices and excellent quality in the same product or service is like a needle in a haystack. Competing with such a rival is very though, hence you can now see the predicament Africa is in now competing with countries like Bangladesh whose reputation precedes it.

Aside from this Africa needs to control its operating time and structure to be at least on par with Asian nations who have been in control of the textile industry for decades now. To ensure business continuity in today's world of fierce competition, an organization must reduce operating downtime by changes in current working methods (Shekar, Beloor, & Hegde, 2020). Amid its capacity to minimize worsening unemployment, poverty, and raise economic power, and increase the impact of various African nations and the continent as a whole on the global market, the African textile industry has suffered many setbacks over the centuries.

Over the last quarter-century, the global economy has undergone substantial improvements. Manufacturing exports have outpaced manufacturing output growth, and developing countries are gaining a greater share of the global market in both static and dynamic manufacturing. Asia has become the "world's factory" as industrial activity has moved to developed countries. East Asia and the Pacific generate about 58 percent of the manufacturing value added in developing economies, with China

accounting for more than half of that. From 2000 to 2010, export growth from Sub-Saharan Africa developed at a rate of 14.5 percent per year on average. However, this development was insufficient to keep up with the rest of the developing world. Over the same time, the region's share of industrializing countries' manufacturing exports fell from 3.5 to 2.8 percent (Can Africa Break In?, 2016).

China, Bangladesh, and Vietnam are the world's top three textile exporters. The Vietnamese textile and garment industry alone generated upwards of US$ 39 billion in export revenue in 2019, accounting for 16 percent of GDP. The textile industry has expanded at an annual rate of 17 percent on average over the last five years (Dao , Tran, Nguyen, Ngoc , & Barysheva , 2020).

The rise of Asian Countries has shown that new competitors to global markets might succeed. The Asian success story, on the other hand, demonstrates what is required. Asia only became a major player in global manufacturing in the 1980s. By that time, the difference in per capita income and wages between China and the OECD economies had grown large enough to compensate for the higher growth opportunities (Can Africa Break In?, 2016).

While the rapid expansion of Bangladesh's clothing industry is well established, the industry is now one of the world's biggest exporters of garments. It produces 75% of the nation's total exports and provides plenty of work opportunities for women (Abdul Mottaleb & Sonobe, 2011).

Bangladesh has established itself as one of the leading manufactures of garments, they did so by maintaining a status quo and ruling the garment industry with an ironist for more than a decade now.

By looking at these statistics you would think that the garment and apparel industry in Africa is in serious trouble. Imports (particularly from Asian countries) hurt it domestically, and it finds it difficult to succeed (Merz & Jauch, 2006). Salvation though for Africa and its garment industry because today Apparel factories in Sub-Saharan Africa are now granted special privileges, similar to Bangladesh three decades ago, with duty-free and quota-free entry to the US market offered by the African Growth and Opportunity Act (AGOA) (Abdul Mottaleb & Sonobe, 2011). Although the barriers are daunting, we can boldly claim that there are many reasons to suspect that Africa will start to compete with Asia someday or at the very least hope.

One very apparent reason is Asia's increasing costs. Asia's rapid development has resulted in increasing manufacturing production costs. Asia unprecedented success has come with consequences.

And one such consequence is an attack on Asia's main attraction in the first place. And this has led manufactures to second guess Asia's capabilities in providing economical comfort. In Asia, terrain can also play a role, due to Africa's better geographical position and its convenient access to all the continents. Furthermore, Asia's geographic position can pose a challenge in terms of transportation costs, and this is additional headache for most (United Nations, 2020).

Another reason may be Asia's attempt to shift its focus with countries like China, Malaysia, and Thailand, among other influential Asian industrializers, are making deliberate efforts to improve the sophistication and technical complexity of their manufacturing.

Malaysia and Thailand have high- and medium-technology export shares of more than 70% of total exports Across the same time, China has Ramped up its medium and export growth share from 45 percent in 2000 to 59 percent in 2010, while Vietnam increased its medium and high-technology export share from about 25 percent to nearly 34 percent.

This is partly a market reaction to increasing wage growth. It also creates a tendency to emulate Japan's, and Korea's, successful experiences in transforming industries to sustain development. Fewer technologically advanced entrants ought to be eligible to join new markets and product groups as countries advance technologically (Can Africa Break In?, 2016).

Africa has made a huge contribution to the development of the global economy. Since it was marginalized during the colonial period, Africa has made inputs such as natural resource trade to serve as a source of raw materials for European imperialists. In recent times, there has been an increasing interest in transforming Africa beyond the supply of raw materials to the expansion of productive capabilities that meet the needs of Africans.

Today the continent is trying to comprehend the degree of application of its current productive capacities, as well as the factors that influence their development. African economies are rich in natural resources, especially in mining clusters. It is

possible that if these resources were optimally mobilized by progressive efficient activities, the economic transition needed to meet the needs of the African people will be achieved. This type of resource mobilization is also essential for the African continent to achieve economic self-sufficiency (Fotoyi, 2020).

Several structural steps have been introduced to put the sector back to full capacity, with a specific emphasis on real worth activities, infrastructure growth, and democratic governance. South Africa, and Kenya are among the countries that have adopted these new reforms, and as a result, their economies have improved in terms of revenue generation, job creation, and GDP growth (Tulinabo, 2014).

Several European retailers, including H&M, Primark, and Tesco, have started sourcing some of their garments from Ethiopia in the last two years. The rest of the apparel industry took notice and as a result interest in all East African countries as potential apparel sourcing destinations has increased since 2013. The resurgence of African agriculture is also adding to the thrill (Berg, Hedrich, & Russo, 2015).

1.2 Productive Mass Producing in the Garment Industry

Over time, the structure of Africa's modern industrial economy has become more diverse, and as a result all eyes are on Africa today. In Asia, the garment industry continues to be a dominated market, while in Africa, it has remained unnoticed Nonetheless, it has potential to be tantalizing (Cheru & Obi, 2010).

The extractive industries (oil, gas, and mining) are significant portions of the economies of many African countries. These natural resources have the potential to provide a tremendous opportunity for development if properly tapped. To generate equitable growth, the country must utilize its natural resource base, which entails turning the country's subterranean resources and agricultural potential into human and physical capital. To facilitate the expansion of profits from the textile industry's value chains, Africans and their governments now impose strict enforcement and perform ongoing monitoring and evaluation to protect African resources. This is because, through consultation and cooperation between African leaders, the continent's mineral resources can bring about the economic change needed to meet the needs of the people, and as a result, regulations must be amended for the betterment of the people (African Development Bank Group, 2021).

Productivity can be defined as a proportion between the quantity of the output and the volume of the inputs. In other words, it assesses how effectively a country's manufacturing inputs, such as labor and capital, are used to generate a given amount of output. Productivity in any industry can be analyzed using two types of production representations sectoral and value added.

Sectoral production is a broader measure of output that excludes intermediate inputs generated within an industry or sector from gross output, which is the total value of products and services produced. Continued increases in productivity growth allows an economy to produce more goods and services without adding to its workforce, resulting in higher living standards (Eldridge & Price, 2016).

When the word efficiency is used in a broader context, it refers to a measure of achieving the best results for the least amount of money. Cost of Production per Unit of Output can be considered a very satisfactory and consistent level of efficiency. An industrialist, on the other hand, would look at performance from a different angle (Palmer & Torgerson, 1999).

The criteria for measuring efficiency can differ depending on the target. It is also worth noting that none of the various methods for determining performance is completely sufficient in and of itself. If both of these parameters are used, there is a good chance that the distortions caused by any one of them alone will be easily offset (Mehta, 1950).

During times of economic expansion, productivity indicators tend to increase, whereas productivity decreases. This is due in part to insufficient measurement. Despite the fact that economic statistics can track cyclical changes in output volume with great precision, they are unable to detect changes in the rate at which inputs are being utilized. particularly, fluctuations in the capital equipment utilization rate.

Productivity is calculated in terms of value added per hour worked, which necessitates the collection of reliable input and output data. and productivity of various industries varies a lot from state to state and there are many disparities in competitive advantage. For a company, they must be able to compete in their own area as well as against the best foreign producers to be considered globally competitive (Pilat & Schreyer, 2001).

A globally competitive industry may or may not be the pioneer in terms of productivity. Industries that are globally competitive will compete against import production from the best external suppliers in their home market. Industries that are globally competitive may either export a massive portion of their output to the home markets of the best external producers.

Competition's existence may be a key indicator of relative productivity levels. However, this finding is vulnerable to the charge that we are only seeing what we want to see. What we already know about competitiveness will influence our assessment of the range of competition (Baily, Gersbach, & Scherer , Efficiency in Manufacturing and the Need for Global Competition, 1995).

The predicament of whether the productivity of an industrial unit can be quantified, and if so, what level of measurement can be applied with acceptable accuracy, is often posed. Although it is generally accepted that an absolute calculation of efficiency is impossible, the relative efficiency of various units can be calculated with reasonable accuracy (Pilat & Schreyer, 2001).

The concept of efficiency, as it is commonly known, is a relative one, and we consider a unit to be effective or ineffective in relation to other units rather than in isolation. Consequently, it assumes the existence of certain established standards of evaluation.

In this sense, we assume that such performance can be quantified, but not with scientific precision. As a result, the main source of complexity is to determine what criteria are acceptable. The value we place on the word efficiency has a major impact on the suitability of a unit of measurement (Mehta, 1950). Absolute productiveness can be interpreted broadly to mean a better quality of life for workers, cheaper costs for clients, and better returns for investors. As it can lead to all these if carefully followed with full co-ordination (Mehta, 1950).

Manufacturing has always had a higher rate of productivity growth than other sectors in all economies. Financial markets that have kept production at a relatively high share of output have continued to rise faster than the average. And because of the incredible diversity of industries, it has become increasingly hard to ascertain how specific industries progress within a market, which projects account for most of the productivity growth, and how important entry and exit are to industry growth.

Therefore, the garment industry should imminently identify its strength to ascertain its specific factor that can help in measuring its productivity and effectiveness (Nandhakumar & Rajarathinam, 2017).

Most of the conventional study of productivity in industrial sectors has been focused on a framework wherein similar, equally competing industry react in the very same manner to factors that influence the sector. In recent times, there has been a surge of interest in developing the modern economics of productivity research and rectifying it with systems of industrial organization. On a global scale, the contribution of various industrial groups to improved business productivity has been praised. The development of manufacturing productivity is driven by growing production levels in elevated factories and decreasing output shares in low-productivity factories (Baily, Charles Hulten, Campbell, Bresnahan , & Caves, 1992).

Although profits and losses are certainly essential measures of a firm's success or failure, they cannot be considered as the only as well as the most essential aspect of the industry's performance. Profits are the product of a number of variables, and because efficiency is just one of them, establishing a link between the level of profits obtained and the productivity levels achieved by various units would not be entirely accurate. As a result, the profit rate as a measure of productivity would have to be assessed considering a number of requirements and caveats (Mehta, 1950).

Mehta Continues by saying the cost of production per unit of output is the most accurate and dependable metric for measuring the results of different units. The higher the productivity of an industrial plant, the lower the cost per unit of production. It hardly needs to be said how complicated it is to procure and validate costs for various units.

