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Antecedents and consequences of integration of supply chain information systems into the textile supply chain. A Kenyan textile supply chain perspective

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Background: Supply chain information systems remained critical for the performance of the supply chain. A number of information systems have previously been used alongside other supply chain drivers when examining the contribution of the supply chain to overall organisational performance. Nevertheless, factors that enhanced integration of information systems into the supply chain remained unclear.

Objectives: This study analysed antecedents and consequences of integration of information systems into the Kenyan textile supply chain.

Method: This study leaned towards the positivist research paradigm in adopting a covariance-based confirmatory research design to explain relationship between variables. The study sample was made up of 290 respondents drawn from textile firms in Nairobi County. Structural equation modelling (SEM) was used to analyse the collected data.

Results: The findings of the study indicated that implementation of information technology (IT) and knowledge and management of IT were significant antecedents of integration of supply chain information systems. Moreover, the study findings confirmed that the consequence of having these antecedents in place was increased performance of Kenya's textile firms.

Conclusion: This study contributed to existing theory on supply chain management by delineating knowledge and management of IT, together with the capability to implement information technology as the main factors required in overseeing integration of information systems into the supply chain. Practical implication of these findings was that integration of information systems into the supply chain may not be achieved without coming up with good strategic plans and having a good IT infrastructure when knowledge and management of IT and capacity to implement it were lacking.

Keywords: antecedents; supply chain information systems; strategic planning; knowledge and IT management; organisational performance.

Introduction

The textile and apparel industry in Kenya is poised to play an integral role in the Big Four Agenda that desires to increase the contribution made by the manufacturing sector to the gross domestic product (GDP) from 9.2% in 2018 to 20% by 2022 (GoK 2017). Under this agenda, the textile and apparel industry is expected to increase its contribution from $350m to $2bn, create 500 000 cotton jobs and also create 100 000 new apparel jobs in this period. The Kenya Association of Manufacturers (KAM 2015) indeed recognises the potential that the textile and apparel sector has for job creation. Kenya Association of Manufacturers points out that the formal and informal sub-sectors of the textile and apparel sector cumulatively employ 200 000 people indirectly and currently engage 40 000 cotton farmers.

According to the Kenya textile and clothing value chain Roadmap 2016–2020, market access provided by the *American Growth and Opportunity Act* (AGOA) has seen Kenya textile sector enjoy strong growth in the period beginning 2006 (p.xii). As such, the textile supply chain has become more complex bringing in different players at all levels who come with differences in structures, operations and performance levels (Omai, Ngugi & Kiarie 2018). Likewise, it is reported that the textile supply chain in Kenya has seen growth in diversity of entities in terms of ownership and structure (Omai et al. 2018).

Despite enjoying strong growth in the last decade or so, Kenya's textile and apparel sector has not been able to keep pace with the global industry dynamism (value chain Roadmap 2016–2020).

Through the roadmap, it is noted that meaningful integration into the global value chain remains elusive and the sector experiences capacity imbalance, weak productivity and limited level of market diversification. This clearly underscores the need for a new strategic orientation that can improve process efficiency. Such a strategic orientation needs to leverage upon integration of information systems into the supply chain for the sake of timely information sharing, enhanced buyer-supplier communication, modernisation of production and optimisation of operations along the chain.

Supply chain information systems (SCIS) first emerged in firms in the 1980s as tools for automating processes such as ordering and accounts settling (Johnstone& Vitale as cited in Harnowo 2015). They have since gained advanced features that enhance collaboration, coordination and information sharing across supply chain partners. Improved features in SCIS have in turn led to improvements in customer services, reduction in operational costs and sustained competitiveness across firms (Ray, Muhanna & Barney 2005).

Scholars have taken cognisance of the critical roles that information systems integrated into the supply chain play amongst other functions: optimising planning and sourcing and delivery of products and services by linking firms with suppliers (Harnowo 2015), instigating organisational change that guarantees increased responsiveness and reduced overheads (Mustafa & Irani 2014), enhancing organisational interaction (Prajogo & Olhager 2012), managing customers (Faed 2013) and decision support (Seuring 2013).

Moreover, integrating information systems in the supply chain has been associated with improved efficiency and reduced costs in the supply chain (Kim et al. 2015).

On the basis of such a background, it becomes clear that integrating information systems into the Kenyan textile supply chain has the potential to enhance the capability of the textile and apparel sector to keep pace with the dynamism of the global industry. This study therefore sought to contribute to existing scholarship on supply chain management by establishing determinants and consequences of integrating information systems into the textile supply chain.

Empirical literature review and hypothesis development

The exponential growth of information technology (IT) is identified as the basis upon which SCIS have evolved (Varma & Khan 2014). Varma and Khan posit that effective integration of SCIS depends on availability of IT in the supply chain. Empirical review of literature in this study therefore revolved around critical facets of IT availability such as strategic planning, IT infrastructure, Knowledge and management of IT and IT implementation.

Strategic planning for IT and effective integration of supply chain information systems

Kearns and Sabherwal (2007) used the context of medium to large international corporations drawn from the United States to show that the quality of IT plans was positively related to integration of information systems into the corporations. Naser Khani et al. (2012) employed the resource-based view to examine antecedents of strategic information systems planning. In their findings, they identified information systems (IS) planning as one of the key antecedents of strategic information systems planning. Meanwhile, Cohen (2003) used the partial least squares analysis to show that organisations drawn from the strategic quadrant of the McFarlan grid were keen on information systems strategic planning (ISSP) practices. To this end, these organisations emphasised establishment of mechanisms to strengthen business strategic planning integration.

