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ENHANCING SUPPLY CHAIN INTEGRATION AND PERFORMANCE THROUGH INFOR-MATION AND COMMUNICATION TECHNOLOGY

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Abstract:
While the significance of Information and Communication Technology (ICT) adoption in business operations has been steadily growing, its impact on supply chain integration (SCI) and supply chain performance (SCP) remains unclear in the existing body of literature. This paper seeks to evaluate the influence of ICT adoption on SCI and SCP, delving into the presence of mediator and moderator variables. Using survey data collected from 259 participants in the dairy supply chain in Iringa, Tanzania, this quantitative study employs structural equation modeling to examine the impact of ICT adoption on SCI and performance, as well as to explore the role of SCI as a mediating factor and the moderating effect of age, gender, skills, and education level. The findings indicate that ICT adoption has no significant direct impact on SCP, as this relationship is entirely mediated by the three levels of SCI (SI, II, and CI), revealing how this connection is influenced by skills and education level. The study offers a comprehensive exploration of ICT adoption within the context of food processing supply chain per-formance, demonstrating how companies can harness the benefits of ICT adoption through SCI. It also underscores that ICT adoption alone does not enhance S CP; rather it is in tandem with a stable SCI that such improvements can be realized.

Keywords:
Supply Chain Integration; Information and Communication Technology; Supply Chain Performance; Processing Industry

1. Introduction
From time to time, the supply chain's evolution has always been affected by world business trends and other notable occur-rences (Khanuja and Jain, 2020). Both socio-economical actions, as well as political actions, have mediated the improvement trend of the supply chain. For this reason, there has been an increasing demand to collaborate with the supply chain actors to ease the coordination process to enable a better, sustainable, and resilient supply chain (Freeman, Dmytriyev and Phillips, 2021). This emerging objective has led to the growth of supply chain integration as a concept and a practice that increasingly connects the supply chain actors and merge all corresponding activities (Albukhitan, 2020) and processes to enable accurate demand forecasting, manufacturing process to improve quality and minimize defects and errors and lastly, the service delivery activities to achieve high customer service standards, improve delivery quality and minimize the time in serving the end customers (Asamoah et al., 2021).

The relationship between supply chain integration and supply chain performance has been reported as one of the major trends in logistics and supply chain today, as many firms have increased the adoption of Information communication technology (ICT) to serve the need for a sustainable and resilient supply chain, which has increased recently due to the COVID-19 emergence (Saragih et al., 2020). Firms have adopted supply chain integration to solidify their upstream and downstream to overcome supply pressures resulting from the increasingly volatile market situations (Gu, Yang and Huo, 2021).

In Africa for instance, the motive to digitalize food supply chains amongst agribusinesses has increased due to the COVID-19 pandemic, global trends and technological advancements (Abban and Abebe, 2022). The efforts have been momentum in building sustainable supply chain operations in sub-Saharan Africa as the motive has led to new technological improvements in food production, storage, warehousing and waste management (Antwi-Boampong et al., 2022). The merits of ICT adop-tion have also positively impacted product innovation, process innovation, organizational innovation and marketing innova-tion in Nigeria and Ghana (Karakara and Osabuohien, 2020). Supply

chain performance cannot be easily separated from the adoption of technology as the integration of systems and operations becomes vital (Sallwa, 2023).

Supply chain integration has been implemented in three critical areas; supplier, internal, and customer integration (De Vass, Shee and Miah, 2018). Supplier integration aims to improve the supplier relationship to enable a mutual supplying strategy to enhance a reliable supply of all materials the focal firm needs to produce and/or offer services (Oghazi et al., 2018). Internal integration is mainly concerned with merging all firm's operations that are blended to form a holistic view of demand fore-casting, material and manufacturing management, and service delivery (Oghazi et al., 2018). On the other hand, customer integration is the linking of the focal firm with its potential customers for the aim of fostering supply relationships, trust, and loyalty and improving the quality of products and services offered to attain a long-term business mutual relationship (De Vass, Shee and Miah, 2018). However, very few firms have been able to implement all three levels and reach full integration due to the high level of financial, non-financial and strategic investment needed (Kumar, Singh and Modgil, 2020).

Like other sectors, the supply chain has been greatly impacted by increasing globalization and ICT development, which has compelled the implementation of supply chain integration into new ICT platforms (Ganbold, Matsui and Rotaru, 2021) Supply chain integration is highly impacted by ICT developments, both hardware and software developments that allow time and effective integration (Alzoubi, no date). Several ICT platforms and developments such as enterprise resource planning (ERP), radio frequency identification (RFID), material resource planning (MRP) and manufacturing resource planning (MRP II) have impacted the supply chain integration (SCI) (Alazab et al., 2021). In Tanzania, the SCI has been adopted in many industries, including the manufacturing and food processing industries (Modgil and Sharma, 2017).

