

# Information communication technology and supply chain efficiency in manufacturing SMES in Bulawayo Province in Zimbabwe

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**Abstract**— There has been a global plummeting trend of failure in most manufacturing Small and Medium Enterprises (SMEs) due to purported supply chain inefficiency. It is imperative for clothing manufacturing SMEs in developing nations like Zimbabwe, with reference to Bulawayo Province, which lacks digitization to integrate Information and Communication Technology (ICT) solutions into their supply chain operations to improving efficiency and maintain competitiveness in the global market. Thus, the purpose of the study was to evaluate ICT and supply chain efficiency in the clothing manufacturing SMEs in Bulawayo Province. Employing the pragmatic approach, data were collected using semi-structured questionnaires from a sample of 107 from a total population of 147 that were triangulated with 15 interviews from clothing manufacturing SMEs in Bulawayo. A simple linear regression analysis through Ordinary Least Squares was conducted to test the relationship between ICT and supply chain efficiency. The results show that ICT has a positive and statistically significant effect on cost performance, agility and delivery performance in Bulawayo clothing manufacturing SMEs. By prioritizing ICT adoption, managers can achieve better cost management, increased responsiveness to market demands, and enhanced delivery capabilities. It is recommended that clothing manufacturing SMEs in Bulawayo should embrace the ICT. Further studies should examine the relationship between ICT and supply chain efficiency in manufacturing SMEs across different industries and nations.

**Index Terms**—information and communication technology, supply chain efficiency, SMEs and material requirement planning

## I. INTRODUCTION

A supply chain is a complex combination of activities involved in producing goods and services and supplying them to customers. As such an efficient supply chain is one in which each step has been optimised to ensure orders are fulfilled by suppliers on time while costs are minimised and also quality products are delivered to customers at the lowest possible cost, (Moyo & Ndlovu, 2022). On another side, supply chain integration is an important subject to business sectors that seek to comprehend ways of harnessing the possibility of supply chain efficiency to generate sustainable value, (Ncube & Sibanda, 2023). Supply chain efficiency is a dominant aspect in today's complex business world, (Sliman, 2015; and Akimo, 2016). In modern years, empirical evidence has shown that fruitful implementation of Information Communication Technology (ICT) in supply chain can help a firm improve its performance as well as gain a competitive advantage (Wiengarten, 2021). The efficient use of ICT has become essential for improving supply chain efficiency in manufacturing Small and Medium Enterprises (SMEs) worldwide in today's progressively connected and competitive business landscape.

Over the years, SMEs have played a significant part in economic growth and justifiable development in numerous developing countries (Organisation for Economic Co-operation and Development (OECD, 2000). According to Tokarchuk (2021), the genesis of the 21st century has evoked the emerging of the SMEs as a vital ingredient of economic growth in first world countries. In a number of developing economies through Africa and Asia, SMEs are gradually becoming the main drivers of invention and economic growth (International Trade Centre report, 2022). Their impact to employment generation, output, exports, poverty mitigation, fiscal empowerment, entrepreneurialism and wealth dissemination deliver a number of impending reimbursements to both the countries and the separable entrepreneurs, (Ajayi and Morton, 2015). Most countries in Europe have focussed mainly on SMEs so much that they have come to be the epicenter of the industrial revolution (Sommer, 2015). In Spanish economy, SMEs generate 66% of jobs and they currently dominate the business environment, (Arbelo, Pérez-Gómez, and Arbelo-Pérez, 2018). On the African continent, with high unemployment rates, individuals are turning towards small formal and informal

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business as a way of sustaining their income, (Tembo, 2020). Many economies in Sub-Saharan Africa have recorded a high number of SMEs in their economies (World Bank, 2018). In South Africa, for example, SMEs account for about 91% of the formal business entities, contributing between 51% and 57% to GDP and providing almost 60% of employment (Kongolo, 2020). SMEs that yield the relevant technological tools are bound to have a competitive edge in any economy (NDS1, 2023). Nevertheless, Zimbabwe has in the past years promoted the growth of SMEs. This has been done through the indigenous policy and the implementation of other policies such as the Zimbabwe Government Strategic Policy on SMEs. Zimbabwean SMEs are employing nearly 80% of the working population, 42% GDP contribution, and are contributing 20% to the consolidated revenue fund (Machivenyika, 2021). Small and medium-sized enterprises are vital economic drivers in the developing world. Therefore, harnessing ICT in SMEs is vital for supply chain efficiency. SMEs faced many supply chain challenges during COVID-19 lockdown, and their survival depended mainly on how much they adopted ICT for remote work, (Moharana, Murty, Senapati & Khuntia, 2022).

Zimbabwe's second biggest city, Bulawayo has transformed extraordinarily with the inroad of clothing manufacturing small and medium-sized enterprises (SMEs) in modern years, (Dlamini, 2020). Throughout the early 20th century, Bulawayo perceived a vibrant success in the textiles and clothing manufacturing sectors, (Moyo and Sibanda, 2020). The city became distinguished for its textile mills and clothing factories backing up the city's economic growth. Manufacturing SMEs played a vital role in this perceived economic growth. On top of economic growth and social well-being, Bulawayo manufacturing SMEs also contribute to the generation of employment, adding value to the economy, (David & Shalle, 2017). They also supply new or niche products that respond to diverse customer needs especially to those in Botswana and South Africa, (Chivasa 2019). When these SMEs get access to fresh capital, ICT tools will boost their competitiveness, connect to global markets, and develop their trade capabilities to increasing national income, (Makiwa and Steyn, 2021).

Information and Communication Technology has become the lifeblood of most manufacturing small to medium enterprises helping improve supply chain efficiency, (Bailey and Bakos, 2020). Similarly, one of the primary benefits of ICT in supply chain is the real-time and accurate exchange of information made possible by using ICT advances especially the internet (Baporikar and Shikokola, 2020). Kusena and Ndlovu, (2019) express that ICT has enabled the digitalization of information, the virtualization of products, a reduction in storage space and the de-materialization of transport, buttressing supply chain efficiency. It is to the best knowledge of these researchers that no study has been done in Zimbabwe on the effect of ICT on supply chain in manufacturing SMEs. As a result, there is a requisite for supplementary empirical exploration on the impact of ICT on supply chain efficiency in manufacturing, thus the main objective of this study was to evaluate the impact of ICT on supply chain efficiency in manufacturing SMEs in Bulawayo.