Although evidence has demonstrated the important role that strategic planning plays in the integration of information systems, most of the evidence focuses on integration of IS into overall organisation operations as opposed to integration in the supply chain. Moreover, none of the studies attempt to show the direct influence of strategic planning for IT on successful integration of SCIS. In view of such scarcity of studies relating strategic planning for IT to effective integration of SCIS, we question whether such a relationship is viable from a Kenyan textile supply chain perspective and postulate that:

> **$H_0$1:** Integration of SCIS in the textile supply chain in Kenya is independent of strategic planning for IT.

IT infrastructure and integration of supply chain information systems

Several studies have made attempts to explore information system infrastructure and organisational performance. Hou (2020), for instance, used the Taiwanese electronic industry context to determine that integration and flexibility of IT infrastructure had an indirect and positive effect on organisational performance.

Moreover, this effect was fully mediated by supply chain capability. Sundram et al. (2018), on the other hand, used the Malaysian manufacturing industry context to show full mediation of supply chain integration on the link between SCIS infrastructure and supply chain information management.

Continuous review of existing literature on IT and integration of SCIS, however, shows a scarcity of studies that enumerate the direct impacts of IT infrastructure on the integration of SCIS. Most existing studies focus more on the role of IT in supply chain management (Harnowo 2015; Heddoun & Benrrezzouq 2020). The question then is whether IT infrastructure is important in the integration of SCIS into the Kenyan textile supply chain. We posit that:

> **$H_0$2:** Integration of SCIS in the textile supply chain in Kenya is independent of IT infrastructure.

IT knowledge and management and integration of supply chain information systems

Knowledge management features prominently in the empirical studies on supply chain management. Pandiyan et al. (2018) employed the Malaysian manufacturing firms' context to show that the relation between information management and manufacturing performance was fully mediated by supply chain integration.

Perez-Salazar et al. (2017) conducted a systematic review of literature on the role that knowledge management plays in supply chain management. In their findings, knowledge management emerged critical for overseeing integration of the supply chain in organisations amongst other important roles. In another study conducted in the Nigerian context, Fagade (2011) concluded that knowledge management improved the business environment in the supply chain of a big conglomerate company with a huge network of partners in the chain.

Although a great deal of evidence exists in relation to the contribution of knowledge management to supply chain management, a gap exists on how knowledge and management of IT actually impact the integration of information systems into the supply chain. Additionally, there is no evidence of the impact of IT knowledge and management on integration of SCIS in the Kenyan textile supply chain. We therefore presuppose that:

> **$H_0$3:** Integration of SCIS in the textile supply chain in Kenya is independent of knowledge and management of IT.

IT implementation and integration of supply chain information systems

Empirical studies document the central role that implementation of IT plays in integration of SCISs. Li et al. (2009) employed the context of Chinese companies to determine that, whereas IT implementation has no significant direct effect on supply chain performance, it impacts positively on supply chain information and in so doing enhances supply chain performance. Li (2006) further analysed the effect of IT implementation from a supply chain collaboration context and confirmed that leveraging on IT implementation was critical for successful collaboration of supply chain echelons, leading to improved market performance. In another study, Wedel (2012) analysed the influence of IT on the performance of the supply chain and went on to show that IT enables higher performance of the supply chain and also increases supply chain effectively. Nevertheless, the nature of the supply chain was not made explicit.

Once again, it is clear that despite the many studies seeking to explore the influence of implementation of IT in organisational performance, there is a dearth of studies focusing on the textile supply chain. Besides, most of the studies zero in on supply chain performance as opposed to integration of SCIS. We therefore question the direct influence of IT implementation on SCIS integration and postulate that:

> **$H_0$4:** Integration of SCIS in the textile supply chain in Kenya is independent of implementation of IT.

Integration of supply chain information systems and supply chain performance

Supply chain information systems have been shown in existing empirical studies to have an effect on various aspects of supply chain performance. Koçoğlu et al. (2011), for instance, used the Turkish manufacturing firm's context to show that supply chain integration plays a critical role in the process of information sharing. Suffice it to say, however, that the study by Kocoglu did not address integration of information systems, but rather it addressed the integration of the entire supply chain. Qrunfleh and Tarafdar (2014), on the contrary, demonstrated that an information systems strategy was likely to enhance the interaction of lean (agile) supply chain strategy and the performance of the supply chain. However, an information systems strategy does not provide guarantee that effective integration of information systems has been achieved.

From the Kenyan state corporations' context, Njagi and Ogutu (2014) established that integration of supply chain in internal operations and external interactions with suppliers had been realised in the corporations and this had correlated positively with the performance of the supply chain. The focus of the study by Njagi and Ogutu (2014) was integration of the entire supply chain. In this way, a gap still exists on how integration of information systems in the supply chain would impact the performance of the Kenya textile supply chain. We therefore posit that:

> **$H_0$5:** Performance of textile firms in Kenya is independent of integration of SCIS in the textile supply chain.

