

# **EFFECT OF SUPPLY CHAIN PRACTICES ON SUSTAINABLE SUPPLY CHAIN PERFORMANCE IN KENYAN TEXTILE AND APPAREL INDUSTRY**

**Kevin Moindi Omai** 

Ph.D. (Supply Chain) Candidate, Jomo Kenyatta University of Agriculture and Technology,  
School of Entrepreneurship, Procurement and Management, Nairobi, Kenya  
kmoindi2003@yahoo.com

**Patrick Karanja Ngugi**

Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya  
ngugipk@gmail.com

**Mburu David Kiarie**

Dedan Kimathi University of Technology, Nyeri, Kenya  
dmburu77@gmail.com

## **Abstract**

*This paper investigates the effect of supply chain practices on sustainable supply chain performance in textile and apparel industry in Kenya. The major practices evaluated in the study were modularity based manufacturing, supply chain relationship, supply chain integration and supply chain responsiveness. For this, a cross-sectional study design was used. Census sampling was used to select participants and the firms to participate due to the small number of textile firms in Kenya. Therefore, 59 key informants were selected from 59 textile firms in Kenya. The findings revealed that modularity based manufacturing, supply chain relationship management, supply chain integration and supply chain responsiveness had a positive effect on supply chain performance in the textile and apparel industry in Kenya with modularity and supply chain integration being the strongest. Thus it can be concluded that supply chain practices are important factors to achieve improvement in the*

*performance of supply chains. The study recommends that textile and apparel firms in Kenya supply chain practices as a way to improving sustainable supply chain performance.*

*Keywords: Modularity based manufacturing, Sustainable supply chain performance, Supply chain integration, Supply relationship management, Supply chain responsiveness*

## **INTRODUCTION**

Pressures have fuelled a continuous change process within firms, impacting all the areas of supply chains, from rapid technological changes, to a much shortened product life cycle (Thatte, 2007). Christopher (2011) further stated that since the late 1990s change and uncertainty surrounding textile firms' supply chain practices and performance with shift in textile global supply chain practices. Over the past decades, the supply chain in textile industry has shifted from the local supply chain collaboration and coordination to global supply chain spread across the world, with Asia, USA, Europe and Africa forming integral part of the textile supply chain practices. Thatte (2013) argued that global supply chain in the textile industry has led to adoption of supply chain management as a way to manage the dynamic supply chain.

Supply chain management (SCM) is a crucial part of modern textiles and apparel business. In addition to the traditional concepts on improving the production efficiency, quality control, and product design, supply chain management focuses on enhancing the collaboration and cooperation among all companies in the supply chain with a goal of satisfying what market wants. With the rise of global supply chain in textile industry, textile industry are under increasing pressure to adopt best practices in supply chain as a way of gaining competitive advantage, the Kenyan textile industry is not an exception (Makori, Magutu, Omai & Akello, 2016).

The Kenyan textile and garment industry is composed of different players at every level of their supply chain with lot of structural, operational and performance differences. In addition, the industry consists of many entities, some structured while other unstructured as part of the supply chain. As such the Kenyan textile-apparel manufacturers face the need to gain competitive advantage in the global supply chain, of which it is part off. Sustainability in the industry has gain attention as the textile firm's faces competitive disadvantages due to poor supply chain practices. Best supply chain practices offer the sector opportunities of improved supply chain performance. This is significant as it addresses the gap in sustainable performance of textile and apparel firms in Kenya.

## Problem Statement

Sustainability is an important performance dimension that has gained significant traction on supply chain designing. Sustainable Supply Chain (SSC) is driven by environmental and social objectives with economic benefits (Taticchi, et al., 2013). A sustainable supply chain offers competitive advantages to firms that have oriented their existing supply chains. Supply chain performance is affected by different drivers, enablers and barriers of sustainable supply chain performance and the sustainability of supply chain performance varies with industry; as such sustainability studies in various sectors are recommended (Khurana, 2016; Oelze, 2017; Köksal, Strähle, Müller & Freise, 2017).

Sustainability issues in the textile and apparel industry have attracted the attention of scholar over the past two decades. The process of turning raw materials into finished garments has significant negative environmental and social implications, including air and water pollution, and exploitation of human resources, especially where production is outsourced to lower labour cost countries (Karthik & Gopalakrishnan, 2014; Köksal, Strähle & Müller, 2018). Research Studies have highlighted that the garment industries not only produce environmental impact but also affect the social wellbeing of the people involved in the process, more so concerning rights of workers. As a result the environmental and social impact of textile firms has been studied, with recommendation on need to embrace best supply chain practices (Connell & Kozar, 2017; Shen, Dong & Perry, 2017).

The textile industry in Kenya is not without sustainability issues, with the textile industry's supply chain identified as having a significant impact on the natural environment, infringement on workers' rights, heavy consumption of energy and water and stagnating revenues from exports (Andebe, 2012). In addition, the Kenyan textile industry also faces the challenge of sustainability in raw material supply due to inadequate supply of locally produced cotton due to poor quality and is heavily reliant on out-dated machines. Tuigong and Kipkurgat (2015) in their study on challenges and opportunities for textile firms in Kenya recommend the adoption of best supply practices as a way of enhancing sustainable financial performance among textile firms in Kenya. Although supply chain practices has been acknowledged as having potential effect on sustainable supply chain performance in Kenya, little is known regarding this relationship. This study thus aimed at determining the influence of supply chain practices on sustainable supply chain performances in apparel and textile industry in Kenya.

## General Research Objectives

The general objective of the study was to determine the influence of supply chain practices on sustainable supply chain performance in apparel and textile industry in Kenya.

## Specific Research Objectives

The specific study objectives for the research were:

- i. To determine the influence of modularity based manufacturing of a firm on sustainable supply chain performance in apparel and textile industry in Kenya.
- ii. To establish the influence of supply chain relationship management of a firm on sustainable supply chain performance in apparel and textile industry in Kenya.
- iii. To assess the influence of supply chain integration of a firm on sustainable supply chain performance in apparel and textile industry in Kenya.
- iv. To determine the influence of supply chain responsiveness of a firm on sustainable supply chain performance in apparel and textile industry in Kenya.