1.3 Effective Resource Allocation

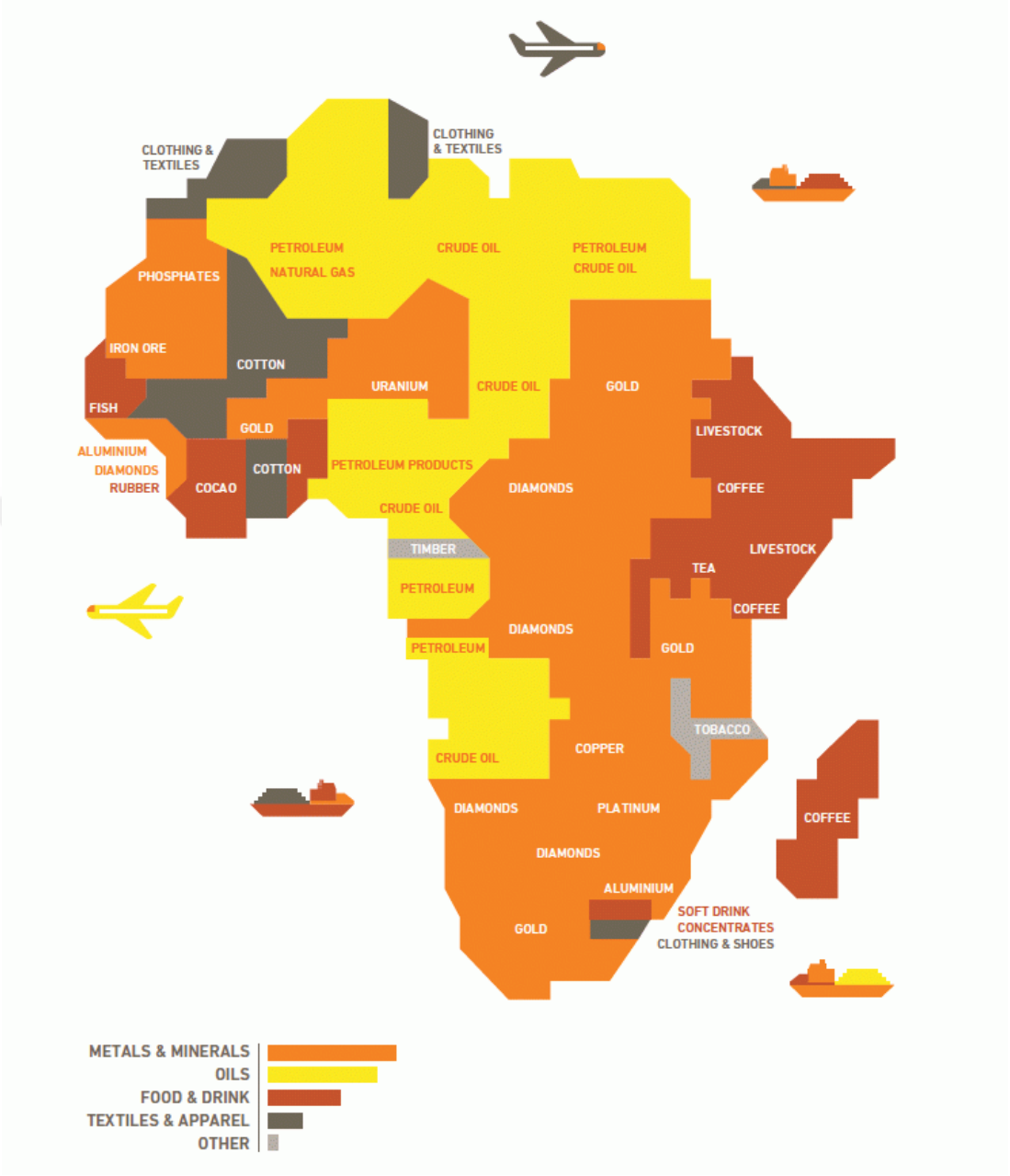

Figure 2: A resource map of Africa (Hklm 2017).

The cumulative importance and abundance of all company resources and asset interactions can be understood as a function of a firm's competitive advantage. The tangible or intangible financial, human, intellectual, organizational, and physical entities available to the firm that allow it to increase its competitive advantage are referred to as resources.

When two firms enter into a resource sharing arrangement, both assign tangible and intangible assets to the relationship from which the partner firm profits. Resources are said to give a company a long-term competitive advantage if they are important, unique, and difficult to duplicate or substitute (Pulles & Schiele, 2013). Thus, the importance of effective allocation of resource is undeniable, the ability of using resource in a production with the at most heedfulness is an art very few possess it does not only save on costs but also increases productivity indefinitely.

The misallocation of resources across firms, which is described as a deviation from the optimal allocation of resources, is being linked to these differences in aggregate productivity, according to a growing body of literature. The optimum utilization in product and increase of heterogeneous firms has positive effects on firm efficiency and size Allocative productivity necessitates wise resource allocation. We can see that the most profitable companies are often the biggest at any given time. Studies show that constant allocative efficiency, or the intensity of the relation between firm productivity and size, varies widely, with important consequences for aggregate productivity (Andrews, Cingano , & Conconi, 2014).

The degree to which, all other things being equal, more profitable firms command a greater share of aggregate jobs, which would be the result of past periods resource changes. the contribution of sectoral allocation to overall economic performance, admittedly, measures of productive efficiency based on the within industry correlation coefficients between a firm's size and its productivity level differ greatly across countries, meaning that some are better at channeling resources to high-productivity areas than others (Friebel & Raith, 2010).

When an economy has distortions, such as when marginal product or marginal value of inputs is not equal across goods, resource misallocation occurs. In this case, an effective reallocation of production factors from low to high-productivity firms will increase aggregate output. Firm-specific distortions are a major component of a growing theoretical literature. The competitive advantage of firms in clusters cannot be explained solely by resource exchange. Competitive advantage, according to the resource-based view is a relative concept that means that businesses must acquire better resources than their rivals in order to be competitive. Companies who have a comparative advantage in resource access would have an easier time achieving a competitive advantage (Andrews, Cingano , & Conconi, 2014).

To succeed and survive firms need to use resources wisely to do so though smart plays should be put in place, and wastefulness of resource should be greatly discouraged. To have a competitive advantage this means that precise measurements should be put in to play for the right outcomes. Although these measurements do not guarantee automatic salvation, they are a steppingstone for a competitive edge over rivals in any industrial setting particularly Africa's garment industry (Mwai, Namada, & Katuse, 2018).

Andrews, Cingano & Conconi (2014) state that few inequalities are, in reality, a key component of a growing academic framework that attempts to explain efficiency disparities between countries or industries by misallocating capital across firms within each country or industry. Although most papers are agnostic about the source of such knowledge, the possible relation among policy-induced distortions and allocative efficiency is probably most obvious in the context of size contingent laws, such as labor market regulations that only apply to businesses above a certain size threshold.

When firms are heterogeneous, size-contingent labor regulation leads to allocative inefficiencies, when too little work is distributed to high-productive firms. When companies are diverse in density labor regulation leads to allocative inefficiencies, as too little work is distributed to relatively high productive firms, both those that remain undersized due to regulatory costs and those that exceed the threshold Threats to a company's environment can be neutralized by heterogeneous firm-specific resources and capabilities. As a result, firms that have customers and are simultaneously superior may benefit from the accumulation of firm-specific knowledge services of durable resources that are relatively important (Mahoney, 1995).

1.4 Multi-Criteria Decision-Making Methods

Multiple-criteria decision-making, also known as multiple-criteria decision analysis, is an operations research sub-discipline that examines multiple competing criteria in decision-making. The phrase multiple criteria decision analysis applies to a number of techniques that have been developed to assist decision-makers in making informed choices. Mcdm is a useful method for resolving problems involving different actors, parameters, and goals. Target, decision maker's expectations, alternatives, parameters, and results are the five components of MCDM problems in general.

MCDM falls into the category of given in. Distinctions amongst Multi Attribute Decision-making and Multi Attribute Decision-making can be catered for based on the number of alternatives under consideration (Kumar, et al., 2017).

A substantial number of academic papers, accredited courses, professional development programs, and scientific conferences have discussed the importance of multi-criteria decision-making (MCDM) over the last decade. MCDM basically uses a methodology that integrates the output of alternatives through a range of conflicting qualitative and/or quantitative parameters, resulting in a solution that needs compromise.

Over the past few decades, Multi-Criteria Decision Analysis has seen a huge amount of use. Its importance in various application areas has grown significantly, especially as new methods emerge, and old methods improve. This paper explores several common multi-criteria decision-making (MCDM) approaches and assesses their suitability for various scenarios (Velasquez & Hester, 2013).

Velasquez & Hester continue by saying the benefits and drawbacks different approaches found in mcdm will has been discussed in depth Their most popular implementations will also be studied to see whether there are any ties between the use of a tool and its benefits and drawbacks. The paper's conclusion would show that some MCDM approaches are best adapted for certain conditions.

Another school of thought on Multiple criteria decision-making (MCDM) says that it is a sophisticated decision-making (DM) technique that incorporates both linear and nonlinear variables. Multiple criteria decision-making (MCDM) is a component of operations research that deals with developing mathematical and statistical methods to aid decision-makers in subjectively evaluating performance criteria. Several previous studies have used MCDM tools and applications to solve problems in areas such as energy, climate, and sustainability in recent years. Complex problems can now be solved with relative ease thanks to technical advances. The use of decision-making aids. MCDM methods were created to identify a superior approach, classify alternatives into a limited number of categories, and/or rate alternatives in a subjective preference order (Mardani, et al., 2015).

The first step in the decision-making process is to choose an acceptable decision-making approach that matches the problem type in order to achieve the

purpose and objectives. And this applies to in mcdm approaches too. Recognizing the decision-making classification tends to be important for choosing the appropriate decision-making method for any form of problem. In order to categorize (Sabaei, Erkoyuncu, & Roy, 2015).

The majority of MCDM methods work for discrete choices that are defined by a set of criteria. The cardinal and ordinal values of criteria can be calculated. Information can be exact or fuzzy, and it can be calculated in intervals.

Decision-makers should deal with any of the above forms of data using modern MCDM approaches. MCDM is a commonly used decision methodology in a variety of fields, including energy and the environment, industry, economy, and development. The use of MCDM techniques and approaches improves decision quality by making implementation more effective, logical, and clear (Mardani, et al., 2015).

Mardani, et al continues by saying MCDM strategies encompass a broad variety of techniques. Methods of MCDM can be divided into two categories: Discrete MCDM, also known as discrete Multi-attribute Decision-Making (MADM), and continuous Multi-objective Decision-Making (MODM) approaches are two types of decision-making methods.

1.4.1 Analytical hierarchy process (ahp)

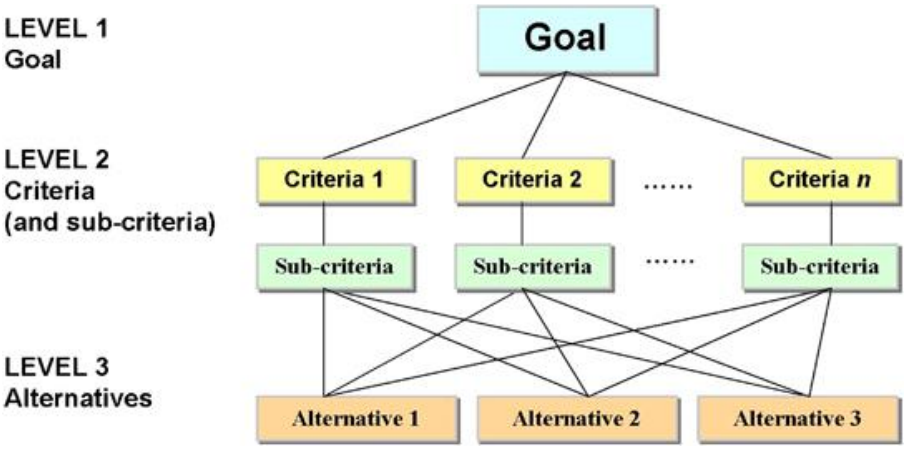

Figure 3: Framework depiction of goal criteria and alternative in Ahp (Decision support system, 2014).

The Analytic Hierarchy Method (AHP) is a broad metric principle and a method of multi criteria decision making. It can be used to generate ratio scales from paired comparisons, both continuous and discrete. Real measures or a fundamental

scale that represents the relative intensity of desires and emotions may be used to make such distinctions (Saaty R. W., 1987).

Numerous academics have become interested in the AHP, owing to the theory's appealing optimization techniques and the fact that obtaining the requisite raw data is easy. AHP is a decision-making aid that can be used to overcome complicated decision-making problems. It employs a multi-level hierarchical structure of goals, specifications, sub-criteria, and alternatives.

AHP is a Saaty-developed MCDM method that uses pairwise comparisons to rank data. This method is linked to a consistency ratio. The weights of the criteria are first computed by pairwise comparisons using Saaty's scale, assuming there are a variety of criteria and alternatives. The alternatives are then compared pairwise against each criterion and presented in separate tables using the scale. The number of each row is calculated, normalized, and then labelled weights in the last column.

The parameters are laid out along the top row, and the alternatives form the left-hand column, in order to create a new table. The number of each row is calculated by multiplying the value in each cell of each column by the weight of the criteria associated with the columns. The calculated numbers are listed in the final table's last column, which indicates how much attention should be paid to the alternatives or global weights (Asadabadi, Chang, & Saberi, 2019). Involved in Ahp is the decision instigators which include decisions and expectations on the perceived worth of each criterion and each alternative, considering all parameters. The dilemma is generated as a hierarchy in AHP, with each decision being broken down from top to bottom.

The target is at the top of the hierarchy, requirements and sub-criteria are in the center, and alternatives are at the lower part (Daim, Oliver, & Kim , 2013).

The rudimentary steps to follow in AHP mode are as follows:

1. <u>The formulation of a comparison matrix</u>

As mentioned before, the primary step is to determine weights of the parameters and calculate them basically a by pairwise comparisons utilizing Saaty's scale, assuming a range of criteria and alternatives are identified initially. The scale used in the presentation was Numerous academics have endorsed the idea, and its efficacy has been proven. Obtaining a pair, A nn single-value comparison matrix A represents the criteria Ai and Aj.

$$A = a_{ij} = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix}$$

Here the relative value of parameters Ai and Aj is expressed by aij (Daim, Oliver, & Kim , 2013).

Table 1: Pairwise comparison matrix (Saaty T.L., 1980).

Preference level	**Numeric value #**	**Explanation**
Equally preferred	1	There seem to be two contributors equally to the target.
Equally to moderately preferred	2	
Moderately preferred	3	One behavior has a marginal advantage over another depending on knowledge and assessment.
Moderately to strongly preferred	4	
Strongly preferred	5	One behavior is strongly favored by skill and intuition over another.
Strongly to very strongly preferred	6	
Very strongly preferred	7	An event is highly preferential over another, as shown by its superiority in practice.
Very strongly to extremely preferred	8	
Extremely preferred	9	The proof that supports one occurrence over another is of the greatest order of validation.