In recent years, the integration of Information and Communication Technology (ICT) into business operations has transformed the landscape of supply chain management, particularly within small and medium-sized enterprises (SMEs). In Bulawayo Province, Zimbabwe, where the manufacturing sector plays a crucial role in economic development, understanding the impact of ICT on supply chain efficiency is essential. Manufacturing SMEs are often characterized by limited resources, which make effective supply chain management vital for their survival and growth in a competitive market. The next section will review the literature relating to ICT and supply chain efficiency.

## II. LITERATURE REVIEW

### A. Supply Chain Efficiency

Supply chain efficiency emphasise on providing quality goods and services to end users at the lowest probable cost by making the best use of such resources as materials and labour (Lysons and Farrington, 2006). The concept of supply chain (SC) has arisen with the conception that the accomplishment of enterprises rest on the interaction between raw materials, orders, information flow, labour force, money, and existing equipment and machinery, and the shift from distinct organization-based administration to an incorporated

management approach being portrayed (Zygmunt, 2018). In today's business world, competition exists between SCs and thus the need of effective supply chain management (SCM), which encompasses entire activities appropriate to the movement and transformation of goods from the raw material stage to the end user. Proficient supply chain allows strategic and operational aids to countries, regions, and undeniably companies (Kot, Goldbach & Ślusarczyk, 2018).

An analysis of world literature in the perspective of SCM depicts a noteworthy inconsistency in the number of researches on Small and Medium Enterprises. A substantial part of research on SCM is about the connection between SMEs sector and their performance in the studied states (Arend and Wisner, 2005). It has been revealed that the deficiency of effective employment of Supply Chain efficiency in SME sectors by means of technology and systems results in a loss of competitiveness while concentration on strategic supply chain performance can advance SMEs sector procedures proficiently to attain the competitive lead (Androniceanu, 2017).

The studies of Onwuegbuchunam, Okeke, Igboanusi, & Ugboma (2018); Kot (2018); Nze & Onyemечи (2018); Oláh et al. (2017); Tvaronavičienė (2015); Thakkar et al. (2011); link with the topic of supply chain efficiency in SMEs and note that some SMEs see the benefits of supply chain management activities such as collaboration leading to a concentration on activities bringing value, more transparent development of strategy and cooperation of supply chain participants in the area of improving competitiveness.

Moreso, a part of SMEs sector recognises Supply Chain Management as a tool to realise consumers' gratification through significant investments in ICT (Kherbach and Mocan, 2015). Matters associated with supply chain performance in the sector of Small and Medium Enterprises are also a matter of interest eagerly raised by the scholars in Poland. Nonetheless, the combination of the two concerns, supply chain efficiency and the role of SMEs in the Supply Chains from the perception of such entities is the area of knowledge inefficiently discovered by Polish researchers (Kot, Goldbach & Ślusarczyk, 2018). Although the authors of the aforementioned studies use expressions like supply chain and small and medium companies in their titles, the real purposes of the studies are not connected to supply chain efficiency in small and medium enterprises. The role of SMEs as supply chain links is documented by K. Zowada (2011), who stresses that these SMEs can link the chain efficiently. He considers that due to its features such as flexibility, capability to acclimatise to consumers' desires, adaptability to variations in the environment and lower plant costs SMEs can attain robust positions in the supply chains.

### *B. ICT and Supply Chain Efficiency*

All things considered, ICT transforms firms, making them more inventive, competitive, and growth-oriented. It is widely agreed upon by Kapurubandara and Lawson (2006) that firms must use ICT in their supply chains to be competitive in the highly competitive global economy of today.

According to Gurure and Takavarasha's research (2020), ICT speeds up innovation processes and adds value for businesses, improving the efficiency of a firm's operations. ICT changes how businesses operate their internal logistics processes as well as their external interactions with suppliers, middlemen, third-party logistic providers, and customers (Evangelista, McKinnon, and Sweeny, 2013). According to Malinguh, Wasike, and Zoltan (2020), this indicates that ICT is utilized to facilitate SC linkages and that this is a result of information being accessible to both upstream and downstream clients. According to Zhang and Yang (2023), ICT facilitates the automated transmission of notifications to the supplier, alerting them when inventory levels at the distribution center or specific retailers reach critical levels.

A number of studies depict that there is ubiquitous supply chain efficiency measurement metrics. The SC efficiency of manufacturing SMEs under study can be measured with the following indicators: cost metrics, delivery time metrics and agility metrics.

### *Cost*

Cost reduction, improvement of supply chain efficiencies, and enhancement of revenue margins are constant goals of most supply chain managers, (Raj, 2024). All expenses associated with running the supply

chain are included in supply chain costs, including the cost of items and overall supply chain management expenses (Bolstorff and Rosenbaum, 2003). Administration, shipping, inventory, and production are all related to supply chain costs (Burt, Petcavage, and Pinkerton, 2010). One of the most important ways of achieving an efficient supply chain is by finding ways to reduce supply chain costs, (Lopienski, 2023). Manufacturing SMEs in the clothing sector must assess the effectiveness of the supply chain from a cost-efficiency perspective, (Negi, 2021). Numerous writers in the USA and India have written extensively about several manufacturing supply chains that factor in cost measurement include Rana and Sharma (2019), Sindhuja (2014), Kumar (2007), and Schonsleben (2004). SMEs would win from low costs and ultimately huge revenues when ICT technologies are deployed successfully (Apiyo and Kiarie, 2018). The results of the aforementioned research were all consistent in suggesting that supply chain efficiency and ICT had a positive association. In support of the aforementioned study, related investigations were carried out by Chan (2003), Tian, Chai, Liu and Ren (2003), Gunasekaran et al. (2001), and Holmberg (2000). Therefore this research hypothesises that:

*H1: There is a positive relationship between ICT and cost performance.*

Shapiro (2001) expresses in contradiction that a business should prioritize non-financial goals like customer service, quality, and timeliness over costs alone. Atkinson et al.'s (1997) illustration, which showed how performance metrics centred on cost are frequently at odds with the company's strategic goals and objectives, provided support for this study. Furthermore, it might be challenging to quantify in terms of money factors like lead time, delivery accuracy, and customer satisfaction, according to Ghalayini and Noble (1996). Hence delivery is another metric taken into consideration.

