


Information and Communication Technology (ICT) Effect on Supply Chain Performance in the Dairy Industry: A Study in the Indian Context

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ABSTRACT

The technology and use of computers helped the Indian dairy industry to change its rural face and its organization. Its revolution in today's supply chain management business validates that they are vital elements that can surely bring success for any internetworked business enterprise. Information technologies can give a business a strategic technology platform that supports electronic commerce and enterprise collaboration among the internetworked enterprise in today's global dairy business environment. The research paper attempts to find the relationship between the information and communication technology as one of the variables of supply chain management with organizational performance which are identified as financial and market performance. Multiple regression technique has been used for the analysis in order to find the predictor variables for various performance measuring variables. The findings suggest that ICT plays a crucial role in enhancing the performance of the dairy companies in the form of increase in performance matrix indicators.

KEYWORDS

Dairy Industry, Information and Communication Technology (ICT), Multiple Regression Analysis, Organizational Performance, Supply Chain Management (SCM)

1. INTRODUCTION

Food safety has become a sensitive issue, for the developing countries like India, upsurging the food demand by 60-90 percent (Kumar et al, 2019, Schmitz et al., 2017). This rise in demand for food is enhanced by wastage done by many industries in which the dairy industry is one. The main reasons for the waste of food are inefficient storage facilities, indecorous packaging, losses due to inappropriate transportation management, poor inventory management (Bravi et al., 2019; Bharucha, 2018; Sheahan et al, 2017). Consequently, dairy supply chains are more concerned with controlling the milk quality and supply fluctuations which are unique to this sector. A time-efficient supply chain known as the cold chain is required for perishable items like milk and its products. This perishability factor can affect the dairy supply chain. Addressing the various proficiencies in the perishable food supply chain led to a reduction in the food loss from origination to the consumption end along with providing majestic financial, economic, and environmental profits (Balaji et al, 2016; Hodges et al., 2011). Supply chain management has been seen as a source of gaining a competitive advantage in the

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business world. Increased competition among the dairy companies resulting from the globalization of supply, processing, and logistics network, high demand of customer service, quality of dairy products, and its competitive pricing has designated the importance of supply chain management in recent years. Success pre-requisite of a dairy industry depends on ICT enable efficient supply chain management. Wastage and poor handling of milk and milk products in the Indian supply chain is the main issue to look after at which occurs due to multiple points involved in the handling of the same. The lack of cold chain or storage facilities and inappropriate transportation facilities techniques has led to inefficiencies in handling milk and its products. There is a compelling case for appropriate infrastructure for storage and transportation, such as temperature-controlled warehouses and vans. Therefore, by adopting and practicing the effective supply chain management practices there will be a tremendous reduction in the loss of milk and its products and also significantly benefits all the dairy supply chain members which include farmers, customers, companies, and stakeholders by the means of increased return on assets to the firm and decrease in price. Numerous studies depict that milk and milk products are easily damaged if the suitable environmental factor is lacking such as right temperature, storing facilities, whilst mandatory to be preserved and controlled on a real-time basis (Zambrano et al., 2019; Schanes et al., 2018). Therefore, to maintain the quality and enhance the shelf life of dairy products, proper warehousing, transportation, cold chain facilities are required which are only possible through implementing IT-enabled supply chain management systems at the workplace. ICT will help in monitoring various tasks involve in SCM efficiently and effectively (Daneshvar et al, 2019; Han et al., 2017). Furthermore, the implementation of an IT-enabled supply chain enhances the capability by getting the real-time response and performance advancement (Wen et al., 2018; Thoni et al, 2017; Han et al., 2017).

Assuming the consequences of the above statements, the paper attempts to establish the role of information and communication technology on the supply chain performance of the Indian dairy industry.

2. ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) TOOLS AND TECHNIQUES IN THE INDIAN DAIRY INDUSTRY

Many difficulties have surrounded the Indian dairy industry such as inadequacy, worsening of perishable foods, inadequate quality, mismanagements in weights and measures, the discrepancy in demand and supply, poor infrastructure, worsen storage facilities, lack of sustainable practices, long lead time, poor services. Proper management of SCM function can help in elevating the operation proficiency, thereby plummeting transportation losses and pilferages. Therefore, the value of information in supply chain management is well recognized and emphasized even in the definition of logistics management (Council of Logistics Management, 2004). Information and communication technology empowered the value chain of the firm along with minimizing the risk and powering the firm to move the products from supplier to customers with full confidence (Kumar et al, 2019, Truong et al, 2018). Firms must know what accurate information is vital for sound supply chain decision-making. Supply chain information must flow internally among the various departments, such as purchasing, manufacturing, marketing, finance, accounting, and logistics, etc., as well as between the firm and its vendors, transporters, forwarders, warehouse, and customers for handling customers' orders, production planning, material requirements planning, distribution requirement planning, finance, and sales forecasting. Availability of timely and accurate information is vital for sound supply chain decision-making as, before the flow of products and services, there is a need for information about requirements or demand. The implementation of modern technologies at the workplace will demonstrate the full strength of the Agri-food supply chain whilst communicating at a faster pace and taking decisions quickly (Kataike et al.,2019; Ulvenblad et al., 2019; Devaux et al., 2018). Huge benefits can be drawn through effective information sharing across the supply chain resulting in competitive advantage (Dubey et al., 2019; Pham et al., 2019; Eckerd et al, 2018). To make a supply chain effective, there are four reasons for timely and accurate information available