The preference level ranges from equally preferred to extremely preferred, with numeric values varying from 1 to 9 reflecting the weight of significance of these preferences in the pairwise comparison.

2. Illustrate the significance of each component

Next, the measurements of criteria weight and alternative local weight that are chosen from existing matrices are determined using the normalization method, which

requires the construction of pair-wise comparison matrices of alternatives and criteria (Aziz, Sorooshian , & Mahmud, 2016).

$$Wi=\sum_{j=1}^{n} aij, i=1,2,\ldots n$$

By use of the above This is how the Complete data for each row is calculated in the Analytical hierarchy process (Aziz, Sorooshian , & Mahmud, 2016).

3. Check for consistency

After presenting the data, double-check the matrix's accuracy. AHP's accuracy is crucial, and it must be tested.

Calculation of consistency index by (CI) by use of below formula

1. Firstly, this formula must be applied) $CI= (Average-n / (n-1)$
2. after getting an answer you should continue by doing then consistency ratio $= \frac{Ci}{Ri}$

Only if the accuracy ratio is equal to or less than 0.10 are the comparisons considered fair (Aziz, Sorooshian , & Mahmud, 2016)

Table 2: Random consistency index (RCI).

									0	**1**	**2**	**3**	**4**	**5**
I		.58	.90	.12	.24	.32	.41	.45	.49	.51	.48	.56	.57	.59

After measuring each step using the appropriate and correct method, an answer is derived, and this answer is then put to the test using the consistency index in an acceptable man to decide the ultimate desired outcome of an answer, which should be 0.10.If the CR is greater than 0.1, the consumer is criticized for making inconsistencies in their comparisons, and the statistics are returned to them for modification. The consistency test should be conducted to determine if the calculations falls above or below the threshold (Asadabadi, Chang, & Saberi, 2019).

1.4.2 The technique for order of preference by similarity to ideal solution (topsis).

TOPSIS is one of the multi-criteria decision-making numerical approaches. This is a process that can be used in a number of circumstances and has a basic mathematical model. Besides that, it is a very realistic approach, and the system has been used for the past 3 decades.

There are several studies on TOPSIS's history and applications (Pavić & Novoselac, 2013).Yoon and Hwang invented the TOPSIS approach for the first time in 1981. The basic principle is that the preferred alternative should be the furthest from the ideal solution and the closest to the negative-ideal solution (Balioti , Tzimopoulos , & Evangelides, 2018).

Pavić & Novoselac (2013) say, TOPSIS is a balancing tool. These capabilities involve for a balance between different parameters, with a good result in one criterion compensating for a poor result in another. The TOPSIS approach assumes that each criterion has a preference that is either exponentially increasing or decreasing.

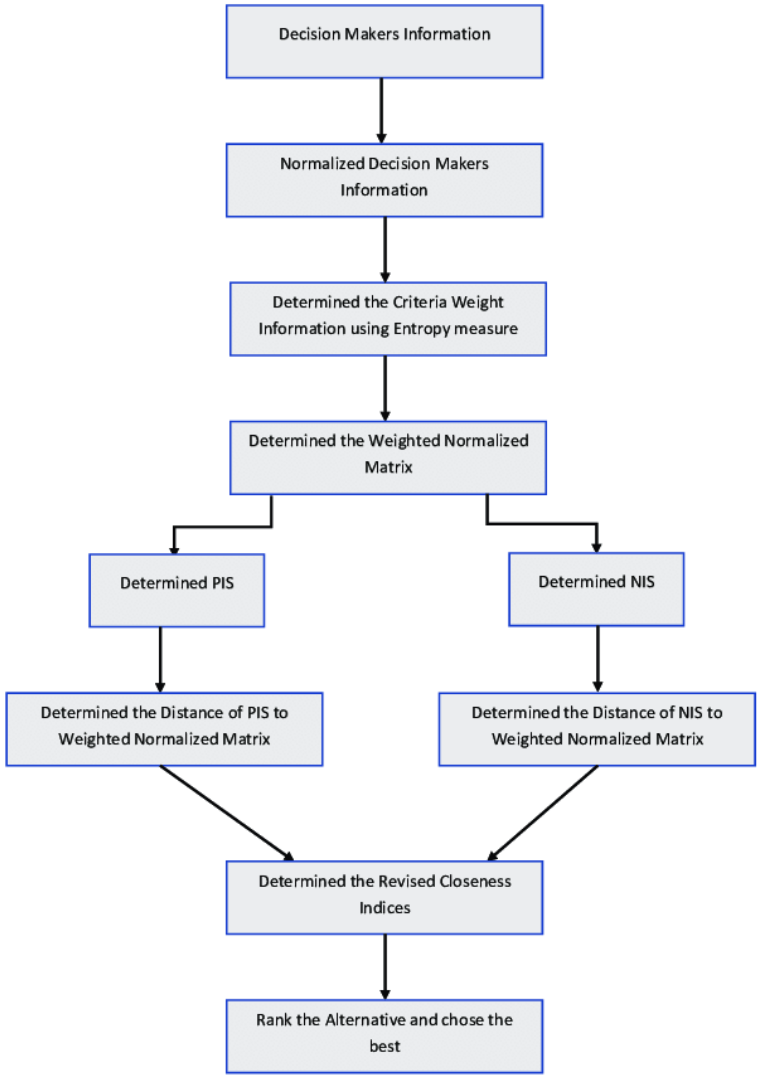

Figure 4: Steps in Topsis Approach (Batool, Ahmad, Abdullah, Ashraf & Chinram, 2020).

1. Establish the decision matrix that has been normalized.

Simplified formulas are used to transform the different criteria scales into a comparable scale in the fuzzy setting, in order to avoid the complicated normalization formula used in classical TOPSIS (Balioti , Tzimopoulos , & Evangelides, 2018).

This phase aims to convert various attribute measurements into dimensionless attributes so that comparisons between criteria from various sources are possible. The procedure is as follows, where rij denotes the normalized values.

$$rj\left(\frac{a_{ij}}{c_j}\frac{b_{ij}}{c_j}\frac{c_{ij}}{c_j}\right)$$

According to (Balioti , Tzimopoulos , & Evangelides, 2018) This is the conversion to a linear scale

2. Build the normalized weighted decision matrix

here we have a set of weights wj for j = 1,..., n parameters. Multiply the corresponding weight in each column of the normalized decision matrix.

$V_{ij} = W_{ij}. R_{ij,}$ J= 1, 2, … m, I = 1, 2, … n

As shown in (Balioti , Tzimopoulos , & Evangelides, 2018).

3. Find the positive ideal and negative ideal solutions to the problem.

$$\text{This is the ideal positive solution } A^{+} = \{V_1^{+}, \ldots\ldots, V_n^{+}\}$$

$$\text{Negative ideal solution } A^{-} = \{V_1^{-}, \ldots\ldots, V_n^{-}\}$$

As shown in (Onder & Dag, 2013)

4. Determine the separation steps for each choice using the below formula

For Positive $S_i^{+} = \left[\sum_i^n (v_j^{+} - v_{ij})\Delta^2\right] \Delta^{\frac{1}{2}}$

For negative $S_i^{-} = \sum_i^n \left(v_j^{-v_{ij}} \Delta^2 \Delta^{\frac{1}{2}}\right.$

As shown in (Onder & Dag, 2013)

4. Measure how near you are to the Ideal Solution.

$$C_i \frac{S_i^{-}}{(S_i^{+} + S_i^{-}}$$

As shown in (Balioti , Tzimopoulos , & Evangelides, 2018).

CHAPTER 2: THEORETICAL FRAMEWORK

A strong manufacturing base is often regarded by officials and academics as a critical path to economic growth and development. This is the one thing that intends to unlock manufacturing potential and encourage industrialization, among other things, in order to drive sustainable growth and jobs. As such in these chapter three aspects that contribute to the phenomenal structure of Africa's mass-producing efforts and its resource allocating strategy are reviewed in detail.

2.1 Resource Dependency Theory

Resource dependency theory is founded on the idea that in acquiring resources, an organization, such as a corporation, must participate in transactions with other individuals and organizations in its environment. Resource dependence theory (RDT) is concerned with how external resources used by an organization, such as raw materials, affect its behavior. Because an organization's ability to gather, change, and utilize raw materials faster than competitors can be critical to success, the theory is crucial (Hillman, Withers , & J, 2009).

Although such transactions may be beneficial, they may also generate unfavorable dependencies. Resource dependence theory has various major implications because obtaining external resources is critical for any company's strategic and tactical management. These concerns include the best organizational structure, board and staff recruiting, production methods, contract structure, external organizational links, and other aspects of corporate strategy.

According to dependency theory, underdevelopment is exactly the result of the integration of Third World economies into the capitalist world system dominated by the West and North America, so dependency in development studies refers to a situation in which one country or region relies on another for support, survival, and growth.

Third-world countries are economically poor countries in Asia, Africa, Oceania, and Latin America that are grouped together because they have common traits such as poverty, large birthrates, and economic reliance on advanced countries. As a result, the word connotes that the third world is exploited and that its future is revolutionary. (Eke Jeffry , 2013).

Africa's post-2000 development boom has resulted in rapid and beneficial change across the continent. However, it is reasonable to claim that a substantial portion of Africa's recent economic success can be linked to high global commodity prices, which provide huge returns to resource-rich African nations. Elevated levels of resource dependency, on the other hand, might lead to a growth trajectory in which income inequality develops and poverty reduction is stifled. Furthermore, cross-country evidence suggests that many resource-dependent countries are plagued by a slew of institutional and governance shortcomings, which could exacerbate an unequal economic path. Furthermore, many African economies are facing significant revenue losses as a result of illegal financial transactions (Bhorat, Naidoo, Chelwa, & Stanwix, 2017).

2.2 Factors Affecting Mass Production Efficiency in Africa's Garment Industry

Manufacturing processes around the world depend on the quality of their goods to allow the production of cost-effective products. The costlier and more inefficient your production process is, the more expensive your goods will be to manufacture. Production efficiency is a term that refers to a state of optimal capacity in which all available resources are completely exploited in order to produce the most cost-effective product possible. In simpler terms, this is the capacity to perform or generate anything without wasting resources, time, or energy.

For instance (Kalkanc, 2020) Describes how some garment industries manages its resources effectively, Roll starts, and scraps may be repurposed in manufacturing processes. Cloths that are condiments and faulty remnants are used in 15% of the final production process, as are rolls and trimmings, both finished and discarded. Yarn waste efficiency levels range between 5.5 and 10%, while combed yarn waste can reach up to 12% and total loss percentages can reach up to 23% during fabric and apparel manufacturing processes. Significant raw material recovery is possible if waste materials from clothing and the manufacturing and spinning processes are repurposed.

It is essential for the US manufacturing to maintain its competitiveness in the international market as the administration and Congress focus on economic and legislative measures to raise productivity and efficiency. It is likewise motivated to reduce the intensity of energy usage and associated costs for new ways to remain

competitive by use of the energy-efficient technology in the automotive industry (Shui, Jin, & Ni, 2015).

Efficiency is beneficial to any company. Increased process productivity often provides a slew of benefits. Productivity also includes workers, which is the initial and perhaps most apparent advantage in today's mass manufacturing environment.

Today we are dealing with an ever-increasing barrage of technological change, so we must improve our productivity if we are to meet the challenge. Furthermore, there are other issues, like how today's constantly changing innovations demand a dynamic, up-to-to-date training of the staff in order to ensure their ongoing relevance.

In emerging economies like Africa, efficient industries are vital in the development process, and you see, policies that are congruent with African industries while allowing for their growth, especially in the apparel or garment industry, would also contribute to the development of domestic markets, thereby creating employment for individuals, such policies being the direct cause of African industries' greatness and competitive advantage.

For instance, (Chandra & Shukla, 1994) Claim that, the exposure of the Indian economy to global competitive forces presents Indian manufacturers with new challenges and opportunities. Industries are looking for export markets, which have become more desirable as the Indian rupee's value has declined.

However, an industry's competitive advantage cannot be developed or maintained exclusively by an export-oriented strategy. The development of the domestic market is a critical factor in determining an industry's competitive advantage.

The output-to-input ratio of production is important when discussing productivity problems. While time and quantity are critical, it is often the volume, not the standard of production, that determines productivity. The art of exhaustively using inputs to generate maximum output is referred technical efficiency it is how effectively a given set of inputs is used to generate an output.

A business is said to be technically efficient if it produces the maximum amount of production with the fewest possible inputs, such as labor, resources, and technology. This metric represents a firm's capacity to maximize production from a given set of inputs (Karne & Venkatesh, 2005).

Industrial efficiency plays a larger role in all facets of industrial prosperity, as demonstrated by its ability in maximizing resource use to stimulate economic growth. Additionally, industrial efficiency improves business efficiency which translates to an economy's capacity to embody all acquired expertise.