For example, ICT has brought new automation of processes and activities and new methods of moving materials upstream and products downstream in the supply chain (Modgil and Sharma, 2017). Among the improvements introduced is the integration of former practices and information systems management, which led to e-procurement, e-sourcing, e-payment, e-collaboration, e-informing, and e-integration (Smidt and Jokonya, 2022). To date, the impact of these various information systems on supply chain performance is not certain. (De Vass, Shee and Miah, 2018) and (Alzoubi, no date) have shown the link between ICT adoption and supply chain integration despite being silent about the influence factor that the adoption of ICT has on the SCI of a firm. In their studies on the impact of information systems on SCI and management and the role of ICT on electronic SC management and performance respectively, they have been able to expose various ICTs such as Industry 4.0 and the Internet of Things (IoT) and how they can improve business operations.

In the African context, the adoption and impact of ICT on the supply chain were still unclear, though it was revealed to enable the compatibility of SME operations with the business environment (Ejemeyovwi, Osabuohien and Bowale, 2021). When examining the adoption and impact of ICT in South Africa (Özcan, 2010), concluded that for a smooth process of adopting ICT in SMEs, firms should improve the employees' capacity and restructure their firm's operations to be able to enjoy the impact of the adopted ICT's. ICT's impact on SCI and processing firms' performance in African states remained unanswered despite studies showing a link (correlation) between the variables. For instance, (Özcan, 2010) revealed a link between ICT adoption and performance when examining the adoption of ICT in South Africa; (Som, Cobblah and Anyigba, 2019) revealed the same findings when examining the relationship between information integration, relational integration and operational integration and supply chain performance in Ghana: and (Oghazi et al., 2018) when the examined influence of information system on supply chain integration on the African context. Despite this uncertainty regarding the influence of ICT adoption on SCI and SCP, many African focal firms and supply chain actors have opted to adopt ICT in their SC activities and opera-tions without proper justification for the cause while hoping to form resilient and sustainable supply chains (Kayisire and Wei, 2016). In response to this problem, this study aimed at examining the relationship between the two and assess the influence of ICT on supply chain integration and performance concerning a dairy supply chain firm in Iringa (Tanzania). This will enable us to answer the main two questions;

RQ1: How does ICT adoption influence supply chain integration?

RQ2: How does SCI influence supply chain performance?

Empirically, the study focused on enriching the supply chain literature body (by investigating the relationship between ICT, supply chain integration, and supply chain performance in processing industries in Tanzania) and helping supply chain managers better understand how to employ ICT to improve supply chain integration and performance at large.

To the pro-cessing firms in Tanzania, the study's findings enable them to correct the shortfalls that affect their supply chain integration to increase the effectiveness of the supply chain at large.

2. Literature Review

2.1. The influence of ICT on supply chain integration in manufacturing firms

The study by (De Vass, Shee and Miah, 2018) provides evidence to support the argument on how information systems affect supply chain integration and performance. To integrate supply chain activities, this study focused on the next generation of embedded ICT systems that are internet-connected and operating in a digital environment (Internet of Things [IoT]). This cross-sectional survey, which was informed by the organizational capacity theory, showed that internal, customer and supplier integration had a positive and significant impact on supply chain performance as well as organizational performance in general. The survey covered 227 Australian retail businesses, and structural equation modeling was used to statistically analyze the data (SEM).

(Kalyar, Shafique and Ahmad, 2020) conducted a study to investigate the potential role of innovativeness in determining supply chain integration with the moderating role of environmental uncertainty. The study involved 321 manufacturing SMEs in Pakistan and the collected data were analyzed using partial least square-based structural equation modeling (SEM). The study accredited the presence and influence of environmental uncertainty as a moderating variable of the relationship between supply chain integration and performance. The study identified the dimension of supply chain integration which comprised of internal integration (II), supplier integration (SI), customer integration (CI), and external integration orientation (EIO), and supply chain performance was measured by the efficiency and effectiveness of the focal firm towards serving their customer and fulfilling their objectives. Unlike other studies, this paper conceptualized supply chain integration as a multidimensional construct, encompassing internal integration, supplier integration, customer integration, and external integration orientation (EIO). The study also depicts the vital part of ICT in innovativeness in coordinating the supply chain in emerging and volatile markets.

However, the relationship between ICT adoption and the three levels of SCI cannot be independent and complete without confounding factors (Dixit et al., 2021). According to (Dixit et al., 2021), user desire in adapting to ICT developments is moderated by factors such as age, gender, skills and education level. This is compatible with the Unified theory of acceptance and use technology (UTAUT) model which explains the key constructs affecting user intentions to adopt information systems. In their study on examining enabling factors affecting the adaption of ICT in the Indian built environment sector, (Dixit et al., 2021) revealed the presence of moderating variables on the relationship between the independent variables (Influence, ex-pectation and external environment) and user intention as a dependent variable. The findings approve the UTAUT model of (Kamble et al., 2023) and from this view, the model is adapted with four confounding factors in explaining the adaptability of ICT at ASAS and the outcomes ((De Vass, Shee and Miah, 2018): (Yu, Huo and Zhang, 2021)). The four factors are age, gender, experience and education level.