## THEORETICAL REVIEW

### SCOR Model (Supply Chain Operations Reference)

The Supply Chain Operations Reference model was introduced by the Supply Chain Council (SCC), an independent, not-for-profit, global corporation interested in applying and advancing the state-of-the-art in supply-chain management systems and practices. SCC was established in 1997, when 69 visionary supply chain practitioners from a variety of industry segments formed a cross-industry forum to discuss the issues related to supply chain management. The Supply Chain Operations Reference model (SCOR) is a management theory used as a tool to address, improve, and communicate supply chain management decisions within a company or supply chain environment and with suppliers and customers of a company (Tu *et al.*, 2004).

The model helps to explain the processes along the entire supply chain and provides a basis for how to improve those processes by measuring specific supply chain performance through defined metrics. The score model advocates for a lean supply chain where waste has been eliminated and the metrics in the SCOR model entails measuring supply chain plans which include sale and operations planning, source which include upstream flow from supplier side, make whose main concern is at the transformation stage where there is manufacturing, assembly and kitting, deliver entails transportation optimization and lastly return where the measures entails shipping mistakes and product quality. The SCOR model has been described as the most promising model for supply chain strategic decision making (Tu *et al.*, 2004).

The SCOR-model comprises five components: Plan, Source, Make, Deliver and Return. Each of these components is considered both an important intra-organisational function and a critical inter-organisation process. The five components of the model are integral part in modular manufacturing, supply chain relationship management, supply chain integration and supply chain responsiveness.

Plan: Planning the design and configuration of a supply chain is found to contribute to achieving competitive advantages. The major planning tasks include developing joint business plans among supply chain (SC) partners, determining SC quality objectives, creating process improvement plans, conducting demand and material replenishment plans, and setting up production plans. Decisions in the Plan area affect the entire supply chain activities, either directly or indirectly.

Source: This step describes sourcing infrastructure and material acquisition. It describes how to select suppliers, manage inventory, develop supplier network, keep delivery promise, and evaluate supplier performance. It also discusses how to handle supplier payments and when to receive, verify, and transfer products (Soffer and Wand 2005).

Make stage involves transforming demand through manufacturing and production. The Make step includes production activities, packaging, staging, inventory process, material flow, releasing, etc. It also includes managing the production network, equipment and facilities, and transportation. The make component is seen as make-to-stock, make-to-order, or engineer-to-order, with employees as the most valuable resource (Georgise, Thoben, & Seifert, 2012).

The delivery decision area includes delivery plans, quality service expectations, inventory management, order management, warehousing, transportation, and import and export regulatory compliance. It also includes receiving orders from customers and invoicing them once products have been received. Delivery reliability (such as on-time delivery) and responsiveness (such as just-in-time delivery) are important component of this stage.

Return. The return process is a reversed logistics process. This process involves the management of business rules, return inventory policy, transportation arrangement, and regulatory requirements and compliances. Companies must be prepared to handle the return of containers, packaging, or defective products. All return defective products should be traced back to the source. Reliability and responsiveness are important quality indicators for the return process (Thilakarathna, Dharmawardana, & Rupasinghe, 2015).

The benefits that SCOR can deliver in terms of fostering true supply chain commitment to quality assurance through joint planning on quality standards are reflected in supply chain customer-facing performance. Studies by (Kocaoğlu, Gülsün and Tanyaş, 2013; Thilakarathna, Dharmawardana and Rupasinghe, 2015) have indicated that SCOR model promotes collaborative and commitment among supply chain partners thereby contributing to sustainable performance in firms. In this study, SCOR-model was employed to empirically analyse the relationship between supply chain practices (practices involving planning, sourcing, order transformation through making, order delivery, and return processes) and sustainable supply chain performance in textile firms.

## Resource Based Theory (RBT)

The resource-based view of the firm (RBV) and the resultant resource-based theory (RBT) provide an important framework for explaining and predicting the basis of a firm's performance (Barney & Clark 2007). According to Peteraf and Barney (2003), a firm achieves a competitive performance when it is able to generate more economic value than the marginal (breakeven) competitor in its product market. A firm has achieved a sustainable supply chain performance when it is creating more economic value than the marginal firm in its industry and when other firms are unable to duplicate the benefits of this strategy (Barney & Clark 2007).

Resource based view (RBV) has received significant attention in explaining supply chain practices. The key concepts of RBV are resources, capabilities, and strategic assets. RBV argues that variance in firm performance can be explained by strategic resources, such as core competence, network flexibility and absorptive capacity. Firms that combine resources in a unique way may achieve an advantage over their competing firms who are unable to do so. By owning scarce resources and assets and excelling in core competencies and capabilities, firms can reach a market advantage and gain a sustained competitive advantage (Knudsen 2003).

RBV claims that integration by specific asset investments enables partnering firms to build competitive advantage because of their rare, valuable, non-substitutable, and difficult-to-imitate nature. Resource complementarity or the need for particular resources is another reason for supply chain collaboration. By investments in relation-specific assets, substantial knowledge exchange, combining complementary and scarce resources or capabilities, supply chain practices can create unique products, services or technologies. Supply chain practices also enables firms to concentrate on their core competencies, which increase firm specific skills and realize economies of scale and learning effects (Hunt & Davis, 2012).

Much of the supply chain management (SCM) literature that investigates resources and performance rests on the premises of the resource-based view (RBV). At its core, the RBV tries to explain sustained competitive advantage as stemming from internal resources that are valuable, rare, inimitable, and non-substitutable. These resources may include both tangible (firm's logistic network) and intangible assets (information shared). Supply chain practices can be a source of sustained competitive advantage, because; Supply chain practices exhibit resources that can enhance competitive advantage and supply chain practices may facilitate the acquisition of strategic resources in factor markets (Carter, Kosmol& Kaufmann, 2017).

Inter-organizational activities that occurs in the supply chain relationship management and supply chain integration among various actors are important resources that organization acquire over time, and which can contribute to improved performance. Through the process of information sharing, internal integration, vertical integration and external integration, the firms

can acquire resources that can improve the sustainable supply chain performance of textile and apparel industry (Bohnenkamp, 2013). Further, this theory also views raw materials, investment in modular manufacturing through equipment as a key asset that can give textile firms competitive advantage. Best supply chain practices are viewed as crucial assets and resources that can result to improved sustainable supply chain performance. This theory was also central in providing the framework to understand the relationship between supply chain practices and sustainable supply chain performance.