Methodology

This study sought to establish antecedents and consequences of SCIS in the textile supply chain in Kenya. The researcher therefore leaned towards the positivist paradigm that advocates for causal relations in predicting antecedents of SCIS. In view of the positivist assumptions, this study adopted a covariance-based confirmatory research design to explain relationships between the variables (Butler 2014).

The motivations of using the covariance-based approach were: the need to explain relationships between items; the nature of reflective constructs under study, which had more than three items each, and the large sample size involved (Landsheer 2010).

This study targeted firms dealing in textile and apparel production and operating in Nairobi City County.

Statistics drawn from the Textile and Apparels Report produced by Hivos East Africa in 2016 show that the County had 26 textile and apparel firms with a total population of 1186 staff (104 heads of section and 1082 middle management staff). The study therefore used a study population of one

thousand one hundred and eighty-six (1186) staff drawn from production or operations management, logistics and transport, procurement and customer service sections of the firms. Choice of these sections was informed by their central role in the textile supply chain. The criteria for selection of participating staff were two, namely, the staff was a head of section of the sections directly involved in the supply chain or middle-level management staff. Bearing in mind the number of parameters under study and the need to avoid over-correlation of standard errors (Yu & Muthen 2002), a sample size of two hundred and ninety (290) respondents (25 heads of section and 265 middle-level management staff) was arrived at using the sample size formula suggested by Getu and Tegbar (2006).

A two-stage stratified sampling was conducted to identify first the number of heads of sections and then the number of staff to be drawn from each section. Data were collected using a questionnaire developed by the researcher, which had six sections consistent with the six latent variables under study. Two research assistants were recruited to help in administering the paper-based questionnaire. Data analysis was performed using Analysis of Moment Structures (AMOS version 18) in conjunction with structural equation modelling (SEM). Structural equation modelling is considered as a second-generation multivariate method that allows a simultaneous analysis of variables in the model (Chin 1998). The choice of SEM was based on its capability to combine factor analysis and multiple regressions (Kroehne, Funke & Steyer 2003). In this way, it was possible to confirm indicators of the study constructs whilst, at the same time, examining relationships between the constructs. Besides, SEM has previously been successfully used for confirmatory and causal modelling of situations similar to the one the study focused on, which involved latent variables (Amir, Mehdi & Anuar 2012).

A six-factor measurement model was proposed for the study. Each latent variable was measured using four indicators, each of which was regressed on the latent variable. Reliability of the indicators took note of possible existence of random errors resulting from variable measurement and therefore depicted the associated error term. Variables were operationalised and measured as shown in Table 1.

The measurement model was validated using AMOS version 18. Analysis of Moment Structures has been found to be suitable for handling covariance-based structural equation models (Butler 2014). The criterion for model validation was the 'goodness of fit'. The idea was to examine how the hypothesised measurement model fitted the sample data. Absolute, incremental and parsimony fit indices were used to test the model fit. The choice of these indices was premised on the understanding that AMOS relies on the three categories of fit indices (Afthanorhan 2014). Afthanorhan therefore posits that there is a need to ensure that the three categories of fit indices achieve the required level of fit. The following indices recommended by Cheung and Rensvold (2009) were used to validate the default indices as presented in Table 2. Absolute Fit indices included chi-squared

TABLE 1: Variable definition and measurement.

Variable	Nature	Indicator	Measurement
Strategic planning for IT	Exogenous (Latent)	SPI: Management participation SP2: Long-term business plan SP3: Global market and competitiveness SP4: Strategic partnerships	Ordinal
IT infrastructure	Exogenous (Latent)	IS1: Internet connectivity LS2: IT investment IS3: Software and hardware availability IS4: Enterprise resource planning	Ordinal
Knowledge and IT Management	Exogenous (Latent)	KM1: IT Training and education KM2: Core competency training KM3: Investment in knowledge capital KM4: Cross-functional training	Ordinal
Implementation of IT		ITI1: Top management support ITI2: Cross-functional project team with IT skills ITI3: Project Management IT4: Required financial support	Ordinal
Supply chain information systems	Endogenous (Latent)	AA: Analytical ability DC: Data compatibility AE: Alertness and evaluation AI: Application integration	Ordinal
Organisation performance	Endogenous (Latent)	OP1: Profitability OP2: Reliability OP3: Responsiveness OP4: Accountability	Ordinal

IT, information technology.

TABLE 2: Recommended indices.

x^2 *sig.*	χ^2/df	GFI	AGFI	NFI	RFI	CFI	RMSEA
$p \leq 0.05$	< 5.0	> 0.90	> 0.90	> 0.90	> 0.90	> 0.90	< 0.05