The relationship between ICT and supply chain integration is said to be positive, as narrated by (Khanuja and Jain, 2020). (Khanuja and Jain, 2020) revealed the positive link between the two variables, showing ICT has become an enabler of supply chain integration, simplifying the process of integration and improving performance at large. (Som, Cobblah and Anyigba, 2019) revealed a positive effect of ICT on supply chain integration, elaborating on how information systems help the inte-gration of information and operations to strengthen supply chain integration at all three levels (suppliers, internal, and cus-tomer integration). The influence of ICT on supply chain integration has been significant due to the increasing need for an agile and sustainable supply chain, which results from the technological advancement and growth of global supply chains (Kaliani Sundram, Chandran and Awais Bhatti, 2016). Thus, it is hypothesized that:

H1: ICT adoption has a positive impact on supplier integration.
H2: ICT adoption has a positive impact on internal integration.
H3: ICT adoption has a positive impact on customer integration.

2.2. The influence of supply chain integration on the supply chain performance of manufacturing firms

SCI has improved the interconnectedness of SC actors to allow a smooth flow of information, items, and finance along with the transformation of raw materials into finished goods to serve customers (Khanuja and Jain, 2020). To authenticate the statement, this study assessed the influence of SCI on SC performance. The study investigated how supplier interactions and flexibility have improved order fulfillment (Kalyar, Shafique and Ahmad, 2020); how functional interactions and quality control have improved return on investment (ROI) (De Vass, Shee and Miah, 2018); and how order fulfillment and after-sales services have impacted products' prices (Saragih et al., 2020).

(Som, Cobblah and Anyigba, 2019) conducted a study to examine the effect of supply chain integration on supply chain performance. The study conceptualizes supply chain integration into information integration, operational integration, and relational integration. On the other side, the supply chain performance was moderated by the company's age, company own-ership, and employee size. The findings revealed that information and operation integration had a positive effect on supply chain performance and relational integration harmed supply chain performance. This implied that Ghana's supply chain managers should invest more in information and operation integration with a focus on improving supply chain performance.

(Jajja, Chatha and Farooq, 2018) conducted a study to assess the impact of supply chain risks on agility performance; focusing on the mediating role of supply chain integration. In this survey study, the knowledge of resource-based view (RBV) with the extension of dynamic capabilities views (DCV) guided the survey that involved more than 22 countries situated in Europe, it was revealed that a firm's supply chain risk has a negative association with supplier, internal and customer integration. The study also revealed that supplier and customer integration mediate the relationship between a firm's supply chain risk and agility performance. Lastly, by the use of structural equation modeling, it was revealed that; supplier and customer integration mediate the relationship between internal integration agility performances. The study concluded that internal integration is the basis for the establishment of suppliers and customer integration and suggested to firms improve agility performance through employing integrative practices and modern information systems.

As suggested by (Frederico et al., 2020), the implementation of supplier integration has improved due to the increasing adaptability of several information systems such as Material requirement planning (MRP), Manufacturing resource planning (MRP II), and Enterprise resource planning (ERP). Evidence from (Freeman, Dmytriyev and Phillips, 2021) has proved the positive relationship between supplier integration and supply chain performance as explained by the RBV theory. Not only that, (Berton et al., 2020) revealed other advantages of supplier integration that include improvement of quality of the in-volved processing activities and functions and the finished product. Therefore, it is hypothesized that:

H4: Supplier integration has a positive impact on supply chain performance.

In measuring internal integration, the study focused on demand forecasting accuracy, manufacturing or processing planning, sourcing, distribution, quality control, and improved processes, as adapted from (Khanuja and Jain, 2020) and (Ganbold, Matsui and Rotaru, 2021). Internal integration is said to have a positive and significant relationship with supply chain per-formance because it reduces the cost of internal processing in providing value to customers while maintaining quality and timeliness (Ganbold, Matsui and Rotaru, 2021). With the adaptation of information systems such as the MRP and MRP II, internal integration has been able to improve manufacturing accuracy and quality management to enable the timely delivery of value at a low cost (Khanuja and Jain, 2020). Thus, it is hypothesized that:

H5: Internal integration has a positive impact on supply chain performance.

This study assessed the relationship between customer integration and supply chain performance. In doing so, customer inte-gration was measured by timely delivery, order fulfillment, quality management, cost minimization, and after-sales services, as adopted from (Danese, Molinaro and Romano, 2020)(Berton et al., 2020). Customers, including distributors and wholesalers, can improve order fulfillment, after-sales services, and the match of demand and supply as a result of a well-integrated rela-tionship with the focal firm (Berton et al., 2020). Thus, it is hypothesized that:

H6: Customer integration has a positive impact on supply chain performance.