Finally, but certainly not least, it is a measure that shows how efficiently businesses convert processes into revenue. Africa's garment industry is in desperate need of mass production efficiency due to its failure to compete with other industry giants. And for that fact of a matter, the focus shifts to efficient production capabilities that will allow them to close the gap between themselves and their rivals in the short run while also providing them with a long-term competitive advantage.

Over the last quarter-century, the global economy has undergone dramatic changes. Exports of manufactured goods have grown at a rate significantly faster than manufacturing output and developing countries have increased their share of the global market for both simple and complex manufactured goods.

Between 1992 and 2012, the share of manufacturing output produced by developing countries nearly doubled, rising from 18% to 35% of global production. Asia has become the world's factory as manufacturing has shifted to developing countries. East Asia and the Pacific region account for approximately 58 percent of the manufacturing value added in developing economies, with China alone accounting for over 50 percent (Can Africa Break In?, 2016).

Africans must shift their technique to accommodate to compete in the various waves of industry, especially in garments, but also to deal with accusations of inefficiency and inability to serve individual needs. While no solid feature determines any form of manufacturing productivity, metrics include bringing goods to market, creating products that cost the least amount of labor and delivering the most goods with the most possible output in Africa's garment industry.

One of the most striking characteristics of Africa's economic crisis over the last decade has been the near-complete absence of any discussion of industry or manufacturing. The World Bank's influential analyses have tended to emphasize the importance of reviving primary product exports and agriculture at the expense of manufacturing.

Occasionally, it has been argued that the manufacturing sector developed with state protection and assistance is grossly inefficient and requires massive rationalization, including the abandonment of unprofitable enterprises (Riddell, et al., 1991).

Although the numerous challenges facing the apparel industries of the African continent has always existed, they still possess tremendous potential to alleviate the unemployment and poverty, strengthen economic control, and expand the reach of various African nations and the continent on the global market. The time to act in Africa as a whole is now, if appropriate steps are taken to prioritize African industries, especially the garment industry, hundreds of thousands of people will benefit.

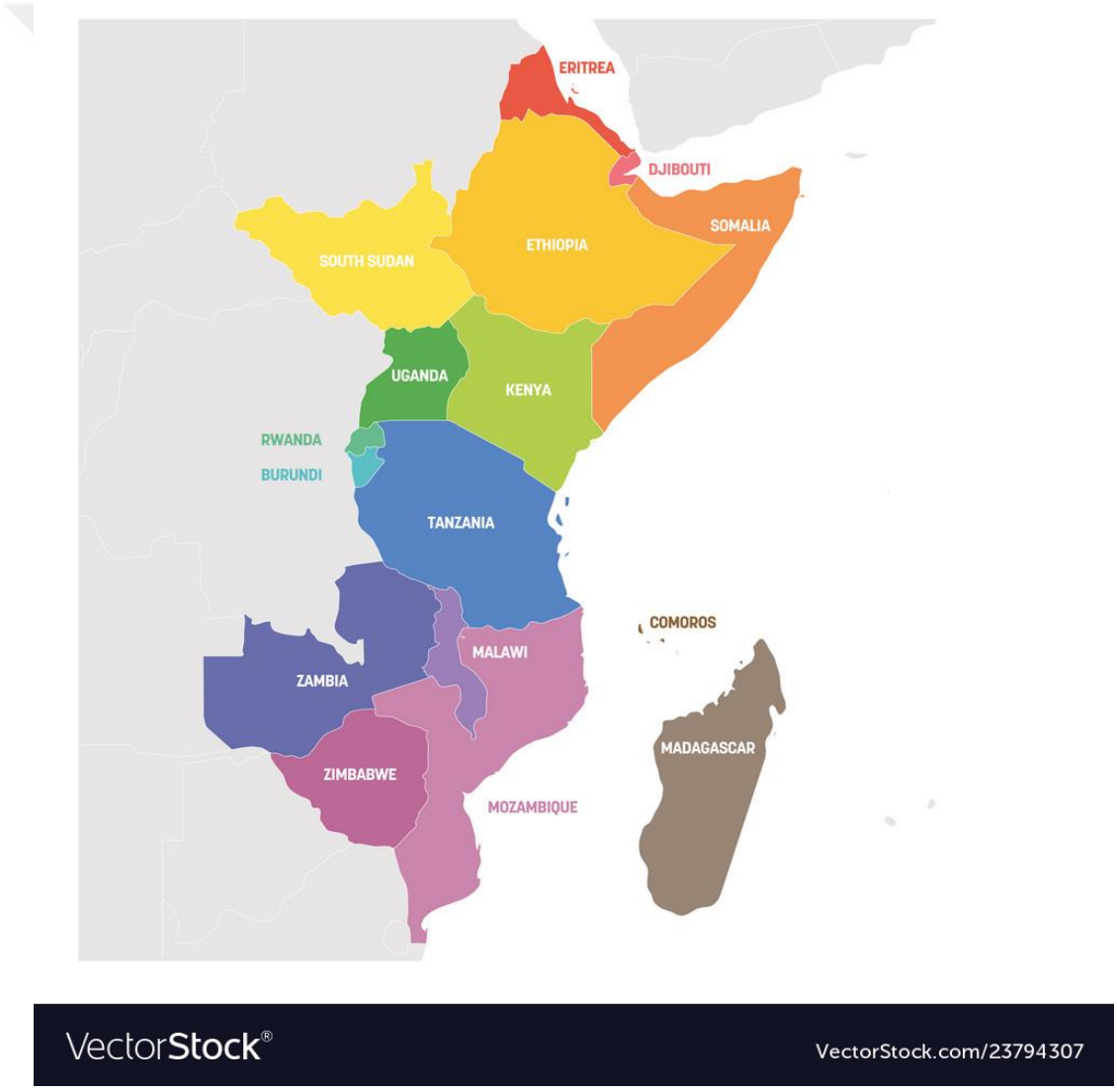

Figure 5: East African countries among them Kenya and Ethiopia (Vector Sector,2021).

African factories' inefficiency is not a new issue; it has been exacerbated by a number of factors, including inadequate infrastructure, inefficient customs processes, a scarcity of technical and managerial expertise, and low levels of social and environmental enforcement. Nonetheless, things are improving for Africa's garment industry.

While the renewal of the African Growth and Opportunity Act (AGOA) is expected to boost textile and garment shipments from Africa to the United States, as some Turkish textile manufacturers eye Kenya and Ethiopia for manufacturing operations, African countries urgently need to upgrade infrastructure and streamline customs procedures (Kohan textile journal, 2019).

Industrial excellence in Africa is perhaps best represented via peripheral lenses and maybe perhaps this does not capture reality as it is. In principle, the apparel and textile industries in Africa should be extremely strategic, as they are in various places of the globe. It is a highly interconnected sector with substantial merits and benefits, a considerable propensity for job creation in both the explicit and implicit industries, and it benefits developed countries at various stages of growth. However, in practice, it is having difficulty recognizing its potential, a potential that encases the future of Africa and its garment industry if properly maintained gradually. However, as of today, these external factors seem to be eroding all of the industry's positive attributes and adversely affecting Africa's garment industry.

Kohan textile journal continues by saying Africa's textile and garment industry is optimistic that its exports to the United States, the world's largest market for such products, will increase significantly following President Barack Obama's 10-year renewal of the African Growth and Opportunity Act (AGOA) – a provision of the United States' General System of Preferences that allows duty-free imports of a wide variety of African products.

This is also attracting a large number of Turkish, Indian, and Chinese textile companies to African countries, particularly Ethiopia and Kenya, not only to escape rising production and labor costs at home, but also to take advantage of duty-free exports to the United States under the AGOA.

Lewis and Sharpley argue that restructuring incentives to promote manufactured exports is critical for reviving both the manufacturing sector and the economy of African countries like Kenya as a whole. They place a premium on tariff reductions and devaluation while maintaining a prominent level of aggregate demand. In short, they conclude that the degree of tacit and explicit support for manufacturing has reached an unsustainable level, and that the sector is a drain on growth rather than a stimulant (Riddell, et al., 1991).

2.3 The Quality Argument of Resource Allocation in Africa's Garment Industry

Textile and clothing manufacturing are vital sectors of any economy due to their high labor intensity and substantial jobs creation, and manufacturing systems of all sizes which can function in challenging areas with limited capital.

Managers are charged with the responsibility of allocating manufacturing facilities over time to concurrent activities while adhering to operational constraints and deadlines and minimizing resource costs. Resources are a significant investment for the majority of businesses. As a result, businesses should use theirs to increase their profitability and sustainability.

Brown (1984) Says, since well before Aristotle's time, philosophers have discussed value in discussions of ethics, and economists have been concerned with value since well before Adam Smith, especially with the origins of economic value.

Philosophers, starting with the German Rudolph Herman Lotze, started an effort in the nineteenth century to establish a general theory of meaning. The value values, or worlds, associated with preference are inextricably linked to human preference.

A meaning, in the context of value, is an enduring conception of the preferable that determines choice and action. Consider this conception of the preferable as a first-order preference that influences all subsequent, second-order preferences (and hence, choice and action), or as the underlying principle of all preference. In any case, value in this context serves as a justification for preference against objects and states of nature that are directly relevant to resource allocation (Brown, 1984).

Businesses must use resources wisely in order to succeed and survive, which means that smart plays should be enforced, and resource waste should be severely

discouraged. Accurate measurements must be used to obtain the desired outcomes in order to retain a competitive advantage. Although these metrics do not guarantee redemption, they provide a foundation for gaining a competitive edge over competitors in any industrial setting, but especially in Africa's garment industry.

While improvements in working conditions and organizational structure can boost productivity and competitiveness, other factors such as resource management also contribute significantly to manufacturing performance. The fundamental belief that manufacturing success can only be accomplished ethically and with proper resource allocation in Africa demonstrates that if there was ever a place that needed this more urgently, and especially in the garment industry, it is Africa.

Optimizing industrial resource management is critical and essential to enhance the process and quality of mass production by allocating resources appropriately. Allocating resources entails defining and allocating resources to different activities over a specified time span. Resources are scarce and the costliest investment a company can make.

As a result, how a company allocates its scarce resources directly affects the prosperity of every industry. The need for tactical resource management and resource distribution is critical in Africa's garment industry.

In essence, resource distribution ensures that resources are assigned diligently and optimally to have the best functioning capabilities in any project whatsoever. Effective resource allocation covers much more than simply matching an individual to a task, it encompasses all the components that contribute to an organization's or industry's peak optimum performance.

The best form of Capital distribution is significant to the operation of every company. It provides a straightforward picture of the amount of work required and connects resources to the company's objectives.

Resource allocation enables you to choose and handle the best available resources for your projects. Appropriate resource distribution maximizes the utility of available resources across the organization. Having the appropriate resource available at the appropriate time is crucial to a project's success.

Tasks are the building blocks of a project. Sometimes, activities are dependent on one another, making proper resource utilization for this fact of a matter is of utter importance. Learning how to allocate resources efficiently through multiple projects requires a vast amount of knowledge, this knowledge should encompass all that matters in industrial success and should not be taken lightly, especially in Africa's garment industry.

Allocating resources efficiently and effectively is difficult and often hindered by a variety of variables, but this does not mean that these actors should deter any entity rather quite the contrary, it should motivate them to achieve ultimate victory.

2.4 A multi criteria decision framework

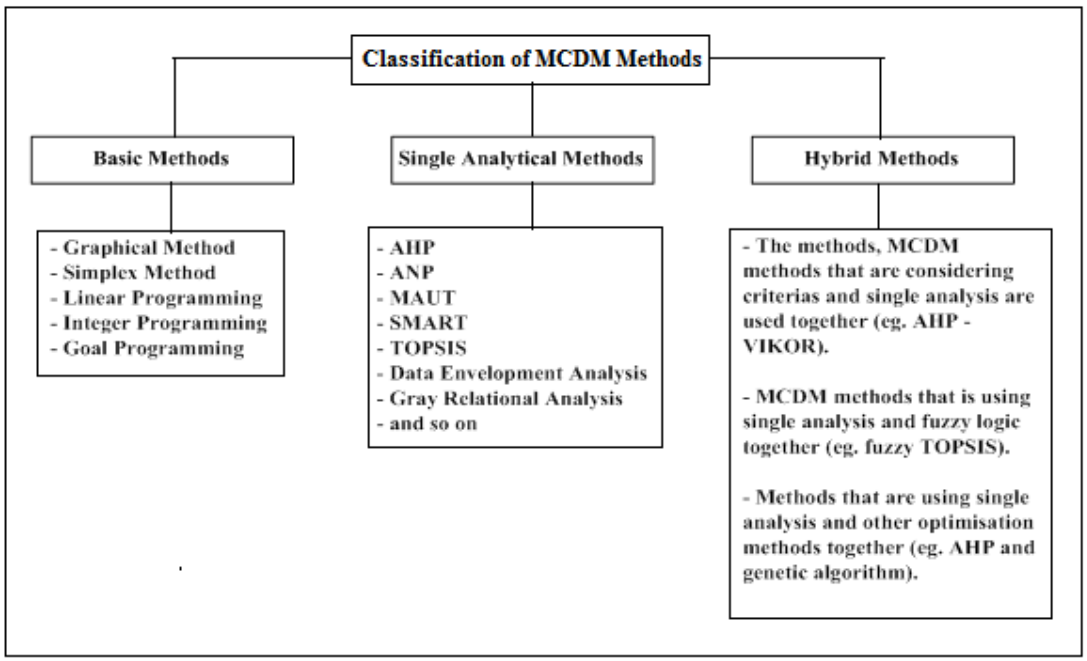

Figure 6: MCDM methods (Murat, 2017).