## **EMPIRICAL REVIEW**

### **Modularity-Based Manufacturing**

Modularity based manufacturing practices is defined as the application of unit standardization or substitution principles to product design, production process design and organizational design (Thatte, 2007). Modularity-based manufacturing practices are a set of actions that enable firms to achieve modularity in product design, production process design, and organizational design (Tuet *al.*, 2004). Schilling and Steensma (2001) suggested that systems will have higher degrees of modularity when their components can be disaggregated and recombined into new configurations with little loss of functionality. A complex system can be easily managed by dividing it into smaller modules and examining each piece separately. The potential benefits of modularity include economies of scale, increased feasibility of product/components change, increased product variety and reduced lead time, decoupling tasks and ease of product upgrade, maintenance, repair, and disposal (Coronado *et al.*, 2004). Modularity manufacturing is viewed in three stages of product modularity, process modularity and dynamic teaming.

Product modularity is defined the practice of using standardized product modules so they can be easily reassembled/rearranged into different functional forms, or shared across different product lines (Tu *et al.*, 2004). Process modularity on the other hand is the practice of standardizing manufacturing process modules so that they can be re-sequenced easily or new modules can be added quickly in response to changing product requirements (Tuet *al.*, 2004). To support these processes is the need for dynamic teaming, which involves having flexible and adaptive functional team in the manufacturing process. Today's rapidly changing manufacturing environment requires a dynamic team structure different from traditional cross-functional teams.

### **Supply Chain Relationship Management**

Supply chain relationship management is defined as activities undertaken by an organization to promote effective management of supply chain engagements both in upstream flow and downstream flow (Lapide, 2013). We have relationships where the buyer and supplier do not

have that closeness on one end and on the other end we have adversarial relationships which have single sourcing as an improved level within the spectrum as it is characterised by lack of mutuality in thought and in action. Donlon (1996) considered outsourcing, supplier partnership, information sharing, cycle time compression, and continuous process flow, as supply chain relationship elements. Further, he classified supply chain in three stages of strategic supplier partnerships, customer relationships and information sharing.

Strategic supplier partnerships defined as the long term relationship between the organization and its suppliers within the relationship spectrum. It is designed to leverage the strategic and operational capabilities of individual participating organizations to help them achieve significant ongoing benefits (Li *et al.*, 2006) assert that a strategic partnership emphasizes long-term relationship between trading partners and promotes mutual planning and problem solving efforts (Li *et al.*, 2006). Strategic partnerships with suppliers facilitate organizations to work closely and effectively with a few suppliers thus giving the partners shared benefits (Thatte, 2007).

Customer relationship is seen as the entire spectrum of practices that are employed for the purpose of managing customer complaints, building long-term relationships with customers, and improving customer satisfaction (Li *et al.*, 2005). An organization's customer relationship practices can affect its success in supply chain management efforts as well as its performance. Successful supply chain management involves customer integration at the downstream and supplier integration at the upstream, considering that each entity in a supply chain is a supplier as well as a customer (Tan *et al.*, 1999).

Information sharing means distributing useful information for systems, people or organizational units. According to Mäkinen (2017), information sharing can take the different form at the supply chain stage. Marinagi, Trivellas and Reklitis (2015) on the other hand classified knowledge shared into two classifications: explicit and tacit. Explicit knowledge, refer to affable knowledge, knowledge that can be put into numbers, words, charts and formulas. Tacit knowledge based on experience and hence can be really subjective and indescribable. This study focused on the use of tacit knowledge sharing as the collection of this data is easier than the explicit information sharing.

### **Supply Chain Integration**

The concept of supply chain integration has recently gained widespread attention in supply chain literature (Zhang &Huo, 2013). Firms are now under increased pressure to integrate their supply chains to become more competitive in order to meet the challenges of current business needs (Danese& Romano, 2011). Flynn et al. (2010) defined supply chain integration as “the



degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organisation processes. The goal is to achieve effective and efficient flow of products and services, information, money and decisions, to provide a maximum value to customer at low cost and high speed”.

Supply chain integration can be seen at two broad levels; external integration and internal company integration. While external integration examines integration that occurs between the firm and its suppliers and customers, internal company integration is associated with the integration of the production and supporting functions within the organisation (Schoenherr & Swink, 2012). External integration refers to the integration of the company with its external environment including customers and suppliers. Internal integration refers to breaking down the functional barriers and working with the different divisions within the organisation as a single unit. The organisation functional divisions are viewed as an integrated process rather than functional silos based on traditional departmentalisation and specialisation (Flynn et al., 2010). Wright (2016) referred to internal integration as “the competency of linking internally performed work into a seamless process to support customer’s requirements”.

Another type of integration highlighted in the literature is vertical integration. Vertical integration can be described as the overall scope of different business activities in a supply chain brought under the management of a single company. It can be realised through two approaches: vertical financial ownership; and vertical contracts (Huang, Yen & Liu, 2014). Vertical financial ownership eliminates company boundaries through mergers and acquisitions, while vertical contracting, which includes exclusive dealing, resale price maintenance, and exclusive territories, offers a viable alternative to vertical financial ownership (Ataseven& Nair, 2017).

### **Supply Chain Responsiveness**

Supply chain responsiveness is defined as the capability of promptness and the degree to which the supply chain can address changes in customer demand (Koçogluet *al.*, 2011). In a rapidly changing competitive world, there is a need to develop organizations and supply chains that are significantly more flexible and responsive than the existing ones and in a very sustainable way. Firms should aptly respond to changing customer needs so as to succeed in today’s uncertain business environment (Muhammad, Sule, Sucherly and Kaltum, 2016) as well as any disruptions in supply (Christopher and Peck, 2004). Supply chain responsiveness can be viewed in terms of operation system responsiveness, logistics process responsiveness and supply network responsiveness.

Operations system responsiveness is defined as the ability of a firm's manufacturing system to address changes in customer demand. Operations system responsiveness includes both manufacturing and service operations. Duclos *et al.*, (2003) and Lummus *et al.*, (2003) in a conceptual study, emphasize that operation responsiveness at each node of the chain is an integral component of supply chain responsiveness. They further argue that in order to meet the end customer's needs, each entity in the supply chain must deliver the product or service in a timely and reliable manner (Prater *et al.*, 2001).

Logistics process responsiveness is defined as the ability of a firm's outbound transportation, distribution, and warehousing system to address changes in customer demand. The responsiveness in the logistic processes is a vital component in the success of a responsive supply chain strategy. Logistics and distribution management includes the activities of transportation of goods from suppliers to manufacturer to distribution centres to final point of consumption. These activities include warehousing, packing and shipping, transportation planning and management, inventory management, reverse logistics, and order tracking and delivery (Thatte & Agrawal, 2017). Responsiveness components in the logistics system include selecting logistics components that accommodate and respond to wide swings in demand over short periods, adjust warehouse capacity to address demand changes, handle a wide range of products, vary transportation carriers, have the ability to pack product-in-transit to suit discreet customers' requirements, and have the ability to customize products close to the customer; and do all of these speedily in order to gain a competitive performance (Mandal, 2015).