2.3. Theoretical framework

Based on (De Vass, Shee and Miah, 2018), the study developed a conceptual framework that comprises one independent variable which is ICT adoption, and SCI levels (supplier integration, internal integration, and customer

integration) as medi-ating variables which mediate the relationship of ICT adoption and SC performance. Furthermore, the relationship between ICT adoption and the three levels of SCI is moderated by age, gender, skills, and educational level as confounding factors (Dixit et al., 2021) as illustrated by Figure 1.

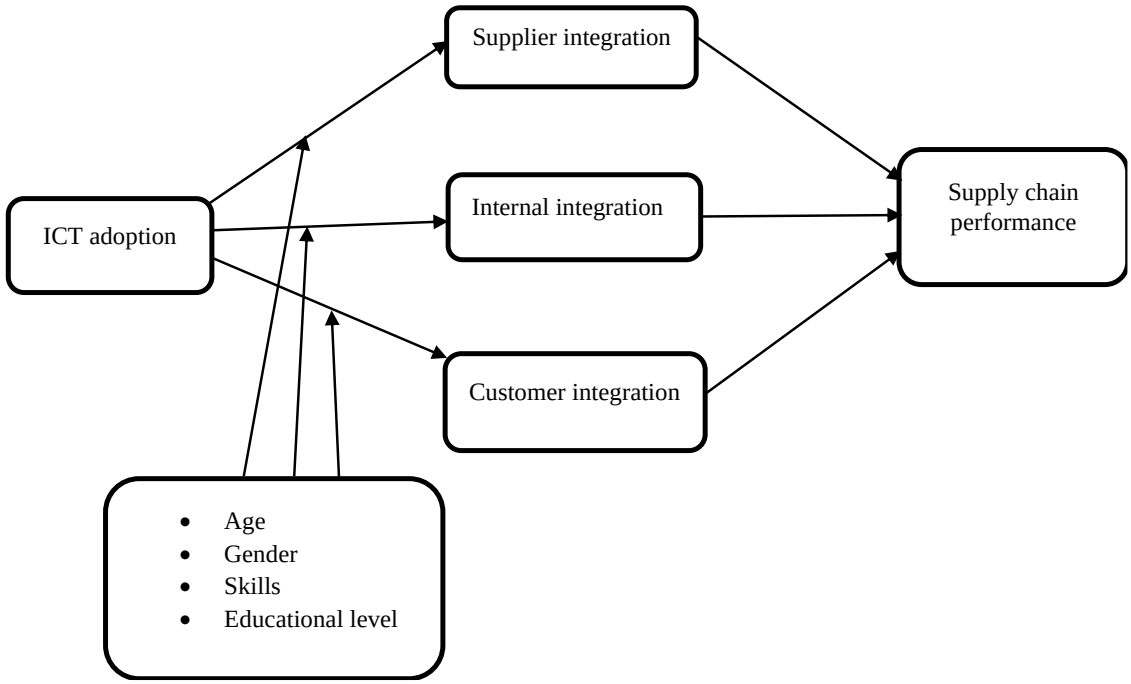

Figure 1: Theoretical framework adopted from (De Vass, Shee and Miah, 2018)

In the above conceptual framework, this study has added four moderating variables from the adopted model of (De Vass, Shee and Miah, 2018) (that is age, gender, skills and educational level) that moderate the relationship between ICT adoption and the three levels of supply chain integration (supplier integration, internal integration and customer integration) as applied in the UTAUT model (Dixit et al., 2021).

3. Material and Methods

3.1. Design and Approach

This study adopted a cross-sectional design (data was gathered and collected only once throughout the study) at ASAS diaries to allow an overall analysis of how ICT influences supply chain integration and performance. This quantitative study was conducted in the Iringa region (covering Iringa rural, Iringa urban, and Mafinga districts) and it involved different respondents such as employees in the fields of procurement, supply chain, and managerial level, suppliers, and customers working with ASAS Dairies Ltd which is headquartered in the respective region in Tanzania. The study was limited to ASAS Dairies Ltd and its supply chain partners due to budget and time constraints to conduct and complete this study. ASAS Dairies' supply chain was selected due to the dominance of the company on supply chain integration, the width of the respective integration and the presence of proper records of its integrated operations and partnerships.

3.2. Population and data collection

The study's population included members of the focal firm (ASAS) procurement, operations and sales departments, distribu-tors, suppliers and customers who have special contractual agreements with the focal firm (ASAS) because

this group could be well identified and reached, and have a lot of relevant information to the concerned topic on how ICT influences supply chain integration and performance as whole.

Table 1: Population of the study

Respondents	Number of respondents
ASAS Procurement department	22
ASAS Operations department	23
ASAS Sales department	19
Integrated suppliers with contracts	78
Integrated customers with contracts	64
Integrated distributors with contracts	53
Total Population	259

3.3. Sampling and sample size

To fulfill this objective through the structural equation modeling (SEM) analysis, the study used census (all the population) since the population was small and could be well managed. According to (Kline, 2018), for SEM to be effective, the popula-tion should be more than 230 cases. Therefore, the population was involved in this study.