#### *Delivery reliability*

Delivering the correct product at the right location at the right time in the right condition, packaged in the right amount with the proper paperwork to the right client is what supply chain delivery dependability refers to, (Nag and Ferdausy, 2021). Delivery times in the manufacturing supply chain industries in Asia and Europe were examined and assessed by Mahamani and Rao (2010) and Liu et al. (2005), respectively. The conclusion was that supply chain efficiency and ICT adoption were positively correlated, with ICT tool implementation improving on-time delivery and ultimately leading to supply chain efficiency. Lehyani, Zouari, Ghorbel & Tollenaere, (2021), put forward that delivery on time (OTD) has become a top priority for both the production and distribution departments. In line with the aforementioned survey, Garg et al. (2004), Katayama & Bennett (1999), and Li & O'Brein (1999) found that effective delivery times enable quick responses to a dynamic market, shorten the average product life cycle in warehouses, and enhance working capital management.

Garg (2004) disagrees, contending that the supply chain process is hierarchical and consists of several tiers of value-delivering business activities. The results of the study showed that as resources expand, supply chains operate and become more organized. As a result, variability disrupts the synchronization of individual operations, resulting in delayed delivery times. Thus, it is reasonable to suggest that:

*H2: There is a positive relationship between ICT and agility performance.*

Therefore, as a way of overcoming disruptions, there is need for agile supply chains, hence agility is another metric taken into consideration.

#### *Agility*

In today's business world which is characterised by high levels of turbulence and uncertainty, organisations require agility in their supply chains to better manage disruptions, (Suresh, 2024). Due to its adaptability, attentiveness, and speed, agility is essential to supply chain management (SCM), which makes operational tasks easier (Luque et al, 2023). Agility plays an important role in supply chain, from meeting customer expectations to optimising operational costs, (Lopienski, 2023). Thus, SMEs that exhibit agility qualities will be in a better position to capitalize on possibilities connected to the market (Chan, Ngai, and Moon, 2019). According to studies conducted in the UK, Bangladesh, Taiwan, and South Africa by Govuzela and Mafini

(2019), Vickery et al. (2010), and Lin et al. (2006) respectively, agile SMEs demonstrated improved business performance. For this reason, supply chain agility is essential to SMEs' ability to react fast to market changes. Organizations are under tremendous pressure these days to manage uncertainty in various supply chain phases in order to increase supply chain efficiency (Gupta, Goh, De-Souza, Meng & Garg, 2014; Mohammadi & Mukhtar, 2017). According to Blome, Schoenherr, and Rexhausen (2013), agility is a growing notion that supports all organizational processes, including supply chain management logistics. Henrich and Perez, (2022) put forward that agile supply chains need skilled, flexible people, comfortable working with and alongside advanced technologies since better results can be obtained by integrating ICT into the supply chain. According to a research by Teittinen et al. (2013), ICT adoption was essential to Chinese manufacturing enterprises' supply chain agility. Furthermore, a research by Yang (2014) shown that Chinese manufacturing organizations might improve supply chain performance and boost agility by utilizing ICT, while Yusuf et al. (2014) revealed comparable outcomes in the UK manufacturing sector. Moreso, Qosasi et al. (2019), examined an Indonesian clothing retailer as a case study and found a positive correlation between ICT and agility for small and medium-sized businesses (SMEs). In order to acquire a competitive edge, the study looked at how ICT affected the firm's capacity to react swiftly and efficiently to changes in the business environment. Based on the research, it was found that the use of ICT improved the business agility of the company and helped SMEs increase their supply chain agility.

*H3: There is a positive relationship between ICT and delivery efficiency performance*

### C. Conceptual framework

Based on literature review, the relationship between ICT as an independent variable and supply chain efficiency as a dependent was conceptualized as shown in Figure 1.