Supplier network responsiveness is defined as the ability of a firm's major suppliers to address changes in the firm's demand both in production and in downstream. A key to responsiveness is the presence of responsive and flexible partners upstream and downstream of the focal firm. The ability of firms to react quickly to customer demand is dependent on the reaction time of suppliers to make volume changes (Thatte, Rao, & Ragu-Nathan, 2013).

Whenever disruptive causes such new technology, terrorist threats or cut-throat competition tend to throw the supply chain haywire, the supply chain networks must be ready to react to any ripple effect. Slack (1991) argues that supplier networks are the essential building blocks of a flexible system. Holweg & Pil (2001) argue that flexibility in the supplier network is an important ingredient of being responsive to changes in customer demand. Thus supplier network responsiveness is believed to be a dimension of supply chain responsiveness in this study. In order to have a competitive performance, organizations need to meet the changing needs of customers by being able to rapidly supply products, including any demand changes in terms of product volume, mix, product variations, and new product introductions.

## Sustainable Supply Chain Performance

Sustainable supply chain management (SSCM) is the management of supply chain operations, resources, information, and funds in order to maximize the supply chain profitability while at the same time minimizing the environmental impacts and maximizing the social well-being (Hassini et al. 2012). Hassini et al. 2012 have also indicated that a number of long term business failures are due to the absence of sustainability goals in the corporation vision (Yang, Han, Zhou & Yuan, 2015). Sustainability has become a strategic business initiative as both large and small companies are realizing that sustainable practices can be both economical and can create new revenue streams. They can as well increase customer and employee satisfaction (Mincer, 2008). With this comes the need to develop key performance indicators to measure the progress of implementing these sustainability practices. As argued in Hassini et al. (2012), current supply chain performance measurement systems are not geared toward the complexities that are involved when measuring performance across supply chain interfaces (Allen et al., 2012).

Based on a three-dimensional sustainability framework, referred to as the triple bottom line (TBL), that considers the economy (profit), the environment (planet), and the society(people) as proposed by Elkington 1997, businesses can create new sustainable and competitive revenue streams (Mincer 2008). This has prompted both academics and practitioners to build models and policies for sustainable operations. Chen and Delmas (2011), Chen and Delmas (2012), Chen et al. (2012), and Odegaard and Roos (2014) propose some quantitative assessment approaches which encompass the three dimensions as economic, environmental and societal.

Cetinkaya et al. (2011) used balanced scorecard concept and divided their indicators into three main classes: economic, environmental, and social. These were further divided into 3 subcategories each: quality, efficiency, and responsiveness in the economy dimension, emissions, natural resources utilization, and waste and recycling in the environment dimension, and finally health and safety, employees, and noise in the social dimension. Erol et al. (2011) used a multi-criteria framework that incorporates all the triple bottom line sustainable dimensions as already explained. Finally, Samuel et al. (2013) presented a framework that included 4 categories of indicators: economic; environmental; social; and labour practices and decent work.

Environmental dimension (Hervani et al., 2005; Patlitzianas et al., 2008) proposes the use of ISO 14031, part of the ISO 14,000 family of standards. They incorporate the following environmental measures: fugitive non-point air emissions, stack or point air emissions, discharges to receiving streams and water bodies, underground injection on-site, releases to land on-site, discharges to publicly owned treatment works, other off-site transfers, on-site and off-site energy recovery, on-site and off-site recycling, on-site or off-site treatment, spill and leak

prevention, total electricity use, total fuel use, total materials use other than fuel, and total water use. (Patlitzianas et al. (2008); Gunasekaran *et al.*, 2001)

Economic dimension (Wang, 2012; Bai et al., 2012) despite the crucial role that companies play in world trade, especially given their production capabilities, Zhu et al. (2005) believe there has been a lag in the implementation of green practices by many firms especially those that have Asian origin. They attribute this to inefficient management tools and the lack of environmental performance indicators that link to economic metrics. They argue that environmental performance, operational performance, positive economic performance, and negative economic performance are all linked to green practices performance measurement.

Social dimension (Norman and MacDonald, 2004) concentrate on social concerns and offer the framework. They classify social indicators into five aspects, diversity, unions/industrial relations, health and safety, child labour, and community. It is based on these studies that the research attempted to measure purely quantitative supply chain performance metrics by linking them to supply chain practices.