3.4. Data collection technique

Data was collected through well-designed questionnaires that were formulated to capture the demographic features of the respondents such as age, gender, level of education, and working experience and the variable information on supply chain integration and supply chain performance. Variable questions were designed in a five-point Likert scale format to enable smooth data analysis while enforcing the reliability of the information collected.

3.5. Validity and reliability

3.5.1. CFA

At first, the primary measurement model which consisted of 33 items narrating the relationship between five variables was sufficient as seen in Table 2. Despite all the fit indices cut-off points being met, 8 constructs were removed from the hypoth-esized model due to low factor loading which led to a new model which consists of 25 items. Again, all the fit indices observed as suggested by (Kline, 2018) had good scores as per the cut-off points, hence the modified measurement model was accepted for SEM analysis. The scores were; CMIN/DF: 0.076, CFI: 0.955, RMSEA: 0.026, PCLOSE: 0.093 and SRMR: 0.044.

Table 2: CFA Model Fit Indices

Fit Indices	Cut-off Points	Proposed Model	Modified Model
CMIN/DF	< 0.3	0.117	0.076
CFI	≥ 0.90	0.928	0.955
RMSEA	≤ 0.05	0.033	0.026
PCLOSE	> 0.05	0.081	0.093

SRMR	≤ 0.8	0.051	0.044

3.5.2. Cronbach's Alpha

As the general rule for Cronbach's alpha reliability test states, Cronbach's alpha score for each latent variable and overall score should be above 0.70 (Collier, 2020). From the findings, the data generated were reliable as the overall Cronbach's alpha score was 0.882 and all latent variables scored > 0.70 (Collier, 2020). Also, the researcher ensured respondents involved in the study were aware and familiar with the phenomena and variables researched to give consistency to the generated findings. Detailed Cronbach's alpha scores are shown below for each latent variable.

Table 3: Data reliability test

Variable	Variable Indicators	(α)
ICT adoption	ICT1, ICT2, ICT3, ICT4, ICT5, ICT6, ICT7.	0.856
Supplier Integration (SI)	SI1, SI2, SI3, SI4, SI5, SI6, SI7, SI8	0.908
Internal Integration (II)	II1, II2, II3, II4, II5	0.725
Customer Integration (CI)	CI1, CI2, CI3, CI4, CI5, CI6	0.866
Supply Chain Performance (SCP)	SCP1, SCP2, SCP3, SCP4, SCP5, SCP6, SCP7	0.777
All	All 33 variables	0.882

3.6. Data Analysis and Ethical Issues

Data analysis included structural equation modelling (SEM) which was used to explore the predictive ability of ICT towards supply chain integration and later reveal how the supply chain integration influences supply chain performance. The analysis was aided by Statistical Packages for Social Science (IBM SPSS Statistics version 28) and Analysis of Moment Structures (AMOS) software version 26. The study considered and maintained ethical values in the conduction of the study especially during the data collection and analysis stage to ensure respondents' voluntary participation, informed consent, the anonymity of all the involved respondents and confidentiality of the collected information and data to only be used as per the studies objectives, as per the ethical clearance guidelines and standards.

4. Results and Discussion

4.1. Respondents' profile

It is apparent that male respondents were more responsive in participation (61.8%, n=160) than females. Furthermore, the findings show respondents aged between 41-50 years (46.3%, n=120) participated more than other age groups. This evidences how mature the involved respondents were and they were able to make rational decisions in representing others in this study. To ensure the respondents involved had enough knowledge and exposure to understand and participate positively in this study, respondents holding bachelor's degrees (59.5%, n=154) were the majority followed by master's holders. Findings show a good balance in representing the views of all dairy supply chain actors as the groups that participated differ by a few. Suppliers were the leading group accounting for (30.1%, n= 78) followed by the ASAS staff. To ensure that the respondents understand the major trends including the implementation of SCI, findings revealed the majority of the respondents represent firms with more than 20 years of operations (35.9%, n=93).

4.2. Results from Structural Equation Modeling (SEM).

4.2.1. Structural Model Fit

The structural model consists of 25 items and involves direct and indirect relations between ICT adoption and SCP. Since the measurement model had a mediator variable and the original conceptual model had a moderator variable,

this part will involve structural model fit, hypothesis testing, mediation effect and moderation effect. To ascertain model fit, the study adopted the five global structural fit indices as suggested by Kline (2016). It was found that the structural model was accepted to explain the highlighted relationships and test the hypothesis as the fit indices score were CMIN/DF: 0.254, CFI: 0.961, RMSEA: 0.023, PCLOSE: 0.091 and SRMR: 0.042 as seen in the table below.