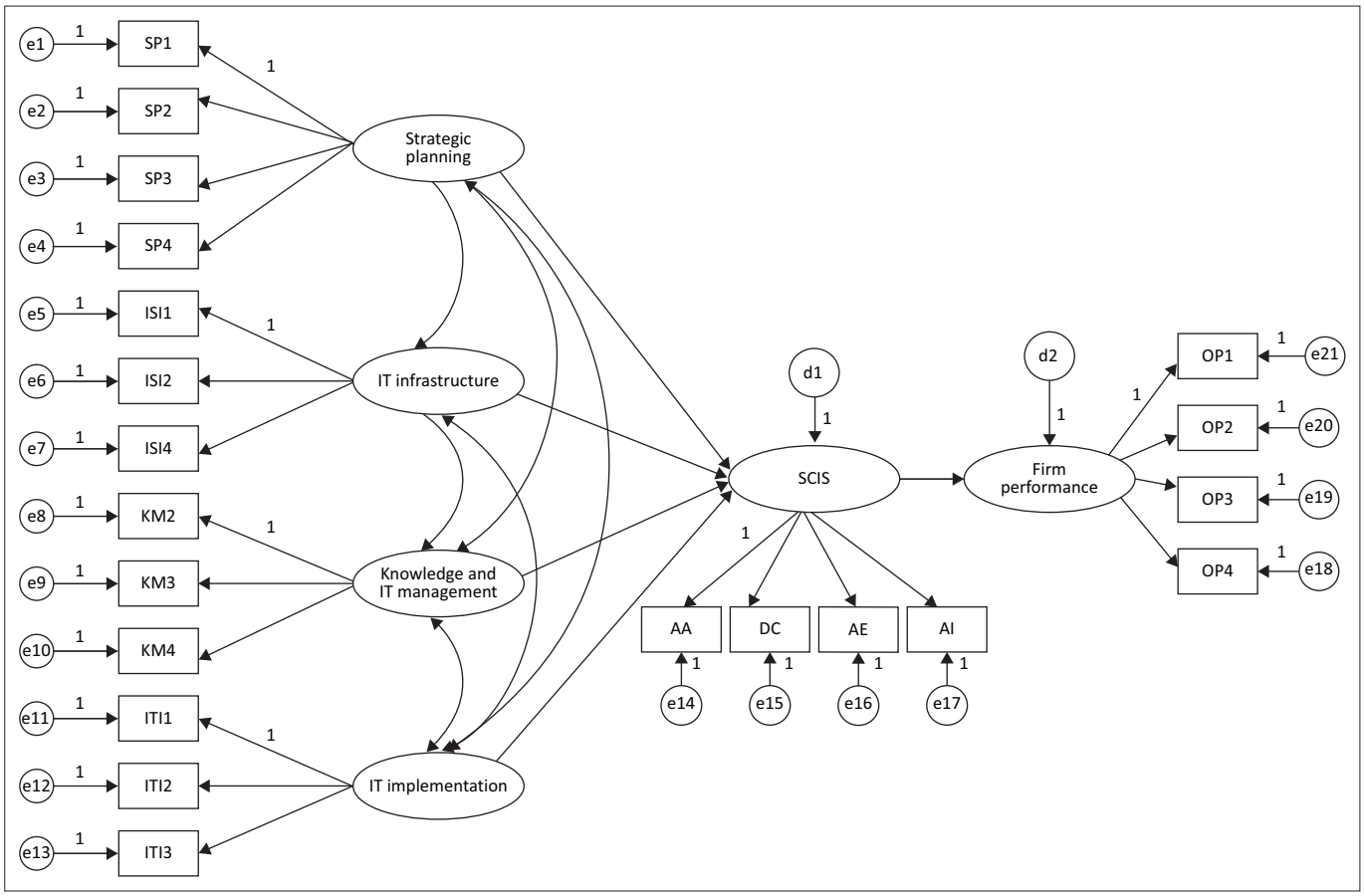
Source: Cheung, C.W. & Rensvold, R.B., 2009, 'Evaluating goodness-of-fit indexes for testing', *MI Structural Equation Modeling* 9(2), 235–255. https://doi.org/10.1207/S15328007SEM0902_5

GFI, Goodness of Fit Index; AGFI, Adjusted Goodness of Fit Index; NFI, Normed Fit Index; RFI, Relative Fit Index; CFI, Comparative Fit Index; RMSEA, Root Mean Square Error of Approximation.

significance (x^2 *sig*.), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) and Root Mean Square Error of Approximation (RMSEA) and Incremental Fit Indices included Normed Fit Index (NFI), Comparative Fit Index (CFI) and Relative Fit Index (RFI) and the Parsimonious Fit Index in the form of the ratio of the Chi-square to the degrees of freedom (χ^2/df).

chi-squared significance (x^2 *sig*.), (Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) and Root Mean Square Error of Approximation (RMSEA); Incremental Fit Indices such as Normed Fit Index (NFI), Comparative Fit Index (CFI) and Relative Fit Index (RFI) and the Parsimonious Fit Index in the form of the ratio of the Chi-square to the degrees of freedom (χ^2/df).

The proposed structural model indicated the SEM path model showing the direct effects of the suggested antecedents, SCIS and firm performance (Figure 1). Strategic planning for IT, IT infrastructure, knowledge and IT management and implementation of IT were exogenous variables being regressed on SCIS, which were the first endogenous variable;



SCIS, Supply chain information systems; IT, information technology.

FIGURE 1: Proposed structural model.

SCIS was then regressed on firm performance as the second endogenous variable.

The structural model (Figure 1) was validated following similar guidelines to those used in the measurement model. Consequently, the default model fit indices were compared with those suggested by Cheung and Rensvold (2009). If it was necessary to modify the model as suggested by modification indices, the modifications were made until a fitting model was achieved. The path estimates (Standardised regression weights) and the variance explained (R^2 value) were used to test for causation and power.