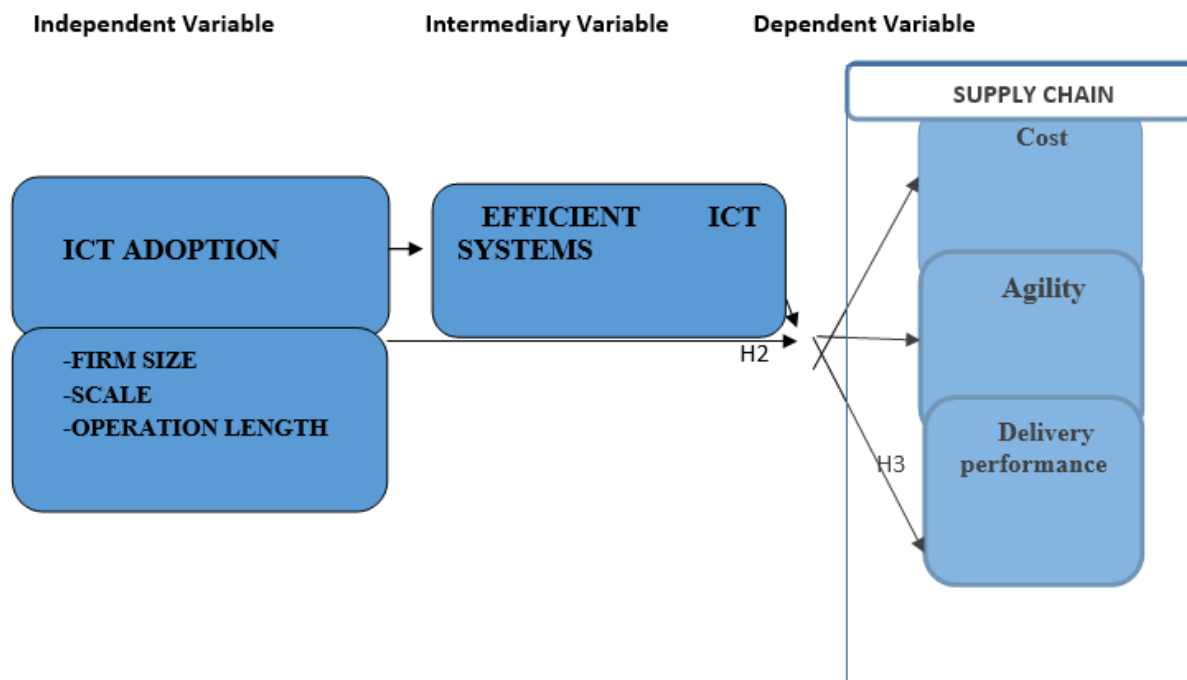


Figure 1: Conceptual model

The framework predicts that supply chain efficiency can be affected by the level of ICT adoption. ICT adoption is the main independent variable and the dependent variables are supply chain cost, agility and delivery performance. Other control variables are firm size, scale, and operation length. Presumably, ICT adoption and efficient processes can influence supply chain efficiency. The literature interrelated what other

researchers have previously established relative to supply chain efficiency and ICT. The next section will present the methodology.

### III. METHODOLOGY

To understand the relationship between ICT and supply chain efficiency, confirmatory or explanatory research design, was used following Forza (2002) and Byrne (2016). That is, the pragmatic research philosophy serves as the foundation for this study. Within the confines of a particular study, positivism and interpretivism can coexist in pragmatic research. According to Collis and Hussey (2014), it also supports the use of both quantitative and qualitative research methodologies which the current study is following. Data were gathered using questionnaires and the research findings were triangulated with interviews. Working on a population of about 147 clothing manufacturing SMEs in Bulawayo, (Zimbabwe Business Directory, 2023), the sample size of 107 was used guided by the Krejcie and Morgan (1970)'s sample selection table.

Through a precise selection of respondents who were informed about ICT and the supply chain efficiency of manufacturing SMEs in Bulawayo, the researcher employed judgmental or purposive sampling choosing managers, supervisors, and shop floor employees who are engaged in supply chain operations mainly form the clothing industry. In order to obtain more detailed information, a qualitative data collection method, key informant interviews (KII) were done with fifteen interviewees from various departments to critically explore the respondents' perspectives on the use of ICTs and supply chain efficiency (Bird, 2016). Ethical considerations were followed. To assess the questionnaire's reliability, the researchers used the Cronbach alpha coefficient. The questionnaire's variables showed Cronbach's alpha values all above 0.713 which is above the acceptable reliability threshold of 0.7 (Sekaran and Bougie, 2020). Correlations tests were done to check for multicollinearity among the independent variables

The correlations indicated a stronger relationship between the two variables is indicated by correlation coefficients near one, whereas weaker correlation is indicated by correlation coefficients near zero. A 5-item summarized measurement scale from Ozkanlisoy and Bulutlar's writings from 2023 was used to evaluate the cost metric; the delivery metric was assessed using a 4-item summated scale that included items taken from Power et al. (2010); and the agility metric was assessed using a 3-item summated scale that included items taken from Wieland and Wallenburg (2013).

### IV. MODEL SPECIFICATION

A simple linear regression model using the Ordinary Least Squares (OLS) guided by the following quantitative model specification was used.

$$SupChainEffic_i = \beta_0 + \beta_1 ICTAdop + \beta_2 FirmSize + \beta_4 Scale + \beta_5 OperLength + \varepsilon(1)$$

Where *SupChainEffic* is supply chain efficiency. This is the outcome variable that the model aims to predict. Supply chain efficiency as a dependent variable is represented by three variables which are cost, agility and delivery performance.  $\beta_1 ICTAdop$ : This is an independent variable. This coefficient represents the impact of Information and Communication Technology (ICT) adoption on supply chain efficiency. A positive  $\beta_1$  would suggest that greater ICT adoption improves efficiency.  $\beta_2 FirmSize$ : This variable likely measures the size of the firm of the SME in terms of number of employees. Large firms may benefit from economies of scale, while smaller firms may be more agile.  $\beta_4 Scale$ : This refers to the scale of the SME. Similar to firm size, its impact on efficiency could be positive or negative, depending on how well the firm manages its scale.  $\beta_5 OperLength$ : represent the operational length or the duration of operational activities. Longer operational processes might indicate inefficiencies, or they could reflect more complex supply chain that requires time to manage effectively. The Error Term ( $\varepsilon$ ) captures all other factors that might influence supply chain efficiency but are not included in the model. It accounts for randomness or omitted variables that could affect the outcome.

The Ordinary Least Squares (OLS) method is highly relevant to the research on ICT and supply chain efficiency in clothing manufacturing SMEs as it makes robust quantitative analysis possible which gives researchers the ability to statistically assess the connection between ICT adoption and a range of performance criteria, including cost performance, agility, and delivery performance. The quantitative data collected through the use of OLS can assist in informing policy and strategic decision-making. The technique (OLS) assesses the direction and strength of the correlations between supply chain efficiency, a dependent variable, and independent variable (ICT), giving precise information about how ICT influences supply chain performance. By offering statistical significance checks, the OLS approach assists in establishing if the benefits of ICT on supply chain efficiency that have been seen are significant and not the result of chance. The knowledge obtained from OLS regression might operate as a starting point for additional research into particular ICT practices or tools that improve supply chain efficiency. Therefore, the application of the OLS technique enhances the study by offering a strict framework for examining the intricate relationship between ICT and supply chain effectiveness in SMEs engaged in the clothing manufacturing industry.

## V. RESULTS PRESENTATION

The demographic variables are presented in table 1 (Source: Authors' calculations). Approximately 51% of SMEs in the clothing industry registered less than 10 employees, implying that a majority of clothing SMEs in Bulawayo are small enterprises. These are followed by 30% representing 10 to 49 workers which represent the growing SMEs.