MCDM approach can be used to create distinct options that are limited to a number of parameters. As there are an infinite number of possible attributes, the fundamental values of criteria can be determined. Either a particular piece of information is precise, or it is general.

Making decisions in response to modern MCDM methods should be applied to all types of data, the first step in problem solving is to choose a practical solution that is relevant to the problem and its objectives. This also holds true for MCDMs the goal

of any type of problem decision making appears to be decision recognition. For the purpose of efficient data management.

Multi-Criteria Decision Making (MCDM) is one of the fastest growing fields of research in a wide variety of disciplines. The core issue is how to test a set of alternatives using a variety of parameters. Although this is a critical issue in practice, there are few tools available, and their accuracy is difficult to assess.

Thus, the question 'Which approach is the best for a particular problem?' has become one of the most critical and perplexing.

Multi-Criteria Decision-Making (MCDM) has grown into a very fertile and common subfield of Operational Research/Management Science in recent years, with an ever-increasing application to a remarkably diverse collection of problem scenarios (Genovese, 2018). MCDM techniques are critical components of decision theory and analysis.

Multi-criteria decision analysis has been applied to a broad range of areas, including energy management, environmental planning, public services, healthcare, transportation, logistics, marketing, human resource management, and finance. Multi-criteria decision-making techniques have been widely adopted by both public and private bodies, including companies and organizations. While multi-criteria decision problems may have a wide variety of contexts, they all share the following characteristics. Each criterion falls into one of two groups.

Benefit criteria are those that should be maximized, while expense criteria are those that should be minimized. Any criterion of the second type can be naturally converted to a criterion of the first type (Žižović, Damljanović , & Žižović, 2017).

They aim to explicitly incorporate more than one criterion into the decision-making process. The aim of MCDM methods is to assist decision makers in learning about the challenges they face, in learning about their own and other parties' personal value systems, in learning about organizational values and goals, and in guiding them in determining a preferred course of action through exploration of these in the context of the issue.

Two MCDM methods for ranking are the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity Ideal Solution (TOPSIS). (Abediniangerabi, Fathi, Farahani, Kamalirad, & Golshan, 2014).

Abediniangerabi, Fathi, Farahani, Kamalirad, & Golshan continue by saying AHP has been used in almost all applications involving decision-making under various criteria.

This model assigns weights to the elements of each level using pairwise comparisons, determining their relative value using Saaty's 1 to 9 scales, and finally calculating global weights for evaluation at the bottom level. Whereas The TOPSIS is predicated on the premise that the ideal alternative should be closest to the positive idea solution (PIS) and furthest from the negative idea solution (NIS).

They test each alternative against a set of parameters and then choose the best ones. This is the challenge known as multi-criteria decision-making (MCDM). In MCDM problems, if one of the alternatives is unquestionably the best on all metrics, there is clearly no challenge or dilemma.

However, this is a rare occurrence. As a result, numerous schemes have been proposed to assist decision-makers in solving MCDM problems, with the aggregation operator being one of the most frequently used. With the increasing complexity of the decision-making environment and the decision-makers' limited expertise, it is difficult for decision-makers to communicate their choice using precise numbers.

To begin, a variety of methods have been developed to address MCDM issues (Wang, Chen, Zhang, Chen, & Wang, 2017).

MCDM approaches may be used to facilitate complex planning exercises, such as prioritization, weighing and choosing alternatives, and allocating resources among competing activities. Additionally, these approaches may be applied to situations involving several stakeholders, which can result in conflictual situations.

MCDM methods have found widespread use in almost every area of science. Given the prevalence of such methods (and their variants), it is critical to have a firm grasp on their relative worth and applicability in a variety of contexts. As such, this special issue includes methodological and applied articles that advance the field of multi-Criteria Decision-Making significantly (Genovese, 2018).

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research design

Using a hybrid of two multi-criteria decision-making approaches namely AHP and TOPSIS, this research aims to examine the efficacy of mass production strategies and the levels of potency we are attempting to achieve through the perspective of Africa's garment industry. We attempt to base this study on the wavelength of reliability and credibility. Based on this knowledge, we evaluate and isolate the issue and identify the characteristics of our intended goal by the aid of descriptive research hence our justification for choosing this research method.

A case study approach was utilized for this because when you wish to gather concrete, contextual, in-depth knowledge about a specific real-world subject, a case study is an acceptable research design. It allows you to investigate the case's essential qualities, meanings, and ramifications. A case study is a research method for gaining a comprehensive, inter knowledge of a complicated subject in its real-world setting. It is a well-established research strategy that is widely employed across many fields, especially in the social sciences (Norman , Yvonna , & Lincoln , 2011).

It was determined that this would be the focus of this study which would expertly identify ways to improve mass production performance and resource allocation. It is important to use both primary and secondary data which includes both qualitative and quantitative information. We chose this approach because of its importance to our subject and how closely it correlates to the subject at hand. In other words, we chose to strategize in this way in order to acquire data that would aid us in our study.

3.2 Analysis and Measurement

As stated, before A case study approach was used since it is an acceptable research design when you want to obtain concrete, relevant information about a specific actual topic. It helps you to investigate the case's most important characteristics, meanings, and implications. We agreed that if we want to emulate performance in our research, we needed to inspect and analyze all relevant data thoroughly. The demand for apparel is increasing dramatically in Africa, and suppliers must take advantage. This is primarily due to global awareness campaigns that are

rampantly opening the door for African manufacturers and in this case, there is untapped potential in the continent's garment industry.

The following will be examined in order to decide the extent to which mass production should be efficient in all forms and how resources should be allocated.

1. Number of dependable strategies in relation to productivity

2. Flexibility and adaptability level

3. The impact of proper resource allocation on productivity

4. A routine for distributing resources

This thesis will concentrate on manufacturing inputs, such as labor and capital that are used to generate a given amount of output for the degree of reliable strategies. In order to have a positive impact on efficiency, proper resource allocation is necessary. When addressing efficiency issues, the output-to-input ratio of production is important. Although both time and quantity are important, efficiency is often determined by volume rather than quality. optimal productivity is the art of comprehensively utilizing resources to produce maximum output. It is the effectiveness with which a given set of inputs is used to generate an output. Finally, we will closely track how, where, and what resources are used in the industry because, as we all know, the combined value and availability of all company resources and resource connections can be interpreted as a feature of a firm 's competitiveness.

3.3 Developing Performance Alternatives for Mass Production Efficiency

Through vigorous research and the analysis of many cases that were relevant to our thesis and with unanimous understanding of African industries especially it's garment/apparel industry and how they operate or what they lack in their operations led to the setting of the standards or much more appropriate the alternative techniques which mass production efficiency can be reached in these industries. Regarding the above information four alternatives were standardized.

1. TQM**:** is the method of identifying and fixing production defects, streamlining supply chain management, comforting, and rendering the customer experience more enjoyable, and maintaining that workers are constantly informed about current on procedures. TQM (Total Quality Management) has two primary goals, growing efficiencies and enhancing the processes of manufacturing

organizations. Total quality control takes into consideration the needs of the whole organizations and strives to achieve the same level of quality for all aspects of the end product or service. TQM has its origins in the 1950s and has gained in popularity since the early 1980s. Total quality seeks to provide consumers with goods and services that fulfill their needs (Zatzick, Moliterno, & Fang, 2012). When keeping production targets and expectations along with a significant organisational transition, a manufacturing business that has many complexities can be challenged greatly. For several factors, clothing production is a complicated industry.

A diverse range of shapes, seasons, life cycles and multidimensional size are the product range. Many sewn product firms view TQM as the right strategy for meeting double demand for competition and quality, but many firms find it very difficult to maintain their TQM decision-making. In addition, in the field of management and company growth studies, TQM's contribution to the competitive advantage remains unchecked. It can be precisely defined as a quality philosophy that suggests involving everyone in the organisation. It applies to both manufacturers and clients (Syduzzaman, Rahman, Islam, Habib, & Ahmed, 2014). As many scholars unanimously agree on the benefits of tqm undoubtedly it also has its limitations which have been also heavily critised but theoritaclly speaking its benefits outweighs its limitations.

2.Lean manufacturing-A lean approach helps manufacturers maximize the use of their existing resources while curbing waste in the processes. Waste is described as something that consumers do not feel adds value to their lives and are unwilling to pay for.

Toyota developed Lean to reduce waste and inefficiency in its manufacturing operations. The method was so effective that it has now been adopted in manufacturing industries all over the world. Being lean is important for a Business competing against lower-cost countries. Lean aims to remove waste—non-value-added components in every operation. Unless a method has been leaned several times, it involves some waste (Barney & Kirby, Toyota Production System/Lean Manufacturing, 2004).

And this method is of essence in Africa’s garment industry although ideally this needs time to be implemented the rewards are abundant. Another alternative for mass production efficiency that can revolutionize efficiency and as a result productivity is lean manufacturing.

System construction and maintenance has consistently been proven and successful in lean manufacturing. With this process-based thought focused on value, a systematic approach to quality improvement was developed. Toyota Lean Production System has shown how lean thinking accelerated the transition from mass production to lean production.

The lean tools are mostly used in lean applications. The real success of lean implementations can be achieved only when the lean principles are used to achieve this principle, including value stream flow pull, perfection, and when lean tools are used to implement this principle. Lean production takes on the JIT principle and reviews the value of the consumer. The first step in the lean production process is to take account of the customer's true valuation of your product. For example, you could seek sound quality, reliability, affordability if your customer purchases a stereo speaker. The first concept of lean manufacturing is that every phase of the manufacturing process must give the customer a certain benefit (El-Sayed, Lean Implementation in Integrated Design and Manufacturing, 2013)

3.Agile based approach manufacturing-Some means of manufacturing are employing versatility, bottom-up creativity, and keeping pace with changes through an iterative process while others attempt to adapt to new circumstances. agile is concerned about more of making the most out of the available resources and ensuring they have the necessary data to deal with shifts in manufacturing. It is necessary to make any improvements in manufacturing to provide up-to-to-date information. One of the major advantages of an agile manufacturing is the ability to fine-tune production, but more importantly and adaptable to changes in the industry (Drew, 2015). This method is a bit more creativity oriented and has the potential of adaptability which in principle is of utter significance to any industry in our case the apparel industries of Africa. Agile production in a constantly evolving environment is an ability to succeed. In this dynamic market, agility in the industry is an important problem. Agility allows the quick implementation of the action plan in the company and the industry must adopt specified plan

4.Lean six sigma approach- Lean Six Sigma is a composite quality improvement approach with different meanings, ranging from Lean dominant to Six Sigma dominant. lean Six Sigma is a statistical approach, which delivers on customer loyalty and profits by eliminating variability, reducing the amount of work in a total

process, and driving through flow to increase consistency, which leads to an advantage over the rest of the competition levels of variance and error is present in everything; therefore, it is accepted that every employee must be engaged.

Lean provides consumers with the greatest level of consistency, while Six Sigma adds nimbleness to the mix. In LSS, there is a structured process and a specialized set of tools to foster critical thinking skills for employees to strengthen. The Scientific Method can be used to create problem-solving cultures in both Lean and Six Sigma. the Lean Six Sigma approach aims to cut costs, reduce inefficiencies, and increase service levels in order to improve customer satisfaction. This approach offers a full range of tools, processes, along with concepts of Lean and Six Sigma to help the company's operations better (Taylor, Sinn, Ulmer, & Badar, 2015).

Mass production efficiency alternatives

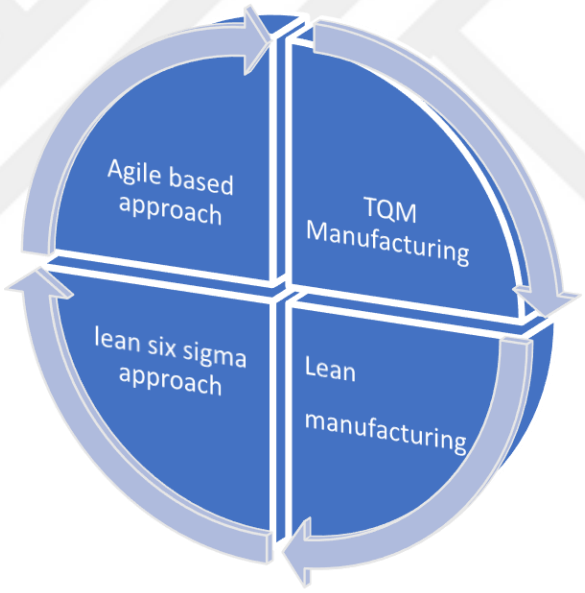

Figure 7: Mass production efficiency alternatives

In our multi-criteria decision-making processes this are the alternatives we will evaluate thoroughly, we have chosen these due to their inherent nature of success were applied and with Africa's potential to reach the heights of its Asian counterparts like Bangladesh, China, and Thailand.