Ethical considerations

Permission to conduct this study was received form the National Commission For Science Technology and Innovation (NACOSTI/P/17/91289/15170).

Results

The reported results relate to descriptive analysis of questionnaire responses on integration of SCIS in the textile supply chain in Kenya and potential consequences, inferential results of validation of the measurement and structural models and the path diagram showing the regression weights of the postulated relationships between the exogenous variables and the endogenous variables on the other.

Descriptive analysis results

Descriptive statistics generated included: minimum response scores, maximum scores, means and standard deviations (SD). The mean response scores were used to capture the typical responses with regard to integration of SCIS in the textile supply chain and the potential consequences. The SDs were used as an indicator of variations in response scores amongst respondents. Consequently, small values for the SDs were an indicator of consistency amongst respondents. Interpretation of the mean scores was made using the following criteria:

Interval	Interpretation
Mean < 1.5	Strongly disagree
1.5 ≤ mean < 2.5	Disagree
2.5 ≤ mean < 3.5	Moderately agree
3.5 ≤ mean < 4.5	Agree
mean ≥ 4.5	Strongly agree

Integration of supply chain information systems in the textile supply chain

Integration of SCIS in the textile supply chain was explored using six items. Respondents were asked to state their levels of agreement to statements that inquired the impact that integration of SCIS has had on the textile supply chain. Results of the descriptive exploration (Table 3) demonstrate that mean response scores ranged between 3.91 and 4.19, and SD were in the range of 0.745 to 0.950. The implication of these statistics is

TABLE 3: Benefits of supply chain information systems in the textile supply chain.

Questionnaire statements	Disagree (%)	Moderately agree (%)	Agree (%)	Strongly agree (%)	Mean	Standard deviation
1. SCIS have improved distribution strategies	0.0	0.0	49.1	50.9	4.19	0.767
2. SCIS have facilitated data transfer and communication amongst supply chain partners	0.9	0.9	53.8	44.3	4.12	0.745
3. Integration of SCIS has streamlined management of inventory in firms	0.0	8.5	53.8	37.7	4.08	0.900
4. The internet has enabled online handling of supply contracts	0.0	6.6	49.1	44.3	4.07	0.834
5. Integration of SCIS has enabled the firm to reduce lead time and paper work	0.9	10.4	38.7	50.0	4.03	0.917
6. Integration of SCIS has facilitated coordination of information flow in this firm	4.7	7.5	54.7	33.0	3.91	0.950

SCIS, supply chain information systems.

TABLE 4: Consequences of supply chain information systems in the textile supply chain.

Questionnaire statements	Strongly disagree (%)	Disagree (%)	Moderately agree (%)	Agree (%)	Strongly agree (%)	Mean	Standard deviation
1. Fake products bearing our logo have surfaced in the market and are damaging our reputation	0.5	1.6	13.6	46.6	37.7	4.21	0.767
2. Software employed in SCIS jeopardises our internal control systems	0.5	5.8	16.2	40.3	37.2	4.12	0.900
3. The firm spends a large amount of money on cyber security	0.5	3.7	17.3	45.5	33.0	4.07	0.834
4. SCIS enables our competitors to gain access to our strategies	2.1	5.2	12.0	48.7	31.9	4.01	0.917
5. Direct attacks by people with malicious intent constrain our use of SCIS	1.6	7.9	16.8	45.5	28.3	3.91	0.950

SCIS, supply chain information systems.

that respondents had consistent agreements on all items. The proportion of respondents agreeing (A) and strongly agreeing (SA) with the items corroborates the mean response scores with associated SDs. The implication of these results is that textile firms are reaping benefits such as improved distribution strategies, improved data transfer and communication, streamlined management of inventory and reduced lead time, amongst others associated with integration of SCIS.

Consequences of integration of supply chain information systems into the textile supply chain

Potential consequences of integration of SCIS into the textile supply chain in Kenya were examined using five questionnaire items. Results of the descriptive exploration (Table 4) revealed that mean response scores were in the range of 3.91 to 4.21, with SDs in the range of 0.767 to 0.950, an indication that respondents appeared to consistently agree with all the items. This was corroborated by the large proportions of respondents showing agreements and strong agreements. This is an indication that several consequences such as theft of firms' logos, threat to internal control systems, expenses on cyber security and direct attacks from malicious people could be attributed to integration of SCIS in the textile supply chain.

Validation of the measurement model

Unidimensionality was achieved for strategic planning for IT, SCIS and organisational performance. In these latent variables, all factor loadings were above 0.6 and were positive as recommended by Awang (2015). In the case of IT infrastructure, one indicator IS13 had a factor loading below the recommended value of 0.6. Similarly, knowledge and IT management had indicator KM1 with a factor loading less than 0.6 and implementation of IT had indicator ITI4 with a factor loading of 0.37 (see Table 5).

The indicators with factor loadings less than 0.6 were deleted from further analysis.

Construct validity was analysed by comparing default fitness indices with recommended fit indices. Table 6 shows that the variables in the measurement model attained construct validity. Default fitness indices satisfied recommended values except for AGFI, which were, however, close to 0.90.