*Table 1: Demographic characteristics of clothing manufacturing SMEs in Bulawayo*

Demographic Variable	Variable	Frequency	Percent
Firm size	Less than 10 workers	45	51.14
	10-49 workers	26	29.55
	50-249 workers	17	19.32
Scale	Local	60	68.18
	National	15	17.05
	International	13	14.77
Operation length	Less than 10 years	44	50.00
	10-20 years	20	22.73
	21-30 years	11	12.50
	30-40 years	8	9.09
	More than 40 years	5	5.68

The least constituted 19% employing 50-249 workers representing the largest SMEs. Computational analysis from questionnaires depicted that a huge number of respondents estimated at 68% operate locally within Bulawayo, while approximately 17% operate nationally within Zimbabwe. A smaller fraction estimated at 15% has ventured into the global supply of clothes. The length of operation of the SMEs in Bulawayo shows that institutions range of less than 10 years amounting to a percentage value of 50% depicting young and sunrise SMEs. Older firms occupy 15% of the manufacturing SMEs in Bulawayo ranging from 31 years to more than 40 years. A large proportion of medium to large firms have 35% ranging from 10 to 30 years. The operational length of the institutions pinpoints that these firms are conversant with matters regarding ICT and supply chain efficiency in the clothing industry.

## Descriptive Statistics

Table 2: Descriptive statistics

Variable	Observations	Mean	SD	Min	Max
Firm size	107	1.682	0.781	1	3
Scale	107	1.466	0.742	1	3
Operation length	107	1.977	1.232	1	5
Cost performance	107	12.023	5.309	5	25
Agility	107	20.454	6.153	4	28
Delivery performance	107	16.034	5.279	3	21
ICT adoption	107	14.489	7.186	5	25

Data were collected from 107 clothing manufacturing SMEs in Bulawayo Province representing various stakeholders on the evaluation of ICT and supply chain efficiency. The means and standard deviations of the data presented in Table 2. Minimum value observed for firm size and scale was 1 (with mean=1.682 and standard deviation of 0.781) while the maximum value observed was 3. For operation length the minimum was 1 (with mean=1.977 and standard deviation 1.232) while the maximum was 5. Cost as minimum value of 5 (with mean=12.023 and standard deviation of 5.309) and a maximum of 25, agility minimum value was 4 (with mean=20.454 and standard deviation 6.153) while maximum was 28, delivery minimum was 3 (with mean=16.034 and standard deviation 5.279) while maximum value was 21 with ICT's minimum being 5 (with mean=14.489 and standard deviation 7.186) while its maximum was 25. The same figure is also showing the standard deviation and mean for all the study variables.

## VI. INFERENCE STATISTICS

Tables 3 (Source: Authors' calculations), Table 4 (Source: Authors' calculations) and Table 5 (Source: Authors' calculations) present inferential statistics on the influence of the adoption of ICT on cost performance, agility and delivery performance of Bulawayo Province clothing manufacturing SMEs respectively.

H<sub>1</sub>: There is a positive relationship between ICT and Cost

Table 3: Model 1 Cost Regression results

VARIABLES	(1) COST	(2) COST	(3) COST	(4) COST	(5) COST
ICT	0.5534* (0.0812)	0.575*** (0.0363)	0.467* (0.036)	0.4897* (0.0632)	0.346 (0.0752)
FIRM SIZE	-0.997* (0.984)		0.568* (0.420)		
SCALE	0.582*** (0.819)			0.515*** (0.319)	
OPERATION LENGTH	2.483*** (0.739)				0.896*** (0.199)
Constant	3.546***	3.688***	2.658***	2.472***	4.320***



	(0.685)	(0.808)	(0.778)	(0.523)	(0.463)
Observations	107	107	107	107	107
R-squared	0.856	0.606	0.671	0.829	0.817

Standard errors in parentheses\*\*\* p<0.01 is 1% level of significance, \*\* p<0.05 is 5% level of significance, \* p<0.1 is 10% level of significance. The dependent variable is Cost.

*H<sub>1</sub>: There is a positive relationship between ICT and Cost performance.*

The principal findings of the linear regression using cost as the dependent variable are shown in Table 3. A regression analysis was used to establish the relationship between ICT and cost performance for manufacturing SMEs. As presented in Table 3, the findings indicate a favorable correlation between Bulawayo's SMEs' cost performance and ICT. This may be accounted for by its 10% significant probability value. This means that, ICT reduces supply chain costs for SMEs by about 55%. The primary independent variable of focus is ICT, with other control variables including company size, scale, and duration of operation. The independent variables are all shown against cost in the first column, and the dependent variable is plotted against ICT and one control variable in the remaining columns and this is done for robustness checks of the primary regression findings in column (1). ICT significantly affects cost as seen in Column 1. ICT accounts for 55% of the cost variance at the 10% significance level. Columns 2-5 of Table 3 are for robustness check for results in column 1.

This paper uses a mixed approach of both qualitative and quantitative methods which are considered to give researchers an informed analysis or debate (Almalki, 2016). In response to the interview question on measuring cost effectiveness, most respondents highlighted that ICT was seen as having an important role in reducing supply chain costs through smooth inventory management. Respondents also emphasized that inventory management systems were used to track demand patterns and create reorder points, further reducing inventory carrying costs. One of the respondents pointed out that:

*"..the adoption of ICT has improved demand forecasting, which has allowed production and procurement activities to be aligned with customer demand, resulting in reduced costs associated with excess inventory or lost sales."*

Qualitative and quantitative results have a common conclusion that there is a positive relationship between ICT and cost performance of clothing manufacturing SMEs in Bulawayo. These findings are consistent with previous research conducted by Rana and Sharma (2019), Sindhuja (2014), Kumar (2007), and Schonsleben (2004). These studies verified that when ICT technologies are correctly implemented, SMEs will benefit from reduced expenses and eventually big earnings. All of the above listed research's findings pointed to a favourable correlation between supply chain efficiency and ICT.

The findings are additionally supported by studies by Obeid and Zaid (2021) who discovered a good correlation between ICT and the cost performance of SMEs in Tunisia. They discovered that ICT level has a substantial beneficial impact on profitability and cost performance using a panel of 70 manufacturing SMEs in the electrical and electronics sector between 2012 and 2015.