Although, Countries in Africa have already voiced their desire for mass production through manufacturing as part of a larger effort to transform their ecosystems and create productive capacity in order to achieve fast and long-term

economic growth. It is high time they realize ways to improve production efficiency if it wants to emulate or mimic even half of what these nations have achieved in the last two decades. With that being said the apparel industry in the heartland of Africa is basically an infant and as such these alternatives were chosen out of the possible many due to their complementary nature and their undoubtable ability to benefit these industries both in the short term and the long term.

3.4 Criteria and Sub Criteria Formulation

Mcdm criterial to be evaluated are of utter significance and have to be reviewed with care in all of its forms. The criterial to be evaluated in the thesis ranges from C1-C4 and each criterion has a sub criterion which ranges from C11-C43 as shown in the table below. Each aspect and alternative were carefully examined and ambitiously formulated on the advice of three Experts.

To aid us with our calculation throughout the study an arithmetic mean approach was utilized and deployed to help us formulate and generate precise numbers in The Analytical Hierarchy Process (AHP).

Table 3: Criteria and sub-criteria

Main Criteria	sub criteria
C1- Reliability	C11- Pace of distribution C12- Quality of functionality C13- Durability of operational machines
C2-Capability	C21- Degree of manufacturability C22- Employee skill level C23- Ability of creating a marketable commodity
C3-adaptability	C31-Resiliencie C32-Versatility C33- Managing employee time
C4-proper resource management	C41-Rate of fixing recurrent errors C42-Employee productivity C43-Degree of recycling efforts

3.5 Calculations of Multi Criteria Decision Making Using Analytical Hierarchy Process

Table 4: Reliability

Mass production efficiency and resource allocation methods alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing
Lean manufacturing	1	4	3	2
Tqm manufacturing	1/4	1	4	3
Lean six sigma	1/3	1/4	1	4
Agile manufacturing	1/2	1/3	1/4	1
Total	2.083	5.583	8.25	10

Table 5: Row averages for Reliability criteria

Mass production efficiency methods and resource allocation alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing	Row average
Lean manufacturing	0.4800	0.7164	0.3636	0.2000	0.44
Tqm manufacturing	0.1200	0.1791	0.4848	0.3000	0.271
Lean six sigma	0.1600	0.0448	0.1212	0.4000	0.1815
Agile manufacturing	0.2400	0.0597	0.0303	0.1000	0.1075
Total					1.00

Table 6: Capability

Mass production Efficiency and resource methods alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing
Lean manufacturing	1	2	5	4
Tqm manufacturing	1/2	1	2	5
Lean six sigma	1/5	1/2	1	2
Agile manufacturing	1/4	1/5	1/2	1
Total	1.9	3.7	8.5	12

Table 7: Row averages for Capability criteria

Mass production Efficiency and resource allocation methods	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing	Row average
Lean manufacturing	0.5263	0.5405	0.5882	0.3333	0.4971
Tqm manufacturing	0.2632	0.2703	0.2353	0.4167	0.2964
Lean six sigma	0.1053	0.1351	0.1176	0.1667	0.1312
Agile manufacturing	0.1053	0.0541	0.0588	0.0833	0.0754
Total					1.00

Table 8: Adaptability

Mass production efficiency and resource allocation methods alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing
Lean manufacturing	1	5	4	3
Tqm manufacturing	1/5	1	1/3	7
Lean six sigma	1/4	3	1	4
Agile manufacturing	1/3	1/7	1/4	1
Total	1.8	9.1	5.6	15

Table 9: Row averages for adaptability criteria

Mass production efficiency and resource allocation methods alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing	Row averages
Lean manufacturing	0.5556	0.5495	0.7143	0.2	0.5048
Tqm manufacturing	0.1111	0.1099	0.0595	0.4667	0.1868
Lean six sigma	0.1389	0.3297	0.1786	0.2667	0.2284
Agile manufacturing	0.1852	0.0157	0.0446	0.0667	0.0780
Total					1.0000

Table 10: Proper resource management

Mass production efficiency and resource allocation methods alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing
Lean manufacturing	1	2	5	3
Tqm manufacturing	1/2	1	2	5
Lean six sigma	1/5	1/2	1	2
Agile manufacturing	1/3	1/5	1/2	1
Total	2.033	3.700	8.500	11.000

Table 11: Row averages for proper resource management criteria

Mass production efficiency and resource allocation methods alternatives	lean manufacturing	Tqm manufacturing	Lean six sigma	Agile manufacturing	Row average
Lean manufacturing	0.4918	0.5405	0.5882	0.2727	0.4671
Tqm manufacturing	0.2459	0.2703	0.2353	0.4545	0.3200
Lean six sigma	0.0984	0.1351	0.1176	0.1818	0.1448
Agile manufacturing	0.1639	0.0541	0.0588	0.0909	0.0679
Total					1.00

Table 12: Preference vector within criteria (row averages)

Mass production efficiency and resource allocation methods alternatives	Reliability	Capability	adaptability	Proper resource management
Lean manufacturing	0.44	0.4971	0.5048	0.4671
Tqm manufacturing	0.271	0.2964	0.1868	0.3200
Lean six sigma	0.1815	0.1312	0.2284	0.1448
Agile manufacturing	0.1075	0.0754	0.0780	0.0679

Table 13: Criteria matrix

Criteria	Reliability	Capability	adaptability	Proper resource management
Reliability	1	1/2	2	1
Capability	2	1	1	3
adaptability	1/2	1	1	1
Proper resource management	1	1/3	1	1
Total	4.5	2.8	5	6

Table 14: Row averages for criteria matrix

Criteria	Reliability	Capability	adaptability	Proper resource management	Row averages
Reliability	0.2222	0.1765	0.4	0.1667	0.2413
Capability	0.4444	0.3529	0.2	0.5	0.3743
adaptability	0.1111	0.3529	0.2	0.1667	0.2077
Proper resource management	0.2222	0.1176	0.2	0.1667	0.1766
Total					1.0000

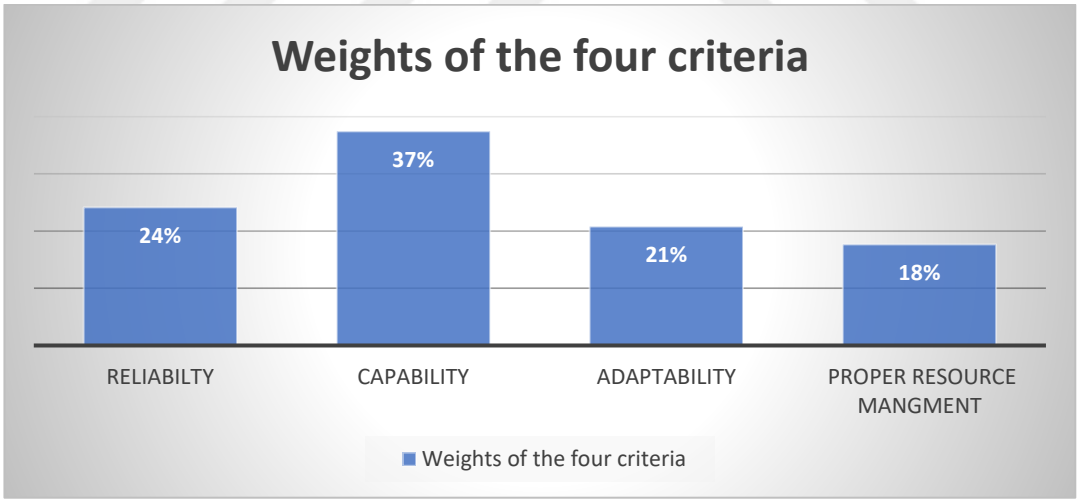

Figure 8: Weights of four criterial

Table 15:

Criteria	Row averages
Reliability	0.2413
Capability	0.3743
Adaptability	0.2077
Proper resource management	0.1766
total	1.0000

Consistency index

Table 16: Row averages for criteria matrix

Criteria	Reliability	Capability	adaptability	Proper resource management
Reliability	1	1/2	2	1
Capability	2	1	1	3
adaptability	1/2	1	1	1
Proper resource management	1	1/3	1	1
Total	4.5	2.8	5	6

*

Row averages
0.2413
0.3743
0.2077
0.1766

A. 1*0.2413 +1/2*0.3743+2*0.2077+1*0.176= 1.0199

B. 2*0.2413 +1*0.3743+1*0.2077+3*0.176=1.5926

C. 1/2*0.2413 +1*0.3743+1*0.2077+1*0.176=0.8787

D. 1*0.2413 +1/3*0.3743+1*0.2077+1*0.176=1.2898

Averages

As the formula of Ahp clearly states we divide each value by the corresponding weight from the preference vector and then dividing them with the number of criteria there is we find the average

- 1.0199/0.2413= 4.2267
- 1.5926/0.3743= 4.2549
- 0.8787/0.2077= 4.2306
- 0.750/0.176= 4.26003

Total = 16.972/4= 4.243

Average =4.243

After finding the average we use the formula below to find the consistency index under determine whether it is of a satisfactory nature or un-satisfactory nature.

Table 17: Computing the Ci (Consistency index) and Measuring Cr ratio (consistency ratio)

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

CI=(Average-n)/(n-1)

So, if CI=(Average-n)/(n-1) (4.243-4)/3=0.081

(4.243-4)/3=0.081

Cr=Ci/Ri

Then CR=0.081/0.90 = **0.09**

Where

Cr= Consistency Ratio

CI=Consistency index

Ri=Random index consistency

which is evidently less than **0.1** thus proving our answer of 0.09 satisfactory

Table 18: Sub criteria matrix for reliability

	pace of distribution	Quality of functionality	Durability of operational machines
pace of distribution	1	5	4
Quality functionality	1/5	1	1/2
Durability of operational machines	1/4	2	1
TOTAL	1.45	8	5.5

Table 19: Row averages for reliability sub-criteria

	pace of distribution	Quality of functionality	Durability of operational machines	ROW AVERAGES
pace of distribution	0.6897	0.6250	0.7273	0.6806
Quality of functionality	0.1379	0.1250	0.0909	0.1179
Durability of operational machines	0.1724	0.2500	0.1818	0.2014
Total				1.0000

Consistency index for reliability criteria

We find the consistency ratio again to make sure the calculations are consistent and are of a satisfactory and we use the same formula as before.

By multiplying the reliability sub criteria matrix with the row averages and the dividing them with row averages we find the following answers

9.0741/3 = 3.0247 So CR ratio = (3.0247-3) =0.0247/2=0.01235

So due to the number of sub criteria being three we divide the answer by 0.58

0.01235/0.58 = 0.0213which is <0.1 and thus satisfactory

And the weighted sub criteria for reliability are as follows

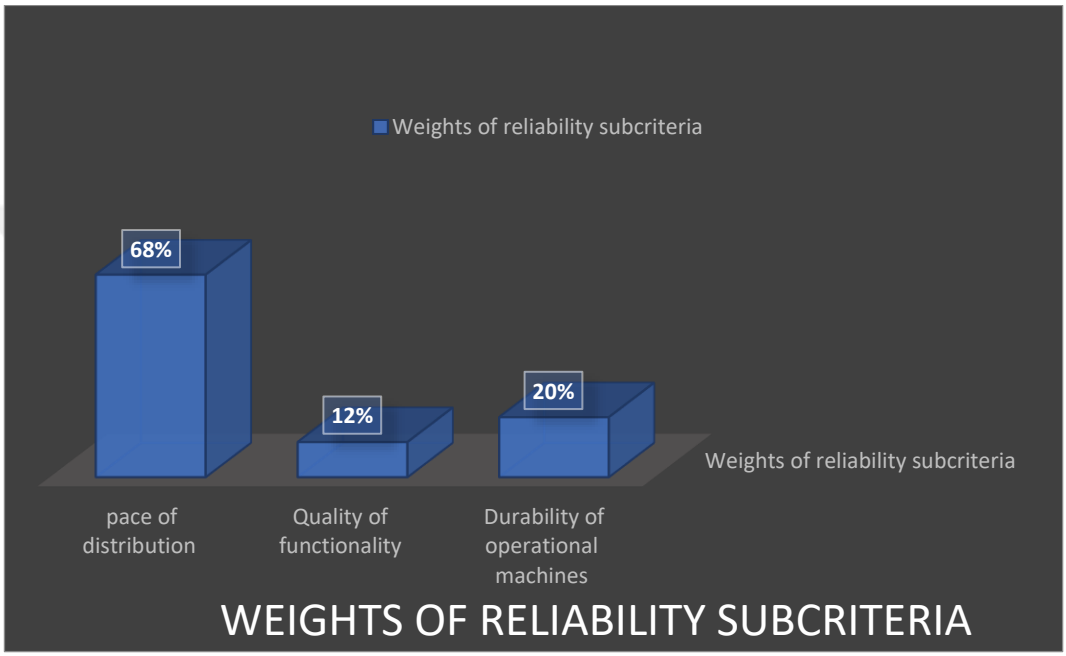

Figure 9: Weights of reliability sub-criteria.