Validation of the structural model

After confirming the validity of the measurement model, validation of the hypothesised structural model was carried out. Results of the AOMS of the initial structural model revealed that the chi-square *p*-value was below 0.05. Similarly, the values of Chisq/df = 1.914, TLI = 0.901 and CFI = 0.918 were within the recommended values. However, the values of GFI = 0.863, AGFI = 0.818, NFI = 0.845 and RMSEA = 0.694 contravened the recommended values. The initial model was therefore adjudged to be a poor fit. Post hoc

TABLE 5: Test for unidimensionality.

Variable	Indicators	Factor loading
Strategic planning for IT	SP1	0.67
	SP2	0.64
	SP3	0.77
	SP4	0.74
IT infrastructure	ISI 1	0.81
	ISI 2	0.68
	ISI 3	0.56
	ISI 4	0.69
Knowledge and IT management	KM 1	0.56
	KM 2	0.69
	KM 3	0.70
	KM 4	0.77
Implementation of IT	ITI 1	0.69
	ITI 2	0.62
	ITI 3	0.61
	ITI 4	0.37
Supply chain information systems	AA	0.77
	DC	0.76
	AE	0.76
	AI	0.70
Organisational performance	OP 1	0.70
	OP 2	0.90
	OP 3	0.76
	OP 4	0.64

IT, information technology.

TABLE 6: Test for construct validity.

Fit category	Name of index	Recommended (Cheung & Rensvold 2009)	Default value
Absolute Fit	Chi-Square	< 0.05	0.04022
	RMSEA	< 0.08	0.02817
	GFI	> 0.90	0.91249
Incremental	AGFI	> 0.90	0.86939
	CFI	> 0.90	0.98595
	TLI	> 0.90	0.98071
	NFI	> 0.90	0.90491
Parsimonious Fit	Chisq/df	< 3.0	1.15074

RMSEA, Root Mean Square Error of Approximation; GFI, Goodness of Fit Index; AGFI, Adjusted Goodness of Fit Index; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; NFI, Normed Fit Index; Chisq, Chi-square; df, degrees of freedom.

modification indices (MI) were used to achieve a better model fit. The model was modified by correlating error terms as suggested by the modification indices. After a series of modifications, the fit indices achieved acceptable levels (Table 7).

The final structural model (Figure 2) reveals that variations in strategic planning of IT, IT infrastructure, Knowledge and management of IT and IT implementation explained 93% of the variation in SCIS as depicted by a coefficient of determination (*R*-square) value of 0.93 lying just above the latent variable SCIS in the figure. Similarly, variation in SCIS explained 51% of the variance in firm performance as indicated by the *R*-square value of 0.51 lying above the latent variable firm performance shown in Figure 2.

The resultant path diagram presented in Figure 3 confirmed the following hypothesis test results. Hypothesis $H_0$1 was supported, an implication that strategic planning for IT was not a significant antecedent of SCIS integration in textile firms in Kenya ($\beta = -0.161$ and $p > 0.05$); Hypothesis $H_0$2 was also supported. Information technology infrastructure was not a significant antecedent of SCIS integration in textile firms in Kenya ($\beta = -0.074$ and $p > 0.05$); Hypothesis $H_0$3 was not supported. Knowledge and management of IT was a positive and significant antecedent of SCIS integration in textile firms in Kenya ($\beta = 0.451$ and $p < 0.05$); Hypothesis $H_0$4 was not supported. Information technology implementation was a positive and significant antecedent of SCIS integration in textile firms in Kenya ($\beta = 0.791$ and $p < 0.05$); Hypothesis $H_0$5 was not supported. Supply chain information systems positively and significantly predict performance of textile firms in Kenya ($\beta = 0.777$ and $p < 0.05$).

TABLE 7: Fit indices for structural model.

Fit category	Name of index	Recommended (Cheung & Rensvold 2009)	Default value
Absolute fit	Chi-Square	< 0.05	0.00022
	RMSEA	< 0.08	0.06935
	GFI	> 0.90	0.96284
Incremental	AGFI	> 0.90	0.91790
	CFI	> 0.90	0.91785
	TLI	> 0.90	0.90086
	NFI	> 0.90	0.94478
Parsimonious fit	Chisq/df	< 3.0	1.91366