Table 4: Structural Model Fit Indices

Fit Indices	Cut-off Points	Adopted Structural Model
CMIN/DF	< 0.3	0.254
CFI	≥ 0.90	0.961
RMSEA	≤ 0.05	0.023
PCLOSE	> 0.05	0.091
SRMR	≤ 0.8	0.042

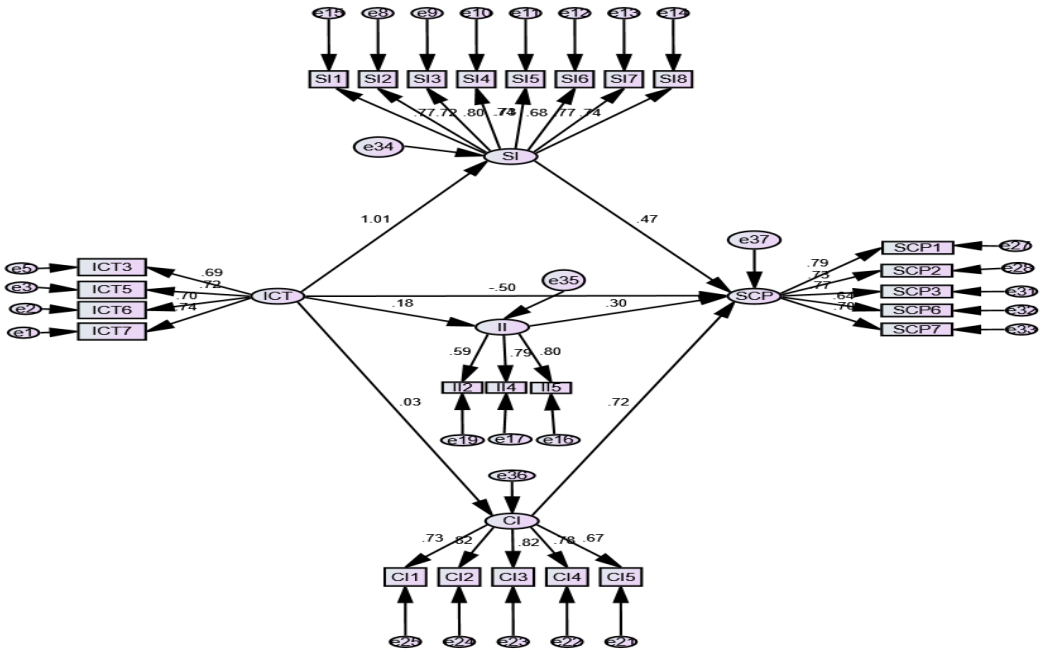

Figure 2: Structural Model

4.4.2. Hypothesis testing

In this study, the six hypotheses were tested using a structural model which involved the retained 25 items from the meas-urement model.

H1: ICT adoption has a positive impact on supplier integration.

H2: ICT adoption has a positive impact on internal integration.
H3: ICT adoption has a positive impact on customer integration.
H4: Supplier integration has a positive impact on supply chain performance.
H5: Internal integration has a positive impact on supply chain performance.
H6: Customer integration has a positive impact on supply chain performance.

Table 5: Structural model regression coefficients

Variables Path	Standard (β)	t-value	P-value
ICT → SI	1.013	11.379	***
ICT → II	0.183	2.538	0.011
ICT → CI	0.034	8.494	***
SI → SCP	0.474	3.386	***
II → SCP	0.301	4.906	***
CI → SCP	0.723	8.998	0.019
ICT → SCP	-0.503	-0.413	0.680

4.2.2.1. The Influence of ICT Adoption on SCI

The regression coefficient from the structural model denoting the path direction from ICT adoption to supplier integration (SI) had a standardized regression coefficient of (β= 1.013, P<0.001). This implies that ICT adoption positively influences supplier integration and this relationship is significant as the p-value is less than the cut-off point. This implies that, when ICT adop-tion increases by 1, supplier integration improves by 1.013. The findings support the hypothesis and as a result, H1 is ac-cepted.

In determining the relationship between ICT adoption and internal integration (II), the regression estimates reveal a significant positive relationship between the observed variables (β= 0.183, p= 0.011). This implies that, when ICT adoption improves by 1, the internal integration improves by 0.183. Relying on these findings, H2 was accepted.

The regression coefficient from the structural model denoting the path direction from ICT adoption to customer integration had a standardized regression coefficient of (β= 0.034, P<0.001). This implies that ICT adoption is significantly positively influencing customer integration. This infers that, when ICT adoption increases by 1, customer integration improves by 0.034. The findings support the hypothesis and as a result, H3 is accepted.

The three findings above are similar to that of (De Vass, Shee and Miah, 2018) who revealed a significant positive relationship between ICT adoption on all three levels of SCI. The similarity projects that, despite the technology adopted (be it the early ICT or the modern technology such as the Internet of Things (IoT) as shown by (De Vass, Shee and Miah, 2018), the influence of ICT on SCI levels remains positive and significant. The same scenario was also evidenced by (Oghazi et al., 2018) who had the same findings as (De Vass, Shee and Miah, 2018). In this study, (Oghazi et al., 2018) focused on the adoption of infor-mation systems and still got the same results as this current study that focused on a wholesome ICT adoption incorporating many facets of ICT.