Table 20: Capability sub criteria

	Degree of manufacturability	Employee skill level	Ability of creating a marketable commodity
Degree of manufacturability	1	1/3	5
Employee skill level	3	1	9
Ability of creating marketable commodities	1/5	1/9	1
Total	4.2	1.4444	15

Table 21: Row averages for capability sub- criteria

	Degree of manufacturability	Employee skill level	Ability of creating a marketable commodity	Row averages
Degree of manufacturability	0.2381	0.2308	0.3333	0.2674
Employee skill level	0.7143	0.6923	0.6000	0.6689
Ability of creating marketable commodities	0.0476	0.0769	0.0667	0.0637
				1.0000

Consistency index for capability sub criteria

We find the consistency ratio again to make sure the calculations are consistent and are of a satisfactory and we use the same formula as before.

By multiplying the reliability sub criteria matrix with the row averages and the dividing them with row averages we find the following answers

9.0876/3 = 3.0292 So CR ratio = (3.0292-3) =0.02920/2=0.01460

So due to the number of sub criteria being three we divide the answer by 0.58

0.01460/0.58 = 0.0252which is <0.1 and thus satisfactory

And the weighted sub criteria for reliability are as follows

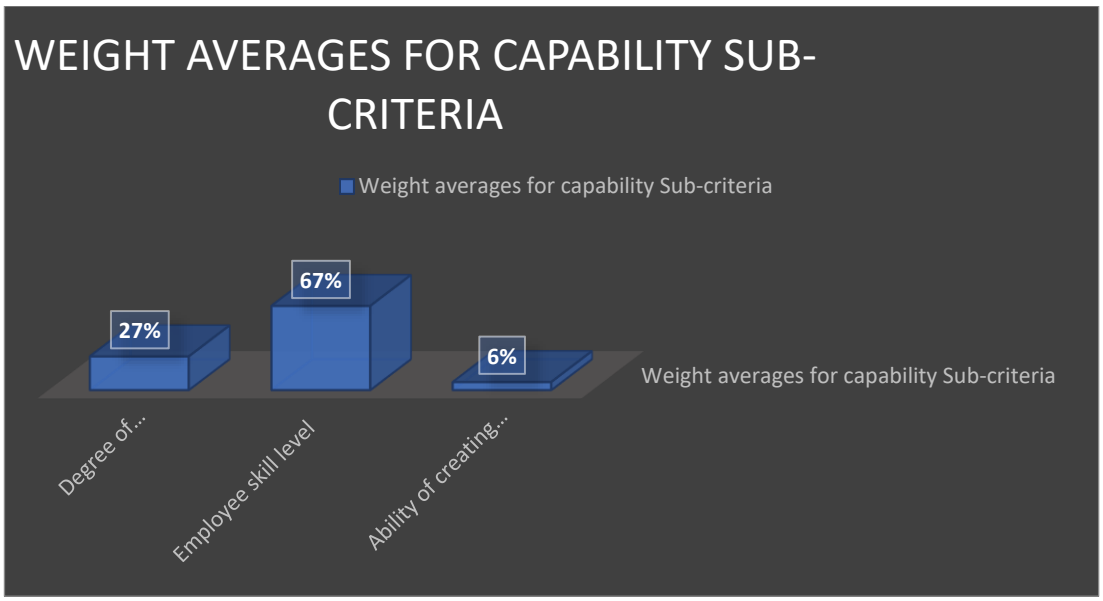

Figure 10: Weight averages of capability sub-criteria

Table 22: Adaptability sub criteria

	Resilience	Versatility	Managing Employee time
Resilience	1	3	4
versatility	3	1	5
Managing employee time	1/4	1/5	1
Total	4.25	4.2	10

Table 23: Row averages for adaptability criteria

	Resilience	Versatility	Managing Employee time	Row averages
Resilience	0.2353	0.7143	0.4	0.4499
versatility	0.7059	0.2381	0.5	0.4813
Managing employee time	0.0588	0.0476	0.1	0.0688
Total				1.0000

Consistency index for Adaptability criteria

We find the consistency ratio again to make sure the calculations are consistent and are of a satisfactory and we use the same formula as before.

By multiplying the reliability sub criteria matrix with the row averages and the dividing them with row averages we find the following answers

So due to the number of sub criteria being three we divide the answer by 0.58

Therefore, after calculations the Consistency Ratio is 0.089 which is <0.1 and thus satisfactory

And the weighted sub criteria for reliability are as follows

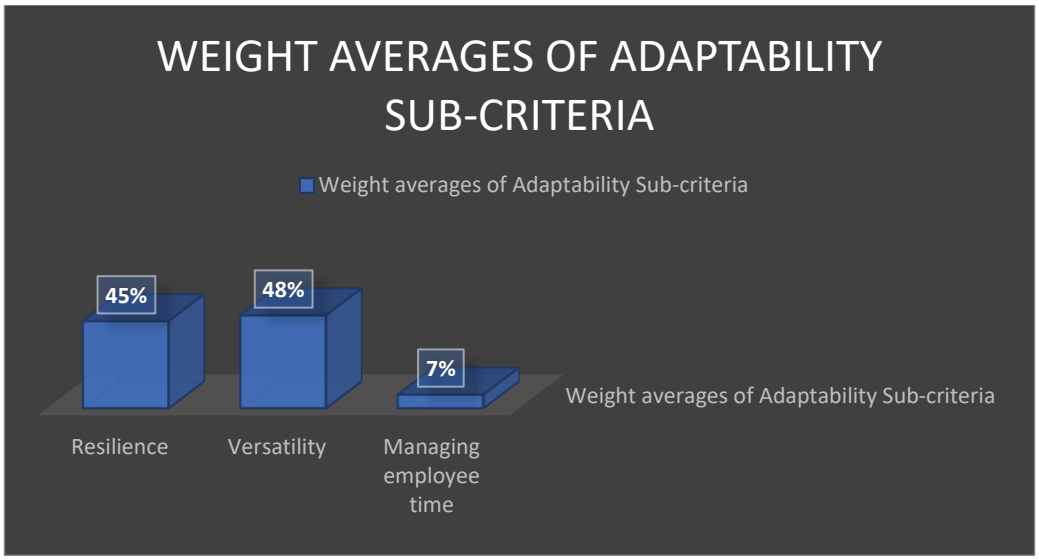

Figure 11: Weight averages of adaptability sub-criteria

Table 24: Proper resource management sub-criteria

	Rate of Fixing recurrent errors	Employee productivity	Degree of recycling efforts
Rate of fixing recurrent errors	1	1/2	6
Employee productivity	2	1	5
Degree of recycling efforts	1/6	1/5	1
Total	3.1667	1.7000	12

Table 25: Row averages for proper resource management

	Rate of Fixing recurrent errors	Employee productivity	Degree of recycling efforts	Row averages
Rate of fixing recurrent errors	0.315	0.2941	0.5000	0.3697
Employee productivity	0.6316	0.5882	0.4167	0.5455
Degree of recycling efforts	0.0526	0.1176	0.0833	0.0845
Total				1.0000

Consistency index for proper resource management sub-criteria

We find the consistency ratio again to make sure the calculations are consistent and are of a satisfactory and we use the same formula as before.

By multiplying the reliability sub criteria matrix with the row averages and the dividing them with row averages we find the following answers

So due to the number of sub criteria being three we divide the answer by 0.58

Therefore, after calculations the Consistency Ratio 0.089 which is <0.1 and thus satisfactory

And the weighted sub criteria for reliability are as follows

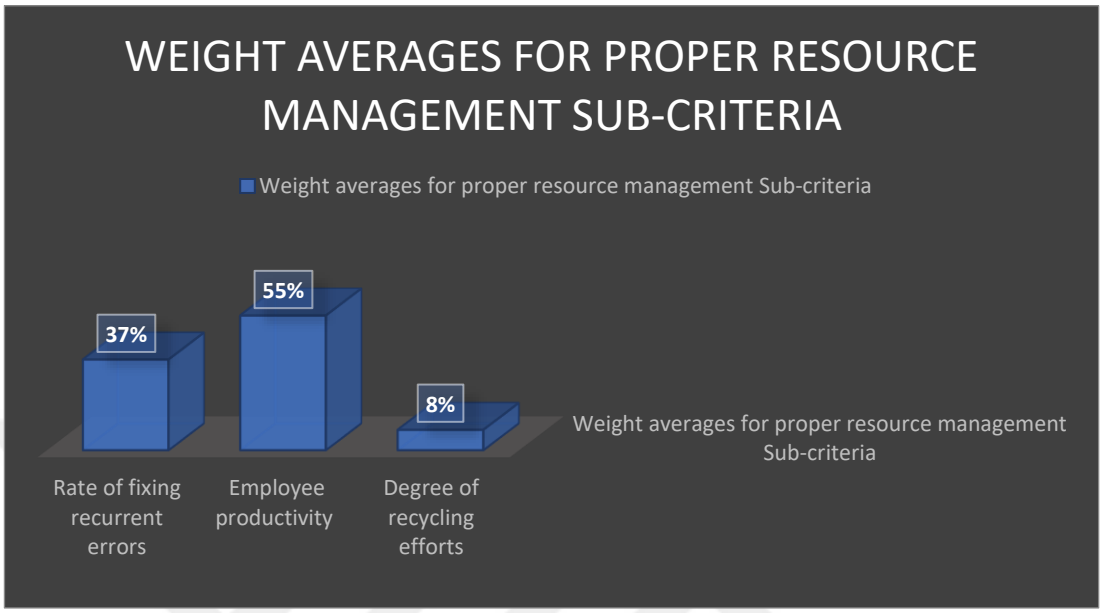

Figure 12: Weight averages for proper resource management criteria

Table 26: Sub-criteria matrix

	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43
C11	1	5	5	3	1/5	5	6	3	6	3	3	6
C12	1/5	1	1/2	1/3	1/7	1	1/4	1/5	2	1/2	1/4	4
C13	1/5	2	1	1/3	1/7	2	1/3	1/4	3	1	1/2	5
C21	1/3	3	3	1	1/3	3	3	1/2	5	3	2	7
C22	5	7	7	3	1	7	4	2	8	4	3	9
C23	1/5	1	1/2	1/3	1/7	1	1/3	1/4	3	1/2	1/3	3
C31	1/6	4	3	1/3	1/4	3	1	1/2	3	1	1/2	4
C32	1/3	5	4	2	1/2	4	2	1	6	4	3	7
C33	1/6	1/2	1/3	1/5	1/8	1/3	1/3	1/6	1	1/3	1/2	2
C41	1/3	2	1	1/3	1/4	2	1	1/4	3	1	1/5	3
C42	1/3	4	2	1/2	1/3	3	2	1/3	5	2	1	5
C43	1/6	0.25	1/5	1/7	1/9	1/3	1/4	1/7	1/2	1/3	1/5	1
TOTAL	8.43	34.75	27.53	11.49	3.53	31.66	20.49	8.59	45.5	20.67	14.48	56

Table 27: Results of all Sub criteria weights

1.	C11	18.40%
2.	C12	2.90%
3.	C13	4.20%
4.	C21	10.00%
5.	C22	26.40%
6.	C23	3.00%
7.	C31	6.10%
8.	C32	13.30%
9.	C33	1.90%
10.	C41	4.70%
11.	C42	7.70%
12.	C43	1.50%

We find the consistency ratio again to make sure the calculations are consistent and are of a satisfactory and we use the same formula as before.