### Supply Chain Practices

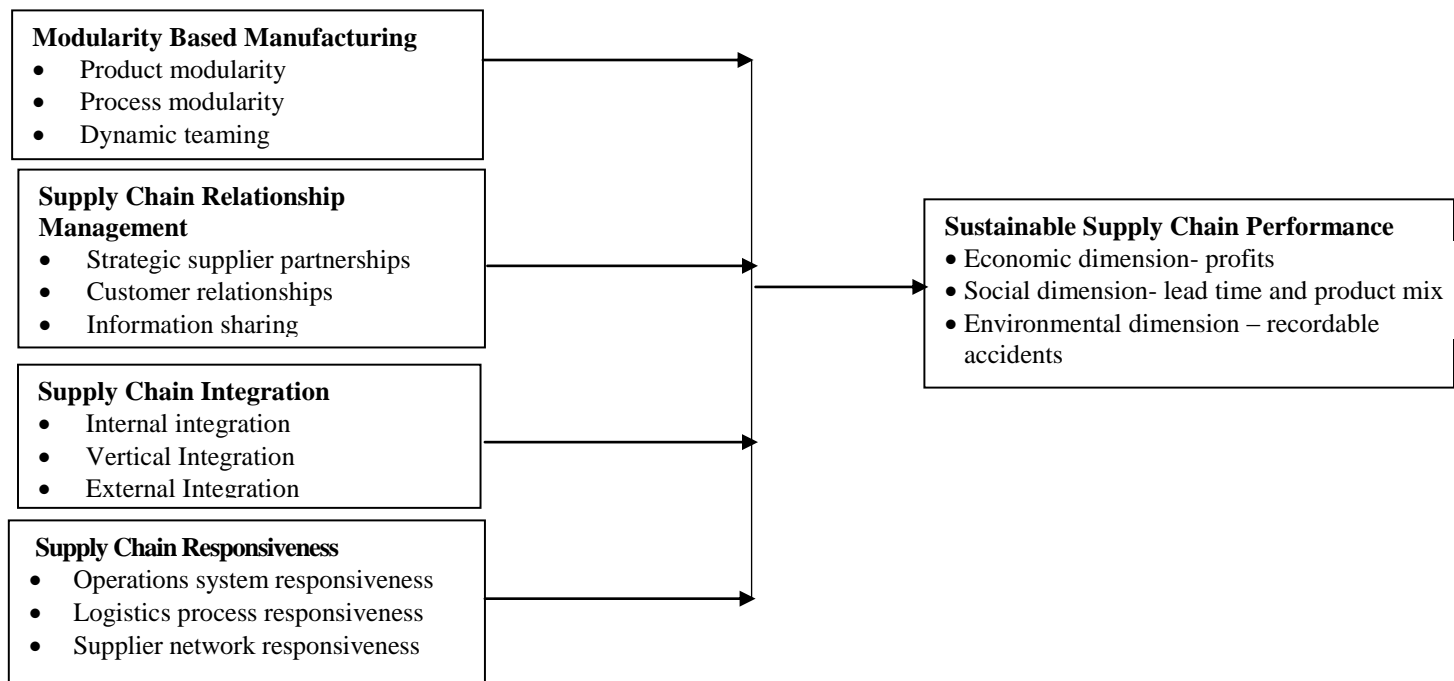


Figure 1: Conceptual Framework

## RESEARCH METHODOLOGY

The study adopted a cross-sectional descriptive study design. Cross-sectional descriptive study design was selected because it allowed for testing of relationship between supply chain practices and sustainable supply chain performance. The target population of the study were the 59 textile and apparel firms in Kenya. These consists of twenty (20) companies that operate in Kenya's EPZ and 39 companies that operate under DAS (Duty Alienation Scheme) scheme under Kenya Association of Manufacturers of which both are under AGOA. Out of the targeted 59 firms, only 55 firms participated in the study. The study targeted one key informant from each firm thus bringing the total sample to 59. The key person was selected based on their knowledge on performance measures used in the study. The study used census to select the participating firms since the target population of the firms was small. After the selection of participating firms through census, the study used purposive sampling to select the respondents who participated in the study. This was used to select respondents who met the inclusion criteria of the study. A pilot study was undertaken on one company, with data collected from that firm used to test the reliability and validity of the questionnaire.

Questionnaire method was the primary method of data collection, with the questionnaire being administered to the senior executives and middle level managers of the textile and apparel industries under EPZ and KAM. Questionnaire was administered through a self-administered interview. This involved the researcher visiting the participating firms and respondents who were requested to fill the question on their own and give back the questionnaire to the research assistant.

Data was collected and analysed using both descriptive statistics and inferential statistics through SPSS version 24. Before carrying out inferential statistics, diagnostics tests were carried out. MANOVA was used to test the relationship between supply chain practices and sustainable supply chain performance. This is because the sustainable supply chain performance variable involved different measures of economic, social and environment indicators.

## ANALYSIS AND FINDINGS

### Joint Regression Analysis between Supply Chain Practices and Sustainable Supply Chain Performance

MANOVA was carried out to test the relationship between supply chain practices and sustainable supply chain performance. MANOVA was carried out for the advantage that it has over ANOVA in that ANOVA when carried out with several dependent variable runs the risk of rejecting the null hypothesis when it is actually true. As shown in Table 1, the adjusted  $R^2=0.524$

indicates that the independent variables factors explained 52.4% percent of the variation in sustainable supply chain performance. This implies that supply chain practices are significant predictor of sustainable supply chain performance by 52.4%, with 47.6% of changes in sustainable supply chain performance occasioned by variables not included in the model.

Table 1: Model Summary

R- Squared	Adjusted R Squared
0.524	0.493

Table 2: Multivariate Tests

Effect		Multivariate Tests(c)				
		Hypothesis				
		Value	F	df	Error df	Sig
Intercept	Pillai's Trace	0.873	135.603a	4	79	0.873
	Wilks' Lambda	0.127	135.603a	4	79	0.873
	Hotelling's Trace	6.866	135.603a	4	79	0.873
	Roy's Largest Root	6.866	135.603a	4	79	0.873
MODULAR MANUFACTURING	Pillai's Trace	0.163	0.871	16	328	0.041
	Wilks' Lambda	0.457	0.872	16	241.987	0.042
	Hotelling's Trace	0.18	0.872	16	310	0.043
	Roy's Largest Root	0.136	2.784b	4	82	0.12
SUPPLY RELATIONSHIP MANAGEMENT	Pillai's Trace	0.091	0.475	16	328	0.023
	Wilks' Lambda	0.290	0.465	16	241.987	0.023
	Hotelling's Trace	0.094	0.458	16	310	0.023
	Roy's Largest Root	0.058	1.186b	4	82	0.055
SUPPLY CHAIN INTEGRATION	Pillai's Trace	0.337	2.56	16	243	0.112
	Wilks' Lambda	0.068	2.648	16	209.306	0.017
	Hotelling's Trace	0.418	2.706	16	233	0.122
	Roy's Largest Root	0.311	6.293b	4	81	0.237
SUPPLY CHAIN RESPONSIVENESS	Pillai's Trace	0.14	0.741	16	328	0.035
	Wilks' Lambda	0.164	0.744	16	241.987	0.047
	Hotelling's Trace	0.154	0.748	16	310	0.037
	Roy's Largest Root	0.127	2.604b	4	82	0.113

a. Exact statistic b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept + MODULAR MANUFACTURING + SUPPLY RELATIONSHIP MANAGEMENT + SUPPLY CHAIN INTEGRATION + SUPPLY CHAIN RESPONSIVENESS.

The general regression Model arrived at was  $Y = 0.127 + 0.457X_1 + 0.29X_2 + 0.068X_3 + 0.164X_4$ .

Where;  $X_1$ = Modular based manufacturing (MM),  $X_2$  = Supply relationship management (SRM),  $X_3$ = Supply chain integration (SCI),  $X_4$  =Supply chain responsiveness (SCR) and  $Y$ = Sustainable supply chain performance of textile firms in Kenya. Hence;

Sustainable supply chain performance = 0.127 + 0.457 Modular Manufacturing + 0.29 Supply Relationship Management + 0.068 Supply Chain Integration + 0.164 Supply Chain Responsiveness.

The Beta Coefficients in the regression model show that all of the tested variables had positive relationship with sustainable supply chain performance of textile firms in Kenya with all the variables tested being statistically significant with p-values less than 0.05.