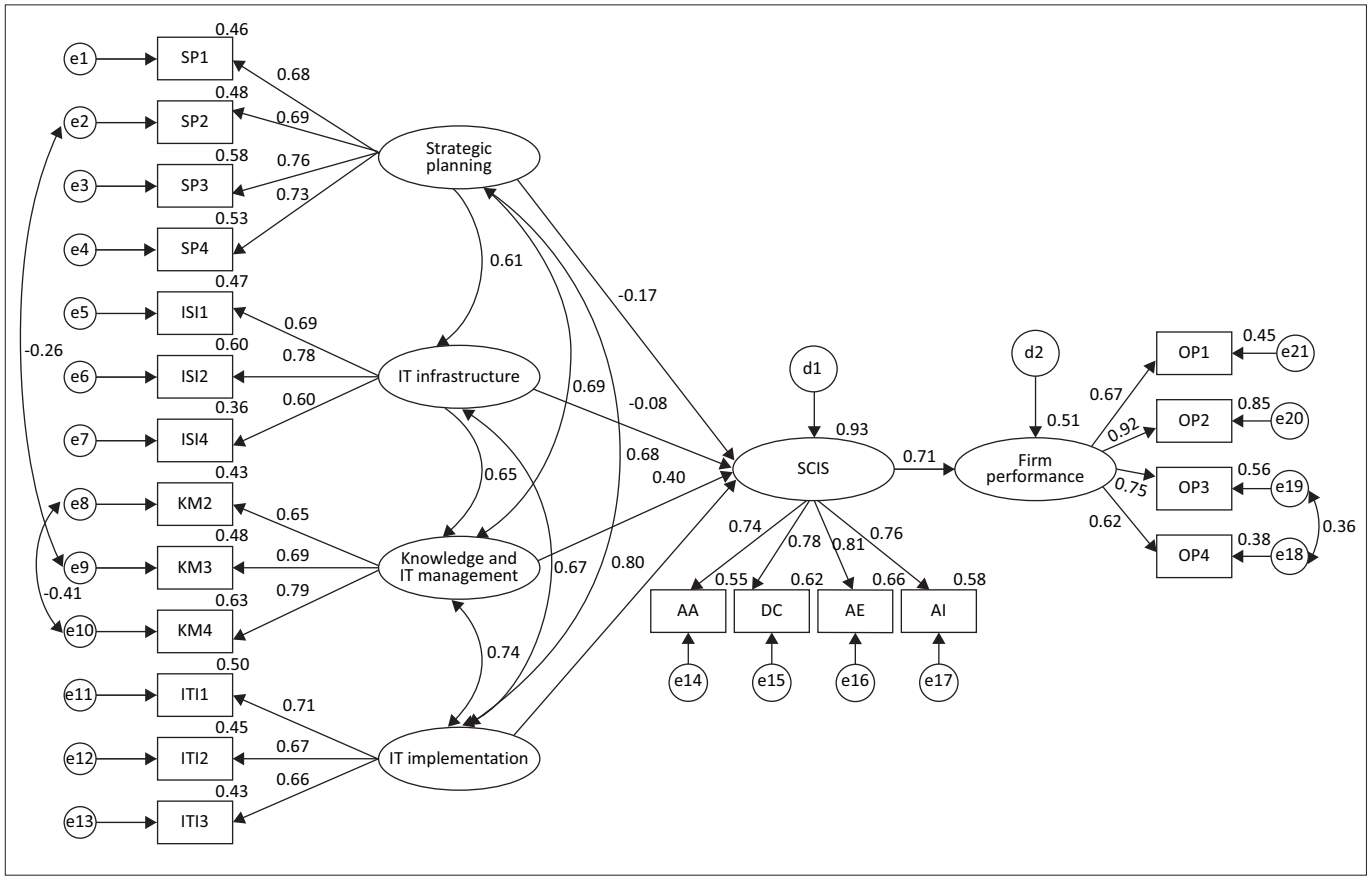
RMSEA, Root Mean Square Error of Approximation; GFI, Goodness of Fit Index; AGFI, Adjusted Goodness of Fit Index; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; NFI, Normed Fit Index; Chisq, Chi-square; df, degrees of freedom.

Discussion

This study reveals that textile firms that have integrated SCIS in the supply chain have seen improvement in their performance in terms of reduced lead times and paperwork, improved transfer of data and communication, prudent management of inventory and improved distribution strategies, amongst others. This study further reveals that integration of SCIS in the textile supply chain is constrained by fear of cyber security threats. Firms are experiencing theft of their logos and labels, threat to internal control systems, direct attacks from malicious people and heavy expenditure on cyber security. This study therefore contributes to the discourse on supply chain performance in the Kenyan context bearing in mind emerging threats to cyber security.

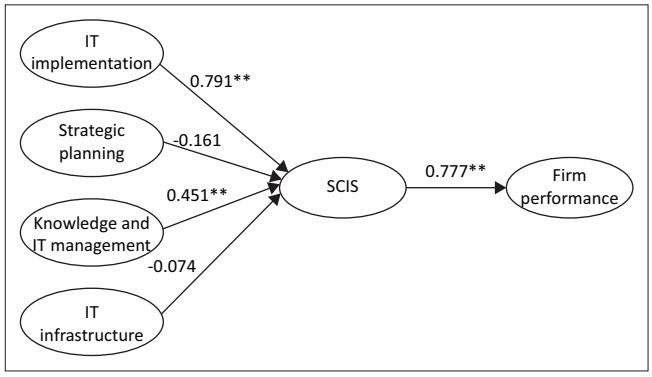
The finding showing that textile firms are reaping benefits from integration of SCIS is consistent with previous studies that have shown that supply chain increasingly continues to play a significant role in the overall performance of an organisation (Wong, Boon-itt & Wong 2011; Zhao et al. 2008). Scholarly publications show that SCIS serve diverse purposes consistent with inherent characteristics and functionality and need to be delineated in terms of suitability to different functions (Saeed, Malhotra & Gover 2011). This study therefore adds a new dimension to existing scholarship by not only looking at the positive impact of SCIS on firm performance but also pointing out that integration of SCIS has consequences on the supply chain such as enhanced risks of cyber crime.

This study establishes that IT implementation and knowledge and IT management are significant antecedents of integration of SCIS in the textile supply chain. However, strategic planning and IT infrastructure are not significant antecedents in this context. This study further establishes that integration of SCIS in the textile supply chain is a significant predictor of



SCIS, Supply chain information systems; IT, information technology.