By multiplying the reliability sub criteria matrix with the row averages and the dividing them with row averages we find the following answers

So due to the number of sub criteria being twelve we divide the answer by the appropriate correspondent in the random consistency Index (RI) which is 1.48

Therefore, after calculations the Consistency Ratio 0.053 which is <0.1 and thus satisfactory

And the weighted compilation of all sub criteria for are as follows

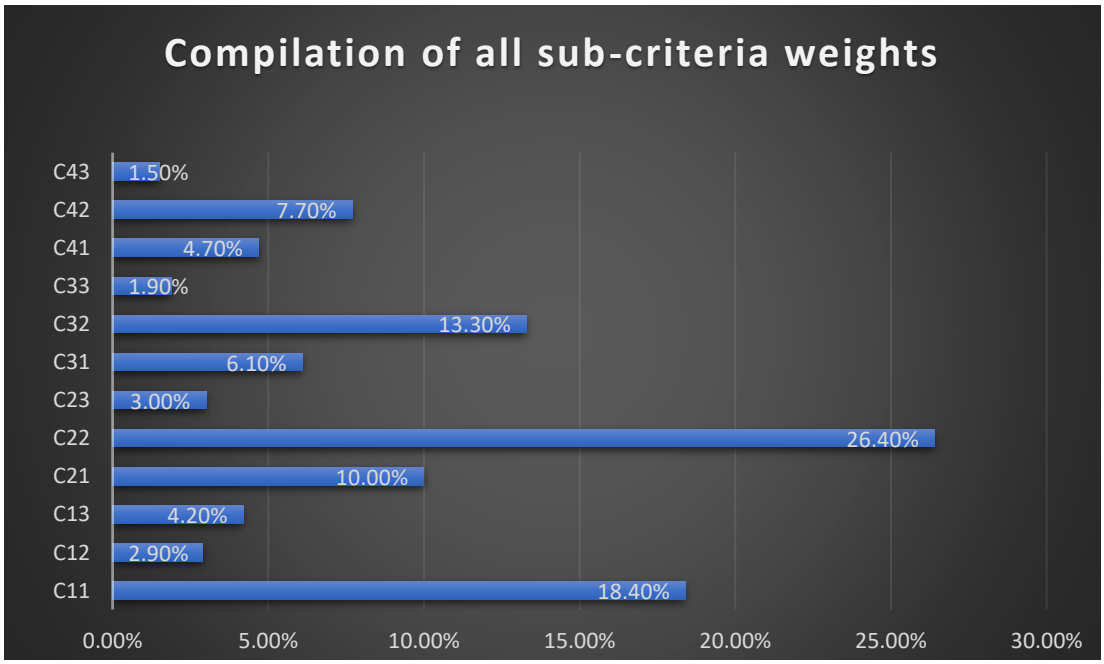

Figure 13: Compilation of all sub-criteria

3.6 Alternatives Are Evaluated Using the Topsis Method

We have chosen scale of 1 to 5 to rank each sub-criteria's importance to the four alternatives that were chosen for mass production efficiency and proper resource allotment 5- being especially important and 1-least important the calculations of the Topsis analysis were done using excel.

Scale of importance

5-Very Important

4-Important

3-Slight Important

2-Not Important

1-Least Important

The matrix below shows the four alternatives for mass production efficiency and resource allocation methods in the African garment industry, as well as the twelve sub criteria and their weights for TOPSIS analysis.

Table 28: Decision making matrix for Topsis

weights	18.4 %	2.9 %	4.2 %	10 %	26.4 %	3%	6.1 %	13.3 %	1.9 %	4.7 %	7.7 %	1.5 %
	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43
Lean Six sigma	4	3	2	3	2	5	4	4	3	5	4	5
TQM manufacturing	3	2	3	3	3	4	3	4	3	4	4	4
Lean Manufacturing	2	1	2	3	5	4	2	3	5	4	4	5
Agile manufacturing	1	2	2	3	2	3	5	5	3	1	2	1

Table 29: Normalized decision matrix

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13
	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43
Lean six sigma	0.7303	0.7071	0.4364	0.5000	0.3086	0.6155	0.5443	0.4924	0.4160	0.6565	0.5547	0.6108
TQM manufacturing	0.5477	0.4714	0.6547	0.5000	0.4629	0.4924	0.4082	0.4924	0.4160	0.5252	0.5547	0.4887
Lean Manufacturing	0.3651	0.2357	0.4364	0.5000	0.7715	0.4924	0.2722	0.3693	0.6934	0.5252	0.5547	0.6108
Agile manufacturing	0.1826	0.4714	0.4364	0.5000	0.3086	0.3693	0.6804	0.6155	0.4160	0.1313	0.2774	0.1222

Table 30: Weighted normalized matrix

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13
	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43
Lean six sigma manufacturing	0.1343746	0.0205061	0.0183303	0.05	0.08147217	0.01846372	0.03320419	0.06548467	0.007904478	0.030857012	0.042711915	0.009162708
TQM manufacturing	0.10078095	0.01367073	0.02749545	0.05	0.12220825	0.01477098	0.02490315	0.06548467	0.007904478	0.024685609	0.042711915	0.007330167
Lean manufacturing	0.0671873	0.00683537	0.0183303	0.05	0.20368042	0.01477098	0.0166021	0.0491135	0.01317413	0.024685609	0.042711915	0.009162708
Agile manufacturing	0.03359365	0.01367073	0.0183303	0.05	0.08147217	0.01107823	0.04150524	0.08185584	0.007904478	0.006171402	0.021355958	0.001832542

Table 31: Ideal best and worst solutions

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13
	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43
Lean six sigma manufacturing	0.1343746	0.0205061	0.0183303	0.05	0.08147217	0.01846372	0.03320419	0.06548467	0.007904478	0.030857012	0.042711915	0.009162708
TQM manufacturing	0.10078095	0.01367073	0.02749545	0.05	0.12220825	0.01477098	0.02490315	0.06548467	0.007904478	0.024685609	0.042711915	0.007330167
Lean manufacturing	0.0671873	0.00683537	0.0183303	0.05	0.20368042	0.01477098	0.0166021	0.0491135	0.01317413	0.024685609	0.042711915	0.009162708
Agile manufacturing	0.03359365	0.01367073	0.0183303	0.05	0.08147217	0.01107823	0.04150524	0.08185584	0.007904478	0.006171402	0.021355958	0.001832542
V+	0.1343746	0.0205061	0.02749545	0.05	0.20368042	0.01846372	0.04150524	0.08185584	0.01317413	0.030857012	0.042711915	0.009162708
V-	0.03359365	0.00683537	0.0183303	0.05	0.08147217	0.01107823	0.0166021	0.0491135	0.007904478	0.006171402	0.021355958	0.001832542

Table 32: Euclidean distance from ideal best

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Si+	SI-
	C11	C12	C13	C21	C22	C23	C31	C32	C33	C41	C42	C43		
													0.1240	0.1098
Lean six sigma manufacturing	0.1343746	0.0205061	0.0183303	0.05	0.08147217	0.01846372	0.03320419	0.06548467	0.007904478	0.030857012	0.042711915	0.009162708	0.0919	0.0865
TQM manufacturing	0.10078095	0.01367073	0.02749545	0.05	0.12220825	0.01477098	0.02490315	0.06548467	0.007904478	0.024685609	0.042711915	0.007330167	0.0808	0.1302
Lean manufacturing	0.0671873	0.00683537	0.0183303	0.05	0.20368042	0.01477098	0.0166021	0.0491135	0.01317413	0.024685609	0.042711915	0.009162708	0.1626	0.0417
Agile manufacturing	0.03359365	0.01367073	0.0183303	0.05	0.08147217	0.01107823	0.04150524	0.08185584	0.007904478	0.006171402	0.021355958	0.001832542		
V+	0.1343746	0.0205061	0.02749545	0.05	0.20368042	0.01846372	0.04150524	0.08185584	0.01317413	0.030857012	0.042711915	0.009162708		
V-	0.03359365	0.00683537	0.0183303	0.05	0.08147217	0.01107823	0.0166021	0.0491135	0.007904478	0.006171402	0.021355958	0.001832542		

Table 33: Performance scores

	Si+	**Si-**	Pi	**Rank**
Lean six sigma	0.1240	0.1098	0.4696	3
Tqm manufacturing	0.0919	0.0865	0.4850	2
Lean manufacturing	0.0808	0.1302	0.6171	1
Agile manufacturing	0.1626	0.0417	0.2042	4

SECTION 4: RESULTS

On the basis of the results obtained, an assessment was made in this study. It would be preferable to evaluate the outcomes in the context of a level of objectivity that is specific to this type of data.

This research was intended to explore mass production efficiency and resource allocation methods of Africa's garment industry. In light of this information, we deployed a Hybrid multi-criteria decision-making technique to produce mathematical calculations that best expressed this thesis. They were four criterial that were evaluated namely reliability, capability, adaptability, and finally proper resource management. And four alternatives lean manufacturing, lean six sigma, TQM, and finally Agile manufacturing.

The journey of becoming Lean begins at the attitude and perception, rather than at the level of the work floor. As a result, the first part is the dissemination of information about the system to the organization's members. It is possible to accomplish this through the use of an accelerated improvement workshop. The importance of lean includes, Inventory levels can be reduced to almost nothing, resulting in significant cost savings.

Only a few minutes are required to transition between assorted designs. This allows for more adaptability and a more rapid reaction to customer needs and requirements (Gupta, 2015). Lean manufacturing methods are part of a comprehensive strategy that includes identifying and eliminating wasteful processes and procedures that are specific to your company, as well as replacing them with more optimal lean solutions.

Successful implementation of this principle can assist a company in increasing customer satisfaction, improving quality, lowering expenses, reducing inventory, shortening delivery times, and eliminating waste. In general, the planned future state established utilizing a lean manufacturing methodology provides considerable operational gains that will boost the company's competitiveness in the marketplace. At its core, lean manufacturing is about removing waste and delivering the best possible product to the client as quickly and with as few barriers as possible to ensure customer satisfaction (Zakuan & Saman, 2009).

The subject of our investigation is the efficiency of mass production and resource allocation using a multi-criteria decision-making process. As a result of conducting a thorough analysis using an integrated AHP-TOPSIS Model, the subsequent performance scores obtained using topsis demonstrate that lean manufacturing is by far the most effective method for mass producing and properly allocating resources, with an overall margin of 61 percent. Quality management and lean supply chain management are the next two most popular practices (48 and 46 percent, respectively), with agile manufacturing coming in dead last at 20 percent. The results are accurate representations of the data collected, and they express the responses of the respondents with great conviction.

Our results show that the importance of efficient mass production in terms of national and global growth is no longer debatable. The only question now is what tried-and-true mass-production methods can we use to ensure productivity. After conducting research, we discovered that lean manufacturing is the most common, followed by Tqm, lean six sigma, and finally Agile manufacturing. This is due to the way lean manufacturing complements the setting of the garment industry, as well as the abundance of capital in Africa, which enables this approach to thrive. A lean strategy allows producers make the most of their current resources while reducing waste in the manufacturing process. Its economic significance was not ruled out because it seemed to be affordable. However, the report did not assess this.

CONCLUSION

By analyzing Africa's garment industry in terms of mass production performance and resource utilization, we can confidently assert that the productivity of all suggested techniques is unquestionably of a high standard. With so many options, Africa's garment industry should be asking itself questions like which option is the simplest to adopt, the most economically viable, and the most profitable in terms of efficiency and resource allocation.

Not only are companies being forced to select the best efficiency-implementation strategy to suit their needs, but they are also being forced to consider what these strategies are aiming to achieve in a larger context. If successful strategies increase sales while raising awareness, businesses can use their best efforts to implement these strategical tactics.

Lots of manufacturing and a small number of service industries use lean manufacturing processes. There are many different approaches to lean production, including just-in-time (JIT), pull production, Kanban. But LP is not a single concept, it cannot be equated with just waste elimination or continuous improvement as a means of improving business processes nor can it improve productivity and competitiveness as a result.

LM has lately spread due to the effectiveness of Lean principles and practices in service primary strategy for manufacturing performance companies and in the attainment of better enhancement. Many businesses have now grasped this concept. As a result, the LM principles have proven effective in the short, medium, and long term (Anvari, Ismail, & Hojjati, 2011).

According to (Barney & Kirby,2004), In order to ensure efficient production, lean

manufacturing needs producers to understand every stage in the process also known as the value stream. This necessitates the elimination of any extra steps or waste throughout the process. When it comes to eliminating waste and ensuring that value flows through the system, it is necessary that every work be highly specified as to content, sequence, timing, and consequence and this is precisely why lean manufacturing is of a caliber of its own and the key to reap its reward is to fully understand all aspects that encompass it.

As stated by (El-Sayed, 2013), Lean manufacturing has given a long-term, proven, and effective strategy to the development and maintenance of manufacturing processes. This process-based way of thinking has resulted in a systematic approach to continuous improvement, which is centered on Value. It has been established that Toyota Lean Manufacturing System has driven the auto industry's transition from mass production to lean production through the use of lean thinking.

The ability of lean manufacturing to maintain a laser-like focus on giving value to the customers while identifying and reducing waste all while continuously improving makes it an amazing faultless process that leaves the greatest number of people gasping in awe of its abilities. In fact, (Elmoselhy, 2015), described it as having a long and illustrious history albeit continuously thriving in the present. In manner of speaking, he is illustrating it as both a legacy and a trend. Clearly pointing out how it never dies with time but grows with it Now more than ever.

Since the direct and indirect goals of the research were accomplished, we can say that this study contributes to the field of manufacturing in many ways. Firstly, there is the identification of current problems of Various African garment industries, alternatives were identified and the degree of to what extent these manufacturing methods are useful are portrayed in more than one mentioning.

Furthermore, both the benefits and the limitations of proposed alternatives were covered in detail and were well documented. The research results showed that the chosen alternatives were fair in terms of Mass production efficiency and proper resource allocation approaches. Undoubtedly this method of boosting Africa’s garment industry efficiency while helping in the correct procedure of resource allocation will not only benefit existing industries with medium to high exposure. but also attract new industries in the continent. The study provided a basis for future research in the techniques mass production efficiency and resource allocation methods.

Finally, in the scope of the research, mass production productivity and resource allocation approaches have reached a point where they are critical in the African garment industry. Improved efficiency and appropriate resource allocation are needed for business development in these industries. Because of the world's rapid growth, these companies must give it their all if they want to keep up with the biggest and baddest of the industry.

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RESUME

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