Turning to other industries, these findings are compatible with that of (Kalyar, Shafique and Ahmad, 2020) who conducted a SEM analysis on 32 manufacturing firms in Pakistan on similar variables. This implies that both the dairy production and manufacturing industries are likely affected by ICT adoption similarly to SCI. (Vanpoucke, Vereecke and Muylle, 2017) also revealed a significant positive influence of ICT on all SCI levels despite using different

dimensions of SCI levels. The SCI level (Vanpoucke, Vereecke and Muylle, 2017) used include operational, relational and informational integration. This im-plies that the influence of ICT on SCI is always the same even when a different dimension of SCI will be involved in the analysis.

4.2.2.2. The Influence of SCI on SCP

Further estimates from the structural model regression coefficient revealed that supplier integration significantly positively influenced the SCP as shown by (β=0.474, $p< 0.001$). This infers that a unit improvement of supplier integration will increase supply chain performance by 0.474. The findings support the acceptance of H4.

Turning now to H5, it is revealed that II has a positive significant influence on SCP as shown by β=0.301 and $p< 0.001$. This implies that an improvement of II by 1, will lead to an improvement of SCP by 0.301. This supports the acceptance of H5.

In the final part of the regression coefficients, estimates revealed a positive significant relation as β=0.723 and $p= 0.019$. This means, customer integration (CI) positively influences supply chain performance, by 0.723 each time CI improves by 1. These findings support the hypothesis and as a result, H6 is accepted.

These findings have extended that of (Modgil and Sharma, 2017) and (Saragih et al., 2020) who ended by showing the cor-relation between the variables. This study has therefore gone further by showing the impact level of SCI on supply chain performance. The findings were compatible with that of (Jajja, Chatha and Farooq, 2018) as both studies revealed a positive significant influence of SI, II and CI on supply chain performance despite (Jajja, Chatha and Farooq, 2018) focusing on agility performance. This implies that the influence of SCI on performance is mostly positive on many different SCP criteria such as agility.

The similarity was also spotted in the study of (Khanuja and Jain, 2020) and that of (Som, Cobblah and Anyigba, 2019). The three studies found the same despite the difference in SCI dimensions as (Som, Cobblah and Anyigba, 2019) included the operational, informational, and relational supply integration levels unlike in this study. To conclude this objective, the in-fluence of SI, II and CI on SCP is evidenced by many studies to be significant and positive, which calls for improvements to be done to expand the engagements with suppliers and customers to increase the supply chain interconnectedness and resilience in delivering value to customers in final markets. The study also exposes the importance of internal integration in serving external needs while maintaining a solid bond between internal functions and operations as shown by (Antwi-Boampong et al., 2022).

Table 6: Summary of the tested hypotheses

Hypothesis	Independent variable	Dependent variable	Relationship direction	Sig	Status
H1	ICT	SI	Positive	0.000	Accepted
H2	ICT	II	Positive	0.011	Accepted
H3	ICT	CI	Positive	0.000	Accepted
H4	SI	SCP	Positive	0.000	Accepted
H5	II	SCP	Positive	0.000	Accepted
H6	CI	SCP	Positive	0.019	Accepted

4.3. Mediation and Moderation Effect

Table 7: Mediation Analysis Summary

Relationship	Direct effect	Indirect effect	Confidence level		P-value	Conclusion
			Lower bound	Upper bound		
ICT > SI > SCP	-0.503	.604	-.380	16.197	.019	Complete mediation
ICT > II > SCP		.069	.020	.151	.020	Complete mediation
ICT > CI > SCP	(0.680)	.031	-.078	.121	.012	Complete mediation

From the mediation analysis summary above, the study assessed the mediating role of SI, II, and CI on the relationship be-tween ICT adoption and SCP. The findings revealed a significant indirect effect of ICT adoption on SCP through SI (β= 0.604, p= 0.019), a significant positive mediating role of Internal integration and Customer integration on the linkage between ICT adoption and SCP (β=0.069, p= 0.020 and β= 0.031, p= 0.012 respectively). Furthermore, the study also revealed a direct effect of ICT adoption on SCP in the presence of the mediators to be insignificant as shown in the structural model and summarized in the table above (β= -0.503, p= 0.680). This leads to the conclusion that; the mediation effect of SI, II, and CI on the rela-tionship between ICT adoption and SCP is a complete mediation effect as there is no significant direct relationship between ICT adoption and SCP.

The findings are not compatible with that of (Kaliani Sundram, Chandran and Awais Bhatti, 2016) who found a complete and partial mediating effect of supply chain integration in the relationship between ICT adoption and SCP. Despite the difference in the study areas, another reason for this divergence of findings may be due to the pace of ICT adoption in Malaysia as re-vealed by (Kaliani Sundram, Chandran and Awais Bhatti, 2016) who emphasized that Malaysia ICT adoption is among the top adoptions in the world, unlike in many African countries like Tanzania. The study findings are divergent from that of (Alzoubi, no date) on the direct effect of ICT on SCP. This might have been caused by the lack of mediating variables in the study of (Alzoubi, no date).