which are: a) for understanding customer satisfaction, managers need information about order status, inventory availability, delivery schedule, shipment tracking, and invoice. And they need the information in real-time b) information substitutes for inventory and other resources while dealing with uncertainty. If used effectively, information takes costs out of the supply chain c) information increases flexibility with regard to when, where, and how the resource is utilized to gain competitive advantage d) web-based information sharing is changing the relationship between buyers and sellers, thus, redefining supply chain relationship. In addition to this, the efficiency and reliability of any process depend upon the timely availability of accurate information related to the process. ICT is playing a significant role in improving the services of the dairy sector, as IT-enabled tools support the SCM process with improved information management and modelling and facilitate the decision support system of the firm. In other words, it can be said that an IT-enabled SCM support organizational process with improved operational benefits helps the firms to gain strategic advantage over its competitors, such as the establishment of the virtual enterprise, framing an e-commerce environment, single-point data storage and access, increased visibility, reduction in transportation and inventory cost, improved supplier and customer management, planning activity through real-time data processing and information trade-off within SCM entities.

3. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The impact of ICT on the SCM process can be observed through the various competitive dimensions of a firm such as reduction in response time, improved logistics management, improved upstream and downstream collaboration for better demand forecasting, establishing cross-boundary vertical integration within units of the firms, etc. Various literature suggests that implementation of ICT enabled supply chain process equipped with “sensing tools”, “improved information sharing” and “control technology” can provide significant support toward sustainability in the dairy industry and managing supply chain operations (Cleaver and Schreiber, 1994; Sigrimis et al., 2001). Dairy farmers need to equip themselves with a two-way information system ranging from farm level to enterprise level. An ICT-enabled SCM provides the farmer with needed information, e.g., daily price update, information about modern techno-farming processes and tools, information related to forecasting of natural calamity and government support, etc. ICT has enabled better quality, transport, production, marketing, and services. It also facilitates the integration of locally generated revenue, manpower, resources, and facilities into the human empowerment grid. ICT acts as integrating and enabling technologies for the economy, and they have a profound impact on the dairy society. ICT implementation in the dairy industry will deliver an advanced, reliable, fast supply of milk and milk products to their customers. ICT tools and techniques like radio frequency identification (RFID) help the dairy industry in automatically recording the logistics operation in the food supply chain. ICT is also playing an essential role in facilitating the implementation of policy and in measuring its effectiveness. The ICT is delivering various tools that are fundamentally needed to collect, process, and manage data and present it in a standardized format. Mohammadi et al (2012) said that the application of information technology has a high influential impact on the improvement of the supply chain. Information and communication technology (ICTs) tools namely supply chain communication system (SCCS), electronic data interchange (EDI), electronic mail (E-mail), barcoding, and radio frequency identification (RFID), enterprise resource planning (ERP), etc. helps in enhancing the performance of the supply chain in the dairy companies. Consequently, from the above discussion, it can be understood that information and communication technology (ICT) act as the heart of supply chain management which helps in providing real-time crucial information by tumbling inconsistency and ambiguity in the system (Nayal et al, 2021, Barnett et al., 2019; Amarnath et al., 2018; Zhou et al., 2018; Siddh et al., 2017).

The study includes crux of literature review derived from various research paper on information and communication technology (ICT) and organization performance through supply chain management practices involving its methodology, key findings and key learning is described in *table 1*.