*H<sub>2</sub>: There is a positive relationship between ICT and Agility*

*Table 4: Model 2 Agility Regression results*

VARIABLES	(1) AGILITY	(2) AGILITY	(3) AGILITY	(4) AGILITY	(5) AGILITY
ICT	0.108*** (0.112)	0.1087*** (0.172)	0.0963*** (0.153)	0.0872 (0.186)	0.1284* (0.197)
FIRM SIZE	-0.751*** (1.352)	-0.375*** (1.352)	0.5872*** (0.566)		

SCALE	0.598 (1.126)	0.598 (1.126)		5.624*** (0.657)	
OPERATION LENGTH	-0.0409 (1.016)	-0.0409 (1.016)			3.675*** (0.365)
Constant	10.27*** (0.941)	10.27*** (0.941)	10.58*** (1.049)	12.21*** (1.078)	13.19*** (0.849)
Observations	107	107	107	107	107
R-squared	0.797	0.797	0.556	0.460	0.541

Robust Standard errors in parentheses

\*\*\* p<0.01 is 1% level of significance, \*\* p<0.05 is 5% level of significance, \* p<0.1 is 10% level of significance. The dependent variable is Agility.

The paper also sought to establish the relationship between ICT and agility for SMEs in Bulawayo Province. Table 4 presents results depicting that ICT and agility for SMEs have a considerable positive association. This is explained by its positive coefficient and the fact that its probability value is less than 0.05. With agility as the dependent variable, Table 4 displays the primary linear regression results. Firm size, scale, and duration of operation are additional control factors, with ICT serving as the primary independent variable of interest. ICT and one control variable are shown against the dependent variable in the other columns, whereas all the independent variables are presented against agility in the first column. It serves as a robustness check for the primary regression findings.

ICT has a substantial and favourable impact on agility, as seen in Column 1. ICT has an approximately 11% beneficial effect at 1% level of significance. According to this, a minimal adjustment in ICT will result in an approximately 11% increase in supply chain agility. Qualitative results from interviews with key informants supported the above quantitative results. In response to an interview question relating to ICT and supply chain agility, one key informant projected that their supply chain can adapt to changes in demand and market conditions. The explanation was based on the availability of ICT tools and devices that help forecast demand. Columns 2-5 of Table 4 are for robustness check for results in column 1.

One informant pointed out that:

*“ICT has enabled our organisation to have an inventory management system which assists in maintaining optimal inventory levels, aiding in adapting to changes in delivery times.”*

In addition, another respondent emphasized that their supply chain is sufficiently developed to respond to operational changes as they can quickly adapt to changes that can be caused by natural disasters or other factors affecting the supply chain. The respondent’s argument was based on how they managed to respond to changes in the era of COVID-19, where with the help of the Internet of Things (IoT), they were flexible and agile enough to adapt to rapidly changing demand and operations.

Prior to these results, the study therefore fails to reject the null hypothesis and conclude that there is a positive relationship between ICT and agility for SMEs in Bulawayo. These findings are consistent with a related study by Qosasi et al. (2019), which examined an Indonesian clothing retailer as a case study and found a positive correlation between ICT and agility for small and medium-sized businesses (SMEs). Based on the research, it was found that the use of ICT improved the business agility of the company and helped SMEs increase their supply chain agility. The findings are also buttressed by Yang (2014) who found that Chinese manufacturing organizations improve supply chain performance and boost agility by utilizing ICT.

H<sub>3</sub>: There is a positive relationship between ICT and delivery reliability

Table 5: Model 3 Delivery regression results

	(1)	(2)	(3)	(4)	(5)
--	-----	-----	-----	-----	-----

VARIABLES	Delivery	Delivery	Delivery	Delivery	Delivery
ICT	0.1032*** (0.121)	0.571*** (0.0499)	0.7981* (0.0764)	0.701* (0.035)	0.0234* (0.0764)
FIRMSIZE	-3.192** (1.471)		4.199*** (0.571)		
SCALE	-0.875 (1.224)			3.624*** (0.660)	
OPERATION LENGTH	-0.445 (1.105)				2.509*** (0.375)
Constant	8.618*** (1.023)	7.762*** (0.806)	8.971*** (1.058)	10.72*** (1.084)	11.07*** (0.872)
Observations	107	107	107	107	107
R-squared	0.674	0.604	0.386	0.259	0.343

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is Delivery.

Lastly, the study intended to establish the relationship between ICT and delivery reliability. Regression model was used and results are shown on Table 5. Furthermore, a favourable correlation between ICT and the delivery performance is evident in the data, as clarified by its probability value which is less than 0.05 ( $P < 0.05$ ). With delivery as the dependent variable, Table 5 shows the key findings of the linear regression. Along with other control factors, ICT is the primary independent variable of interest. While ICT and one control variable are presented against the dependent variable in the other columns, all of the independent variables are presented against delivery in the first column. Therefore columns 2-5 are used for robustness check for the primary regression findings.

ICT significantly and favourably affects delivery of goods and services, as seen in Column 1. ICT has a favourable effect of around 10% at 1% level of significance. This suggests that even a small change in ICT will result in an improvement in delivery performance of about 10%.

Qualitative results from interviews with key informants supported the above quantitative results. Regarding the question on ICT and delivery performance, one of the key informants emphasized that, in comparison to other clothing manufacturing companies, their delivery performance is among the best. They underlined that they can effectively produce and deliver their clothing in accordance with the necessary standards while keeping in mind the needs and expectations of the customers. One informant mentioned that:

*"ICT has played a major role in enhancing our delivery performance, through the use of Enterprise Resource Planning, (ERP) which assists with good and proper planning."*

As a result, order fulfilment served as the company's primary delivery success metric. Thus, the conclusion was that there exists a relationship between ICT and delivery performance in Bulawayo clothing manufacturing SMEs. Prior to these research findings, the study fails to reject the null hypothesis and conclude that there is a positive relationship between ICT and delivery reliability.

These results concur with a related study by Fu et al. (2014), which looked at how ICT affected SME performance in China, adoption of ICT improved delivery reliability as well as innovation capacity and market expansion. The results are also supported by Mahamani and Rao (2010) and Liu et al. (2005), who studied on ICT and delivery times in manufacturing supply chain industries in Asia and Europe, respectively and found that supply chain efficiency and ICT adoption were positively correlated, with ICT tool implementation improving on-time delivery and ultimately leading to supply chain efficiency.