The Y- Intercept ( $\beta_0 = 0.127$ ), predict that the sustainable supply chain performance of textile firms in Kenya when all other variables are zero, implying that without the independent variables that include; Modular based manufacturing, Supply relationship management, Supply chain responsiveness and Supply chain Integration (SCI), the sustainable supply chain performance of textile firms in Kenya will be 0.127.

The study shows that modular manufacturing  $X_1$  with ( $\beta = 0.457$ ,  $p < 0.05$ ) has the strongest relationship with the supply chain performance of textile firms in Kenya, then followed by Supply relationship management  $X_2$  ( $\beta = 0.29$ ,  $p < 0.05$ ), supply chain responsiveness  $X_4$  ( $\beta = 0.164$ ,  $p < 0.05$ ) and finally supply chain integration  $X_3$  ( $\beta = 0.068$ ,  $p < 0.05$ ) respectively. From the analysis all four independent variables (supply chain practices) statistically significantly predicted the sustainable supply chain performance of textile firms in Kenya.

The study findings indicate that there exists a positive and significant relationship between modular manufacturing and sustainable supply chain performance of the textile firms. The results show that for a unit change in modular manufacturing leads to an increase in the firm's profits by 0.457 units. This means that module performance leads to improved financial performance of textile firms. Sudarshan & Rao (2013) argues that the manufacturer's cost is always lower in the modular approach than in the traditional approach in textile firms. Hence, the modular approach favors the manufacturer from the operations point of view. This they argue can lead to improved financial performance of textile firms. This concurs with the assertion of Chiu & Okudan (2011) that modular manufacturing result in efficient use of resources thus lowering cost of production, benefits which can results to improved profits. This study aligns with the findings of Berg, et al., (1996) who established that modular manufacturing leads to increased financial performance.

Concerning supply relationship management, the study revealed that supply relationship management affects the sustainable supply chain performance of firms positively. The study results showed that a unit change in supply relationship management results in 0.290 units of sustainable supply chain performance. This finding implies that textile firms which adopt supplier relationship strategies are likely to experience improved supply chain performance. According to Al-Abdallah, Abdallah & Hamdan (2014) supplier relationships hold the potential benefits of organization flexibility and cost reduction which can reduce to improved organizational performance of manufacturing firms. Supplier relationship management allows firms to streamline and make more effective the supplier processes results inventory reduction smoothing production through reducing costs. According to Field & Meile L. C. (2008) supply relationship management allows for cooperation and long-term commitment with buyers and suppliers, this leads to overall supplier performance. Further, Nyamasege & Biraori (2015) argues that supplier relation allows firms to foster coordination and feedback mechanism that translates to improved supplier performance and organizational performance. These results are consistent to the findings of Field & Meile (2008) who demonstrated that supplier relationship significantly affects supply chain performance.

The study findings also established that there exist significant relationship between supply chain integration and sustainable supply chain performance of textile manufacturing firm. From the findings it was established that an increase unit in supply chain partnership practices results in improved supply chain performance by 0.068. This study demonstrates that firms that adopt supply chain integration are likely to have improved supply chain performance. Supply chain integration allows firms to be closely coupled with customers, thereby allowing transfer of important information to integrated supplier thereby aligning their production and shipping plans to the final market demand. Integration also enables firms to attain a competitive edge by streamlining business processes and by coordinating activities with business partners (Ataseven & Nair, 2017). These findings support the results of Kumar et al., (2017) and Kemunto (2014) who concluded that supply chain integration positively impacts on the organizational performance

Finally, the study results also indicated that there exists a relationship between supply chain responsiveness and sustainable supply chain performance. The findings showed that an increase in one unit of supply chain responsiveness results to increase in sustainable supply chain performance by 0.164 units. These findings demonstrate the potential that supply chain responsiveness holds in enhancing the sustainable supply chain performance of textile firms. This can be attributed to the benefits of supply chain responsive such as providing quick responses to customer demands and preferences and providing an extended enterprise to



enhance cooperation thereby making the firm more responsive and flexible to changes in the market (Singh, 2015). These results are align with the findings of Sukati et al., (2012) who established that supply chain responsiveness give firm competitive advantage.

## **CONCLUSION AND RECOMMENDATIONS**

The study findings show that supply chain management practices that include; supply chain integration, modularity manufacturing and supply relationship management significantly contributes to sustainable supply chain performance of textile firms. Hence it can be concluded that supply chain practices are important factors to achieve improvement in the performance of supply chains. Another conclusion drawn from the study findings is that supply chain practices affects the sustainable supply chain performance differently, with the supply chain integration and modularity manufacturing having the most significant effect. As a result of this study, textile firm's managers have the justification to incorporate supply chain management practices as a way of improving sustainable supply chain performance of textile and apparel firms in Kenya. Further, the study recommends that when firms are faced with limited resources to implement all the supply chain practices, priority should be given to modularity manufacturing which affects approximately half of the change in sustainable supply chain performance.

The study holds several important implications for managers and practitioners. Firstly, by proving the positive impact of modularity based manufacturing, supply relationship management, supply chain integration and supply chain responsiveness on sustainable supply chain performance; the study suggested managers to make appropriate investments on modular manufacturing, supply relationship management, supply chain integration and supply chain responsiveness. This will enable the focal textile firms to efficiently improve their sustainable supply chain performance.

The study also recommends a future research which can focus on a comparative study of the contributions of supply chain management practices that include supply chain practices and green supply chain management to the textile industry as well as other sectors. In addition, Further research should apply longitudinal study to corroborate cross-sectional findings and examine performance prior to and after adoption of supply chain practices in the textile industry at different time periods, providing insights into the refinement of the pertinent items since this research study was a cross-sectional one. In addition to that another research ought to include moderating and mediating variable to test their effects on the relationship between supply chain practices and sustainable supply chain performance.