Problem Statement of the Study

Indian dairy is one the major segment of the agriculture sector contributing 4 percent of the significant share to the Indian economy. In today's dairy businesses, still Indian stands on the top as the largest milk producer country in the world with 190 MT production of milk in 2019-20. Dairying in India has been regarded as the major source of nutritive food, employment, alleviating poverty. The third-fourth population of India lives in rural areas and dairy is considered as the major source of income to them. Despite the majestic development of the dairy sector, India is still dealing with sensitive issues such as poor quality of milk, inadequate infrastructure, lack of storage facilities, gaps between demand and supply, adulteration, lack of technology development to name a few. Out of various issues defined above, lack of information and communication technology development has been an important problem that stopping the Indian dairy industry to rise in the world dairy market despite having gigantic potential. It is believed that the third white revolution is only possible through technological development in the Indian dairy industry. The growth of ICT is mandatory to shift the dairy industry from the traditional approach to technology enable dairy supply chain. The right technology and its implementation at the workplace are the need of the hour for the Indian dairy industry to structure itself better. Many issues faced by the dairy industry can be solved by using technology-based solutions. Technology-enabled supply chains help the dairy industry in maintaining milk quality, monitoring supply chain operations, e-marketplace, effective dairy farm management, product traceability. Lack of knowledge about advanced technologies such as the Enterprise Resource Planning (ERP), Radio Frequency Identification (RFID), Global Positioning System (GPS), Business Intelligence (BI), and Blockchain technology had led the industry down in the world dairy market. Moreover, the dissemination of information and communication technology (ICT) is seen low in the dairy sector due to several infrastructural problems. Consequently, the dairy industry enabled with its ICT framework in the form of the supplier-related database has huge potential in bridging the information gap. Hence, it is very decisive to explore the potential offered by the ICT infrastructure in the Indian dairy industry. Subsequently, keeping the above issues in account, the research paper attempts to explore the relationship between information and communication technology (ICT) practices and supply chain performance identified in terms of financial and market performance.

From the literature and problem of the study discussed above, the study attempts to explore the relationship between information and communication technology and supply chain performance (SCO). Accordingly, study proposes the following objectives and hypothesis.

Objectives of the Study

1. To investigate the impact of adopted information and communication technology (ICT) tools and techniques on the supply chain performance.
2. To suggest a roadmap for improving the performance of the Indian dairy industry through information and communication technology (ICT) tools and techniques.

Research Hypotheses

H1: Information and communication technology (ICT) has a positive influence on enhancing supply chain performance of Indian dairy industry.

4. RESEARCH METHODOLOGY

Exploratory study design has been inculcated aiming at finding out the nitty-gritty of the Indian dairy supply chain, preceded by a descriptive research design, facilitating in evaluating the impact of information and communication technology (ICT) tools and techniques on the dairy industry performance matrices.

Table 1. Critical literature review information and communication technology (ICT) and supply chain performance

Authors and Year	Objective of the study and Methodology	Key Findings	Key Learning
Nayal et al, 2021	The study focuses light on the effectiveness of technology enabled system towards sustainable Agri supply chain. The research adopts SLR method through searching relevant online database from 1999 to 2020 in order to come to conclusion.	The key findings depict that technology enabled agriculture helps in enhancing safety of food, its quality, matching the demand and supply, real time information, trackability and traceability further leading to sustainable development.	Information and communication technology has become a part of every organization because of its importance and contribution in making decision making effective, making supply chain system robust and enabling transparency, ultimately leading to elevate the supply chain performance of agriculture industry.
Kumar et al, 2019	The research paper showed its concerned-on issues related with agri-food supply chain. Moreover, the study examines the contribution of ICT and SCM practices in agri-food supply chain on firm performance. The study incorporates Partial least square (PLS) technique in order to test the theoretical framework and hypothesis.	The findings reveal the significant relationship between ICT and SCM practices, along with positive impression of SCM practices on firm performance.	The ICT and SCM practices play a crucial role in Agri industry leading for firm performance and providing competitive edge over others. Moreover, it facilitates the decision-makers to comprehend the connotation between ICT, SCM practices and OP measures.
Kakhkia et al (2019)	The research paper carried out a structure literature review on information system and supply chain management aiming to provide a classification for existing areas of research. 1500 articles which are from peer reviewed journal over past decades is being studied to classify the topics and methods and also identify major trends and research themes.	The research findings reveal the association between six identified clusters which consists of planning and control,' 'electronic commerce and business,' 'inter organizational systems,' and 'distribution and operations systems' in its four corners and external pyramid has the 'business intelligence and analytics' at the apex and the internal pyramid consists of 'supply chain integration' at the apex.	Information systems (IS) make a strong impact supply chain management (SCM) on processes such as planning, sourcing, and delivering, and at levels ranging from tactical operations to organizational strategy. Furthermore, these papers also show that there is impact of ICT on the performance of supply chains, but apart from that researcher in future should work on how ICT enabled supply chains can co-create value with their customers and secondly how the IOS and e-commerce tools are moving towards open standard and internet-based technologies.
Samadi et al (2016)	This work reviews the body of knowledge related to the relationship between IT and supply chain performance through a systematic literature review study. The research paper includes 33 papers which is mainly based on three themes, 19 IT-related, 17 mediator factors responsible for supply chain performance are identified for the study.	The findings revealed that IT is proven to have a both direct and indirect impact on the supply chain performance.	The current study analyzing the role of IT in supply chain performance revealed that IT plays a very significant role in enhancing the performance of the organization.
Varma and Khan (2015)	Random data have been collected primarily through e-journals, search engines available on internet or in organizational library that are in the domain of general, IT, SCM. The study also reviewed articles related to detection and prevention of e-risks in IT to enable SCM.	The study revealed that the use of IT is considered a prerequisite for effective control of today's complex supply chain. The exponential growth of information and communication technology in supply chain networks has significantly transformed paper-based communication into e-communication. The development of ICT includes electronic data exchange (EDI), radio frequency identification (RFID), barcode, electronic commerce, decision support system, enterprise resource planning (ERP) packages etc. these have developed a complex and dynamic symbiosis with SCM.	This research paper discussed the role of ICT which acts as enabler in SCM with vast benefits to organizations. The study also clarifies how the application of ICT is exponentially growing day by day in SCM for increasing productivity and profitability in business.
Hazen and Byrd (2012)	A meta-analysis of 48 studies that report outcome of EDI or RFID adoption was performed. Regression was used to investigate the moderating effect of the buyer-supplier relationship between LIT adoption and performance outcomes.	LIT plays and important role in enhancing the level of effectiveness, efficiency and resiliency for the firm. The paper also reveals that by adopting LIT improves the buyer-supplier relationship moderates the degree of the efficiency and resiliency.	The study defines the important role of and relationship between LIT adoption and performance measures in terms of efficiency, effectiveness and resiliency. Adoption and implementation of LIT at the workplace leads to the supply chain performance.