4.4. Moderation effect

Table 8: Moderation Analysis Summary

Relationship	Beta	C.R	P-value	Status
ICT → SCI	0.493	7.106	0.000	
AGE → SCI	-0.068	-0.851	0.396	
ICT*AGE → SCI	-0.064	-1.188	0.236	Insignificant
GENDER → SCI	-0.074	-1.204	0.230	
ICT*GENDER →SCI	-0.071	-1.110	0.268	Insignificant
SKILLS → SCI	0.232	3.211	0.006	
ICT*SKILLS → SCI	0.267	4.300	0.000	Significant
EDUC → SCI	0.117	1.984	0.040	

ICT*EDUC → SCI	0.140	1.739	0.014	Significant

In assessing the moderation effect of Age, Gender, Skills, and Education level on the relationship between ICT and SCI, the findings revealed a negative and insignificant moderating effect of Age and Gender on the relationship between ICT adoption SCI (b = -0.064, t = -1.188, p = 0.236 and b = 0.071, t = -1.110, p = 0.268 respectively). However, the findings revealed a positive and significant influence of Skills and Education levels moderating the relationship between ICT adoption and SCI (b = 0.267, t = 4.300, p = 0.0000 and b = 0.140, t = 1.739, p = 0.014 respectively).

To sum up the moderation analysis, it was found that two variables (Age, Gender) insignificantly moderate the relationship between ICT adoption and SCI while skills and Education level are significantly moderating the respective relationship. The findings are different from that of (Dixit et al., 2021), who found all four moderating variables are significantly impacting the relationship between the adoption of ICT and the built environment sector and different from the UTAUT model by (Kamble et al., 2023). This might be because in SCM, Age, and Gender are not directly impacting the adoption of ICT, but rather the skills needed and education level.

5. Conclusion, Originality and Recommendations

5.1. Conclusion

The study is among comprehensive investigations of ICT adoption in the supply chain as it covers all angles from the influ-ence of the adopted ICT on SCP at large. The study has also been able to include mediating variables (SCI) and moderating variables (age, gender, skills and education level). The focal firms still need to improve their internal operations to increase internal integration and the performance of internal functions as much as they do on external integration (Kabelele and Musabila, 2020). All three supply chain levels (SI, II and CI) were revealed to have a positive significant influence on SCP. This implies that the focus of ASAS in creating and maintaining proper integrations is on both angles, the internal efficiency of its operational functions and the external performance of activities conducted in meeting dairy production needs and reaching the market.

5.2. Originality

Despite being limited to the processing sector (dairy production) the study has identified the link between different supply chain actors and how the particular link is strengthened by the adopted ICT. Supply chain members are now aware of the benefits of ICT and SCI and linking them to create value for the end customers while improving each member along the supply chain. Prior to this study, it was difficult to make predictions about how SCI plays a role in improving SCP. This study has been able to show how all three levels of SCI studied can improve SCP and affect the adoption of ICT among SC members. Practically, this will improve the SC network and improve each SC member. Theoretically, the study has proven the (De Vass, Shee and Miah, 2018) model to be significant while also commenting on the UTAUT model regarding the moderating varia-bles.

5.3. Recommendations

Implying from the SEM results, the policymakers in another hand should establish more friendly policies and make im-provements to the existing ones to allow firms to adopt ICT and move into a digitalized business world. Through this, firms' performance will improve, investors will gain more and investment will increase while the government also benefits from the tax collected. This study shows the importance of ICT in the dairy processing industry; therefore, the policymakers should ensure the policy governing ICT development and infrastructure in Tanzania is more helpful in pushing firms towards ICT adoption for the betterment and growth of the firms, industry and the entire business sector.

With reference to the mediation effects results, there is, therefore, a definite need for firms to practice SCI and make thorough improvements, as SCI mediates the influence of ICT on supply chain performance. Adopting ICT alone will not yield the expected results, but rather along the SCI. Moreover, more training should be encouraged for operational staff as it is now clear that, skills and the level of education moderate the adoption of ICT in strengthening SCI.

Companies need to understand how important their SC resilience capability can be improved based on ICT adoption. It is also important to increase supplier, internal and customer integration to manage both upstream and downstream

value chains for a win-win situation for all supply chain actors. Despite the costs associated with the application of ICT on the supply chain, focal firms should hold their allies together and encourage them to adopt new ICT for more returns. The dairy industry, like all other processing industries, should involve stronger supply chain partners as the industry is much more likely to improve based on supply chain integration.

5.4. Future studies

This study was limited to the dairy processing industry in Iringa, future studies can be conducted in different sectors and a wider area of the country (more than one region) and with different methodological approaches. Moreover, this study was limited to SI, II and CI as the level of SCI, Future studies can focus on other levels of supply chain integration such as opera-tional integration, informational integration and relational integration. The relationship between ICT in SCI and performance can still involve the same variables but with different indicators to extend these findings.

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