## REFERENCES

- Al-Abdallah, G. M., Abdallah, A. B., & Hamdan, K. B. (2014). The impact of supplier relationship management on competitive performance of manufacturing firms. *International Journal of Business and Management*, 9(2), 192.
- Allen, M. W., Walker, K. L., & Brady, R. (2012). Sustainability discourse within a supply chain relationship: Mapping convergence and divergence. *The Journal of Business Communication* (1973), 49(3), 210-236.
- Andebe, E. O. (2012). Green supply chain management practices of the textile industry in Kenya (Doctoral dissertation, University of Nairobi, Kenya).
- Ataseven, C., & Nair, A. (2017). Assessment of supply chain integration and performance relationships: A meta-analytic investigation of the literature. *International journal of production economics*, 185, 252-265.
- Awaluddin, M., Sule, E. T., & Kaltum, U. (2016). The Influence Of Competitive Forces And Value Creation On Company Reputation And Competitive Strategy: A Case Of Digital Creative Industry In Indonesia With The Implication On Sustainable Business Performance. *International Journal of Economics, Commerce and Management*, 4(2), 201-234.
- Bai, C., Sarkis, J., Wei, X., & Koh, L. (2012). Evaluating ecological sustainable performance measures for supply chain management. *Supply Chain Management: An International Journal*, 17(1), 78-92.
- Barney, J. & Clark, D. N. (2007). *Resource-Based Theory. Creating and Sustaining Competitive Advantage*: Oxford University Press.
- Berg, P., Appelbaum, E., Bailey, T., & Kalleberg, A. L. (1996). The performance effects of modular production in the apparel industry. *Industrial Relations: A Journal of Economy and Society*, 35(3), 356-373.
- Bohnenkamp, T. (2013). The effect of the resource based view on decisions in supply management (Bachelor's thesis, University of Twente).
- Cetinkaya, B., Cuthbertson, R., Ewer, G., Klaas-Wissing, T., Piotrowicz, W., & Tyssen, C. (2011). *Sustainable supply chain management: practical ideas for moving towards best practice*. Springer Science & Business Media.
- Chen, C-M., & Delmas, M. A. (2012). Measuring eco-inefficiency: a new frontier approach. *Operations Research*, 60(5), 1064-1079.
- Chiu, M. C., & Okudan, G. (2011). An integrative methodology for product and supply chain design decisions at the product design stage. *Journal of Mechanical Design*, 133(2), 021008.
- Christopher, M. (2011). *Logistics and supply chain Management strategies*. 4th ed. FT Prentice Hall, London.
- Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *The international journal of logistics management*, 15(2), 1-14.
- Coronado, A. E., Lyons, A. C., Kehoe, D. F., & Coleman, J. (2004). Enabling Mass Customization: Extending Build-To-Order Concepts to Supply Chains, *Production Planning & Control*, 15(4), 398-411.
- Danese, P., & Romano, P. (2011). Supply chain integration and efficiency performance: a study on the interactions between customer and supplier integration. *Supply Chain Management: An International Journal*, 16(4), 220-230.
- Donlon, J. P. (1996). Maximizing value in the supply chain. *Chief Executive*, 117(1), 54-63.
- Duclos, L. K., Vokurka, R. J., & Lummus, R. R. (2003). A conceptual model of supply chain flexibility. *Industrial Management & Data Systems*, 103(6), 446-456.
- Erol, I., Sencer, S., & Sari, R. (2011). A new fuzzy multi-criteria framework for measuring sustainability performance of a supply chain. *Ecological Economics*, 70(6), 1088-1100.
- Field, J. M., & Meile, L. C. (2008). Supplier relations and supply chain performance in financial services processes. *International Journal of Operations & Production Management*, 28(2), 185-206.
- Flynn, B. B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of operations management*, 28(1), 58-71.
- Georgise, F. B., Thoben, K. D., & Seifert, M. (2014). Supply chain integration in the manufacturing firms in developing country: An Ethiopian case study. *Journal of Industrial Engineering*, 2014.
- Hassini, E., Surti, C., & Searcy, C. (2012). A literature review and a case study of sustainable supply chains with a focus on metrics. *International Journal of Production Economics*, 140(1), 69-82.
- Hervani, A. A., Helms, M. M., & Sarkis, J. (2005). Performance measurement for green supply chain management. *Benchmarking: An international journal*, 12(4), 330-353.

- Holweg, M., & Pil, F. K. (2001). Successful build-to-order strategies start with the customer. *MIT Sloan Management Review*, 43(1), 74.
- Huang, M. C., Yen, G. F., & Liu, T. C. (2014). Reexamining supply chain integration and the supplier's performance relationships under uncertainty. *Supply Chain Management: An International Journal*, 19(1), 64-78.
- Huang, S. H., Liu, P., Mokasdar, A., & Hou, L. (2013). Additive manufacturing and its societal impact: a literature review. *The International Journal of Advanced Manufacturing Technology*, 67(5-8), 1191-1203.
- Hunt, S. D., & Davis, D. F. (2012). Grounding supply chain management in resource-advantage theory: In defense of a resource-based view of the firm. *Journal of Supply Chain Management*, 48(2), 14-20.
- Karthik, T., & Gopalakrishnan, D. (2014). Environmental analysis of textile value chain: an overview. In *Roadmap to Sustainable Textiles and Clothing* (pp. 153-188). Springer, Singapore.
- Khurana, K., & Ricchetti, M. (2016). Two decades of sustainable supply chain management in the fashion business, an appraisal. *Journal of Fashion Marketing and Management*, 20(1), 89-104.
- Knudsen, D. (2003). Aligning corporate strategy, procurement strategy and e-procurement tools. *International Journal of Physical Distribution & Logistics Management*, 33(8), 720-734.
- Kocaoğlu, B., Gülsün, B., & Tanyaş, M. (2013). A SCOR based approach for measuring a benchmarkable supply chain performance. *Journal of Intelligent Manufacturing*, 24(1), 113-132.
- Koçoğlu, İ., İmamoğlu, S. Z., İnce, H., & Keskin, H. (2011). The effect of supply chain integration on information sharing: Enhancing the supply chain performance. *Procedia-social and behavioral sciences*, 24, 1630-1649.
- Köksal, D., Strähle, J., & Müller, M. (2018). Social Sustainability in Apparel Supply Chains—The Role of the Sourcing Intermediary in a Developing Country. *Sustainability*, 10(4), 1039.
- Köksal, D., Strähle, J., Müller, M., & Freise, M. (2017). Social sustainable supply chain management in the textile and apparel industry—A literature review. *Sustainability*, 9(1), 100.
- Kozar, J. M., & Connell, K. Y. H. (2017). Barriers to Socially Responsible Apparel Purchasing Behavior: Are Consumers Right?. In *The Customer is NOT Always Right? Marketing Orientations in a Dynamic Business World* (pp. 79-85). Springer, Cham.
- Kumar, V., Chibuzo, E. N., Garza-Reyes, J. A., Kumari, A., Rocha-Lona, L., & Lopez-Torres, G. C. (2017). The impact of supply chain integration on performance: Evidence from the UK food sector. *Procedia Manufacturing*, 11, 814-821.
- Li, S., Ragu-Nathan, B., Ragu-Nathan, T. S., & Rao, S. S. (2006). The impact of supply chain management practices on competitive advantage and organizational performance. *Omega*, 34(2), 107-124.
- Li, S., Rao, S. S., Ragu-Nathan, T. S., & Ragu-Nathan, B. (2005). Development and validation of a measurement instrument for studying supply chain management practices. *Journal of operations management*, 23(6), 618-641.
- Lummus, R. R., Duclos, L. K., & Vokurka, R. J. (2003). Supply chain flexibility: building a new model. *Global Journal of Flexible Systems Management*, 4(4), 1-13.
- Makori, C.W., Magutu, O.P., Omai, M.K., & Akello, E. (2016). The relationship between real-time information processing and supply chain optimization among supermarkets in Nairobi, Kenya. *International Journal of Economics, Commerce and Management*, 4(2), 315-335.
- Mandal, S. (2015). Supply and demand effects on supply chain flexibility: An empirical exploration. *Knowledge and Process Management*, 22(3), 206-219.
- Marinagi, C., Trivellas, P., & Reklitis, P. (2015). Information quality and supply chain performance: The mediating role of information sharing. *Procedia-Social and Behavioral Sciences*, 175, 473-479.
- Nyamasege, O. J., & Biraori, O. E. (2015). Effect of supplier relationship management on the effectiveness of supply chain management in the Kenya public sector. *International Journal of Managing Value and Supply Chains*, 6(1), 25.
- Oelze, N. (2017). Sustainable supply chain management implementation—Enablers and barriers in the textile industry. *Sustainability*, 9(8), 1435.
- Patlitzianas, K. D., Doukas, H., Kagiannas, A. G., & Psarras, J. (2008). Sustainable energy policy indicators: Review and recommendations. *Renewable Energy*, 33(5), 966-973.
- Peteraf, M. A. & Barney J.B. (2003). Unravelling the resource-based tangle, *Managerial and Decision Economics Special Issue: Integrating Management and Economic Perspectives on Corporate Strategy*, 24 (4), 309–323.