FIGURE 2: Final structural model.



SCIS, Supply chain information systems; IT, information technology.

FIGURE 3: Path diagram.

firm performance. The findings showing that strategic planning and IT infrastructure are not significant antecedents of integration of SCIS in the textile supply chain in Kenya contradict existing empirical evidence (Gunasekaran & Ngai 2004:289) and perhaps explain the apprehension that textile firms in Kenya have towards consequences that may arise from an elaborate IT infrastructure. Loss of vital data through hacking is enhanced through IT platforms such as the web. Consequently, management of these firms is possibly not keen on providing the required infrastructure.

The apprehension amongst textile firms with their security is not far-fetched. Studies report concerns on information and security with regard to potential threats to supply chain cyber security (Urciuoli et al. 2013); uncertainty, risks and cyber security posed by IS for SCM (Boiko, Shendryk & Boiko 2019); challenges being experienced in supply chain as a result of cyber security risks (Pal & Alam 2017) and the struggle that organisations have to go through in managing cyber risks in supply chains (Thomas 2019).

The finding in this study that IT implementation and knowledge and IT management were significant antecedents of SCIS in the context of the textile supply chain in Kenya confirms that the textile industry desires to avail easily accessible and automated information. In arguing that the world's craving for information and automation requires that supply chain partners have the required knowledge and IT management skills, Gunasekaran and Ngai (2004) identify knowledge and IT management as potential antecedents for SCIS.

Besides, in view of the need for enhanced security to information, IT implementation and management are vital elements to be considered.

The finding showing that IT implementation was a significant antecedent of SCIS in the textile supply chain is consistent with findings, which show that in the value chain, technology is everywhere and at all levels (Mulunda 2014). Developing and implementing internal or

core technology is therefore a sure way of exploiting the textile supply chain to the firms' competitive advantage. The gains made from IT implementation are, however, being eroded by lack of adequate strategic planning. Mulunda (2014) points out that management ought to decide on the type of technology strategy that will best suit the needs of the organisation.

Theoretical and managerial implications

These findings possess important insinuations for the theory and practice of information systems and supply chain management. From a theoretical perspective, the findings emphasise the importance of information systems in endeavours to streamline operations in the supply chain when faced with a number of IT factors. This study is a novel one in the sense that it introduces the potential of information systems to mediate the impacts of IT planning, infrastructure, knowledge and management of IT and implementation of IT on the performance of textile firms in Kenya. Suffice it to say that existing studies have only narrowed down to direct effects of these IT facets on supply chain performance (Fagade 2011; Harnowo 2015; Heddoun & Beurrezzong 2020; Li 2006; Sundram et al. 2018) or on the direct effect of SCIS on supply chain management (Koçoğlu et al. 2011; Njagi & Ogutu 2014; Qrunfleh & Tarafdar 2014).

From a managerial perspective, this study underscores the importance of strategic planning for IT, IT infrastructure, knowledge and management of IT and IT in integrating information systems into the supply chain. At the same time, this study highlights the need to recognise the contribution of SCIS in achieving enhanced performance of textile firms in Kenya. This knowledge is particularly useful to policymakers and other textile stakeholders who have been tasked with the responsibility to oversee realisation of the Big Four Agenda expectations of the textile industry. It is therefore incumbent upon textile industry stakeholders to take note of the direct impacts of IT knowledge and management, as well as that of IT implementation on integration of SCIS, to empower supply chain partners with IT knowledge and skills for its implementation. By investing on IT knowledge and implementation, the textile industry is bound to enhance chances of integrating information systems, which leads to realisation of the required contribution to the GDP by 2022 and creation of 500 000 cotton jobs.

Conclusion

Integration of SCIS into the textile supply chain in Kenya contributes significantly in terms of distribution strategies, data transfer, intra- and inter-firm communication, inventory management and reduction of lead times. However, SCIS operate on the IT platforms that elicit fear of threats such as direct attacks from people with malicious intent, hacking and theft of firms' vital documents and interference with internal control systems, amongst other cyber security threats. Knowledge and management of IT and its implementation determine the integration of SCIS into the textile supply chain in Kenya and, with it, improved firm performance. Information technology infrastructure and strategic planning of IT appear not to be significant antecedents of integration of SCIS in the textile supply chain. The findings of this study therefore act as a reminder that SCIS if well understood and implemented have the potential to turn around the performance of textile firms in Kenya.

Limitations

The main limitation of this study relates to the fact that data were collected from textile firms drawn from only one County, the Nairobi City County. This might not have guaranteed external validity in attempting to generalise findings of all textile firms in Kenya. Secondly, this study only relied on questionnaires for collection of data targeting staff of the textile firms. By ignoring views from other stakeholders such as suppliers, this study failed to cover the expected latitude, limiting the capacity to generalise findings.

Recommendations for future studies

Future studies should perhaps look towards widening the scope of textile firms used in the studies to cover other cities and towns in Kenya as opposed to Nairobi city County *perse*. This would strengthen external validity of findings. Moreover, the textile supply chain involves many different stakeholders and partners. Future studies should seek to cover many of these partners by triangulating data collection tools and approaches.

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Author's contribution

E.G.M. is the sole author of this research article.

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Data availability

The data that support the findings of this study are available from the corresponding author, E.G.M., upon reasonable request.

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