## VII. CONCLUSIONS AND RECOMMENDATIONS

The research study draws the conclusion that, in Bulawayo clothing manufacturing SMEs, there is a potentially noteworthy correlation between supply chain efficiency (SCE) and information and communication technology (ICT). This was demonstrated by the connections found between ICT and the supply chain efficiency measurement scales, which comprised of delivery performance, cost performance, and agility. ICT was found to be positively and statistically correlated to all of the three measurement scales of supply chain efficiency. The study's results, when compared to the hypothesis, led the researchers to the conclusion that there is a positive correlation between ICT and cost performance in the Bulawayo manufacturing SMEs. According to the findings, small and medium-sized enterprises that use ICT significantly in their operations experience a decline in supply chain costs. The positive correlation between ICT and manufacturing SMEs' cost performance emphasizes how critical it is for SMEs to adopt ICT in their supply chains.

The favourable correlation between ICT and delivery performance of Bulawayo clothing manufacturing SMEs emphasizes how crucial it is to adopt and apply ICT solutions strategically. Manufacturing SMEs in Bulawayo optimize their supply chain operations via the use of ICT solutions. This has led to better delivery schedules, more efficiency, and ultimately happier customers. Not only does ICT improve manufacturing SMEs' delivery performance, but it also increases the agility of their supply chains. The study shows that SMEs that use ICT solutions are more flexible, adaptive, and responsive when it comes to handling unforeseen obstacles and shifting market demands. ICT gives manufacturing SMEs the capacity to quickly access and analyse real-time data, work with stakeholders, and optimize their operations, all of which increase overall supply chain agility. In a nutshell, supply chain efficiency in manufacturing SMEs is positively influenced by the level of ICT adoption within the firms. Therefore, it is of paramount importance for Bulawayo clothing manufacturing SMEs to adopt and implement ICT to the fullest so as to reap all the benefits encompassing ICT implementation within supply chain activities.

The recommendations on ICT and cost performance are that, Bulawayo clothing SMEs should regularly engage in training and capacity building of employees, so as to continuously improve their ability to use ICT tools and systems which will then results in better cost performance. SMEs must carry out a comprehensive cost benefit analysis before deploying any ICT solutions, to enable them to evaluate the possible influence on cost performance and arrive at well informed conclusions. The government must lead the charge in encouraging SMEs in the clothing sector to use ICT in their supply chains. This can be achieved by improving ICT infrastructure in Bulawayo and also ensuring that ICT enabled supply chains run in a supportive atmosphere, fixing power supply issues and offering more dependable internet connection. To improve supply chain efficiency through ICT, SMEs should collaborate and network with other supply chain members. Collaboration can lead to information and resource sharing which leads to achievement of economies of scale, resulting in reduced costs and overall improved supply chain efficiency.

Based on the findings connected to ICT and agility, the researcher recommends the following: Bulawayo clothing manufacturing SMEs to prioritise investments in reliable ICT infrastructure, inclusive of high internet connectivity, advanced hardware and software devices so as to ensure smooth and efficient operations enabling better agility, especially in today's business world where a lot of supply chain disruptions are being experienced. Agility can be achieved through effective communication and thus Bulawayo clothing manufacturing SMEs should encourage collaboration and information sharing among supply chain members so as to promote real time communication through the use of ICT. SMEs should regularly monitor and evaluate the impact of ICT adoption on their supply chain agility. This will help identify areas for improvement and ensure that ICT initiatives are aligned with the overall business objectives. By implementing these recommendations, clothing manufacturing SMEs in Bulawayo can harness the full potential of ICT to enhance their agility, and improve supply chain efficiency.

Furthermore, where there is an existence of a positive relationship between these two variables, the researcher recommends SMEs to commit resources to the acquisition and upkeep of suitable ICT infrastructure so as to fully utilize the advantages of ICT in enhancing delivery performance. This can assist in adjusting and implementing new technologies that can improve delivery efficiency even more and help to

keep a competitive edge. SMEs to routinely evaluate how well their ICT solutions are enhancing delivery performance. Benchmarking against industry standards, consumer input, and performance measures can all be used to achieve this. To guarantee the best possible use of ICT resources, any necessary modifications or enhancements should be implemented. It is evident how important it is for Bulawayo clothing manufacturing SMEs to integrate ICT in their supply chains, given the favourable association that exists between ICT adoption and delivery performance. Thus, by putting the suggested techniques into practice, SMEs may enjoy the benefits of adopting ICT in supply chains.

#### VIII. PRACTICAL IMPLICATIONS

The results of the study indicate that ICT adoption in supply chain of manufacturing SMEs results in reduced supply chain costs, improved delivery as well as improved agility. The study results contribute in assisting supply chain practitioners to measure efficiency levels and ascertain improvement measures. These practitioners will realise areas where ICT is needed to improve supply chain efficiency, hence action can be taken. An analysis into the findings can allow the management to improve their supply chain efficiency through ICT implementation. The study goes a long way in providing the government with significant information regarding the importance of ICT in manufacturing SMEs supply chains. The recommendations assist policy makers in articulating policies that are in line with enhancing ICT framework in SMEs supply chains.

#### IX. RECOMMENDATIONS FOR FURTHER STUDIES

The study suggests many potential directions for further research. While this study concentrated on Bulawayo's SMEs that manufacture clothing, other researchers may examine the relationship between ICT and the efficiency of supply chains in manufacturing SMEs across various industries and nations. By doing this, any contextual or geographical elements that could have an impact on the connection between supply chain efficiency and ICT will be easier to discover. To see how integrating ICT into manufacturing SMEs' supply chains affects things over time, longitudinal research may also be done. Through time, this will shed light on the long-term viability and efficacy of ICT solutions.

In conclusion, the future work stemming from this research can significantly contribute to enhancing the understanding of ICT's role in supply chain efficiency. By exploring these areas, researchers can provide valuable insights that support the growth and competitiveness of manufacturing SMEs in Bulawayo Province and beyond.

#### X. LIMITATIONS

Although Bulawayo Province is one of the provinces with a high concentration of SMEs, it will be better to use a larger sample that includes other provinces.