- Prater, E., Biehl, M., & Smith, M. A. (2001). International supply chain agility-Tradeoffs between flexibility and uncertainty. *International journal of operations & production management*, 21(5/6), 823-839.
- Reimann, F., Kosmol, T., & Kaufmann, L. (2017). Responses to Supplier-Induced Disruptions: A Fuzzy-Set Analysis. *Journal of Supply Chain Management*, 53(4), 37-66.
- Schilling, M. A., & Steensma, H. K. (2001). The use of modular organizational forms: An industry-level analysis. *Academy of management journal*, 44(6), 1149-1168.
- Schoenherr, T., & Swink, M. (2012). Revisiting the arcs of integration: Cross-validations and extensions. *Journal of Operations Management*, 30(1-2), 99-115.
- Shen, B., Li, Q., Dong, C., & Perry, P. (2017). Sustainability issues in textile and apparel supply chains.
- Soffer, P., & Wand, Y. (2005). On the notion of soft-goals in business process modeling. *Business Process Management Journal*, 11(6), 663-679.
- Sudarshan, B., & Rao, D. N. (2013). Application of Modular manufacturing System in Garment Industries. *Int. J. Sci. Eng. Res*, 4(2).
- Sukati, I., Hamid, A. B., Baharun, R., & Yusoff, R. M. (2012). The study of supply chain management strategy and practices on supply chain performance. *Procedia-Social and Behavioral Sciences*, 40, 225-233.
- Tan, K. C., Kannan, V. R., Handfield, R. B., & Ghosh, S. (1999). Supply Chain Management: An Empirical Study of Its Impact on Performance, *International Journal of Operations & Production Management*, 19(9/10), 1034-1052.
- Taticchi, P., Tonelli, F., & Pasqualino, R. (2013). Performance measurement of sustainable supply chains: A literature review and a research agenda. *International Journal of Productivity and Performance Management*, 62(8), 782-804.
- Thatte A. A. (2007), *Competitive Advantage of a Firm through Supply Chain Responsiveness and SCM Practices: A Dissertation for Doctor of Philosophy*. The University of Toledo, USA, 7-66.
- Thatte A. A. (2013). Supply Chain Responsiveness through Modularity Based Manufacturing Practices: An Exploratory Study, *The Journal of Applied Business Research*, 29(3), 743-763.
- Thatte, A. A., Rao, S. S., & Ragu-Nathan, T. S. (2013). Impact of SCM practices of a firm on supply chain responsiveness and competitive advantage of a firm. *Journal of Applied Business Research*, 29(2), 499.
- Thatte, A., & Agrawal, V. (2017). Exploring Supply Chain Responsiveness Effects On Competitive Advantage Of A Firm. *QRBD*, 211.
- Thilakarathna, R. H., Dharmawardana, M. N., & Rupasinghe, T. (2015). The Supply Chain Operations Reference (SCOR) model: A Systematic Review of Literature from the Apparel Industry.
- Tu, Q., Vonderembse, M. A., Ragu-Nathan, T. S., & Ragu-Nathan, B. (2004). Measuring Modularity-Based Manufacturing Practices and Their Impact on Mass Customization Capability: A Customer-Driven Perspective, *Decision Sciences*, 35(2), 147-168.
- Tuigong, D. R., & Kipkurgat, T. K. (2015). Challenges and Opportunities Facing Textile Industries in Kenya in the Wake of Africa Growth and Opportunity Act. *International Journal of Advanced Research*, 3(9), 520-523.
- Wang, F. (2012). Research on performance measurement of green supply chain management. In *Economics, Trade and Development, International Conference* (pp. 111-114).
- Wright, R. (2016). Supply chain integration and performance: Evidence from Romania. *Journal of Economics and Business* Vol 6(23).
- Yang, J., Han, Q., Zhou, J., & Yuan, C. (2015). The influence of environmental management practices and supply chain integration on technological innovation performance—Evidence from China's manufacturing industry. *Sustainability*, 7(11), 15342-15361.
- Zhang, M., & Huo, B. (2013). The impact of dependence and trust on supply chain integration. *International Journal of Physical Distribution & Logistics Management*, 43(7), 544-563.
- Zhu, Q., Sarkis, J., & Geng, Y. (2005). Green supply chain management in China: pressures, practices and performance. *International Journal of Operations & Production Management*, 25(5), 449-468.