#### AUTHOR'S CONTRIBUTION

Sithokozile Bafana originally conceived this paper, designed graphs and tables, Felix. Chari contributed to data collection and writing of this paper and Simba Mutsvangwa contributed on data analysis.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding to the publication of this paper

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## Informacijsko komunikacijska tehnologija in učinkovitost oskrbovalne verige v proizvodnih malih in srednje velikih podjetjih, v provinci Bulawayo v Zimbabve

**Povzetek** - Na svetovni ravni je opazen trend upadanja uspešnosti večine malih in srednje velikih podjetij (MSP) v proizvodnji, zaradi domnevne neučinkovitosti oskrbovalne verige. Za mala in srednje velika podjetja v proizvodnji oblačil v državah v razvoju, kot je Zimbabve, z ozirom na provinco Bulawayo, ki ni digitalizirana, je nujno, da vključijo rešitve informacijske in komunikacijske tehnologije (IKT) v svoje dejavnosti oskrbovalne verige za izboljšanje učinkovitosti in ohranitev konkurenčnosti na svetovnem trgu. Namen študije je, oceniti IKT in učinkovitost oskrbovalne verige v MSP, za proizvodnjo oblačil v provinci Bulawayo. Podatki so bili zbrani s polstrukturiranimi vprašalniki na vzorcu 107, od skupno 147 prebivalcev, ki so bili triangulirani s 15 intervjuji, z malimi in srednje velikimi podjetji za proizvodnjo oblačil v Bulawayu. Za preverjanje razmerja med IKT in učinkovitostjo oskrbovalne verige je bila izvedena linearna regresijska analiza z metodo najmanjših kvadratov. Rezultati prikazujejo, da ima IKT pozitiven in statistično pomemben učinek na stroškovno učinkovitost, agilnost in učinkovitost oskrbovalne v MSP za proizvodnjo oblačil v Bulawayu. S prednostnim sprejemanjem IKT lahko vodje dosežejo boljše upravljanje stroškov, večjo odzivnost na zahteve trga in boljše zmogljivosti za zagotavljanje storitev. Priporočljivo je, da mala in srednje velika podjetja za proizvodnjo oblačil v Bulawayu sprejmejo IKT. V nadaljnjih študijah bi bilo treba preučiti povezavo med IKT in učinkovitostjo oskrbovalne verige v proizvodnih MSP v različnih panogah in državah.

**Ključne besede** - informacijska in komunikacijska tehnologija, učinkovitost dobavne verige, MSP in načrtovanje potreb po materialu

### APPENDIX 1: QUESTIONNAIRE OF CLOTHING MANUFACTURING SMES IN BULAWAYO

#### PART A: Organizational Characteristics

Please tick in the spaces provided

##### 1.1 Scale

Local	
National	
International or global	

##### 1.2 Length of operation of the firm in years

Less than 10 years	
10-20 Years	
21-30 Years	
31-40 Years	
More than 40 Years	



**1.3 Size of the firm**

Less than 10 workers	
10-49 Workers	
50- 249 Workers	

**PART B: OBJECTIVES RELATED QUESTIONS**

**NB:** There has been an increase in the use of ICT in supply chain management.

**2. Cost performance as a measure of supply chain efficiency**

Indicate the extent to which you agree or disagree with the following statements concerning cost performance.

Use the scale of: 1. Strongly agree 2. Agree 3. Not sure 4. Disagree 5. Strongly disagree

	Measure of cost performance	1	2	3	4	5
2.1	Our supply chain has experienced a decrease in transaction costs					
2.2	Our supply chain has encountered reduction in transport & distribution costs.					
2.3	Our supply chain has experienced decrease in resource usage costs.					
2.4	Our supply chain has encountered reduction in order management costs.					
2.5	Our supply chain has experienced risk reduction costs					

**3. Agility as a measure of supply chain efficiency**

Please indicate the speed of response with which your firm engages in the following activities in change occurrence (1 = slow; 7 = fast)

Scale: 1. Slow 2. Moderately slow 3. Slightly slow 4. Neutral 5. Slightly fast 6. Moderately fast 7. Fast

	Measure of agility performance	1	2	3	4	5	6	7
3.1	Adapt manufacturing lead times							
3.2	Adapt level of customer service							
3.3	Adapt delivery reliability							
3.4	Adapt responsiveness to changing market needs							

**4. Delivery Performance as a measure of supply chain efficiency**

Indicate the extent of your performance in relation to your competitors' performance using a scale ranging from "far worse" (1) to "far better" (7).

Scale: 1. Far worse 2. Moderately worse 3. Slightly worse 4. Neutral 5. Slightly better 6. Moderately better 7. Far better

	Measure of delivery performance	1	2	3	4	5	6	7
4.1	Order fulfilment speed							
4.2	Delivery speed							
4.3	Delivery as promised							

### Part C: ICT ADOPTION MEASUREMENT RELATED QUESTIONS

#### 5. ICT Adoption Measurement

Indicate the extent to which you agree or disagree with the following statements about ICT adoption.

Use a scale of 1. Strongly agree 2. Agree 3. Not sure 4. Disagree 5. Strongly disagree

	ICT Adoption items	1	2	3	4	5
5.1	Our IT infrastructure is equipped to support supply chain-related online activities such as returns and consumer feedback					
5.2	ICT permits the majority of our purchasing and procurement to be conducted online and via the Internet					
5.3	Our information systems support mutual information sharing and inventory tracking throughout the supply chain					
5.4	Orders, inquiries, and comments are received through our website, and online order processing is carried out					
5.5	ICT adoption improves the level of customer satisfaction in our supply chain					

### APPENDIX 2: INTERVIEW GUIDE

#### INFORMATION COMMUNICATION TECHNOLOGY AND SUPPLY CHAIN EFFICIENCY IN MANUFACTURING SMEs IN BULAWAYO

##### Questions

1. How are you reducing your supply chain costs within your organisation?
2. How responsive is your supply chain to changes in manufacturing lead times and delivery reliability?
3. How responsive is your supply chain to changes in level of customer service and market needs?
4. How is your delivery performance relative to competitors?
5. What are the contributions of ICT adoption to your supply chain?