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Table 1. continued

Authors and Year	Objective of the study and Methodology	Key Findings	Key Learning
Asabere et al (2012)	The study is based on extensive literature review which is based on the role played by information and communication technology (ICTs) in SCM.	a) The researchers through their paper presented a review of the role and relationship of information and communication technology (ICTs) and SCM coupled with the importance of information and communication technology (ICTs) in SCM. b) The researchers have revealed that a lot of research has been conducted in this area of information and communication technology (ICTs) integration in SCM and without integration of information and communication technology (ICTs) the outcome of managing supply chain will lead to poor SCM. Procedures and operations are likely to collapse or become highly unreliable, unresponsive and inefficient.	The paper show how ICTs play a crucial role in SCM which ultimately leads to the performance of the company and providing maximum benefits to its stakeholders. It also highlighted the various factors like purchasing, e-procurement, operation, customer relationship, vendor management, transport and logistics, combination of which can used to enhanced and improved the use of ICTs in SCM.
Mandlik et al (2012)	<ul style="list-style-type: none"> • The methodology involves a case study type of research which aims at studying the preparedness of the information and communication technology (ICTs) implementation and innovative development awareness in selected dairy cooperative units in Maharashtra. • The data was collected from both primary and secondary sources which was then analyzed by using statistical tools such as percentage, average, deviation etc. analysis. 	Through the study, it has been found that dairy cooperatives themselves have also taken a very proactive role in implementing the information and communication technology (ICTs). This paper also revealed that top management is ensuring that information and communication technology (ICTs) be used, contributes to more sustainable development of organization, employees and climate change adaption.	Through this study, it was clear how information and communication technology (ICTs) implementation plays a significant role in improving dairy cooperative management. This paper revealed how information and communication technology (ICTs) has enabled services for better use in quality, transport, production, marketing and services. It also facilitates the integration of locally generated revenues, manpower, resources and facilities into the human empowerment grid as per the study.
Mohammadi et al (2012)	<ul style="list-style-type: none"> • Methodology used in this research is the multiple case study approach. The authors have used the descriptive analytical data collection method with the purpose of theory testing. 	The key findings indicate that using information and communication technology (ICTs) is effective on the capabilities, and hence enhances the performance of the dairy supply chain.	The study has shown how the information and communication technology (ICTs) tools, namely supply chain communication system (SCCS), electronic data interchange, electronic mail (E-mail), bar coding, and RFID and from among supply chain capabilities four dimension are included i.e. information exchange, coordination, inter firm activity integration, and supply chain responsiveness and from among the performance of supply chain two variables are identified including marketing performance and financial performance etc. which play an effective role in enhancing and improving the dairy supply chain system.

Data Collection and the Sampling

The population of the study includes 59 registered dairy processing units operating in UP and New Delhi-NCR. Individual registered dairy processing unit's top three executives, i.e., Head of the Unit, Operational Head, and Marketing Head are chosen as the respondent of the study. Judgmental sampling based on the market position of the organization along with plant production capacity (i.e., one lakh liter per day), has been set as the benchmark for selecting the dairy processing units. Ten dairy plants have been chosen out of 59 registered dairy plants operating in UP and New Delhi-NCR and from each dairy plant, three respondents, i.e., head of the dairy company, operations head, and marketing head were targeted for the study, which renders the sample size of thirty respondents. A structured questionnaire, self-administered in nature was used to collect primary data from the above-defined respondents.

Various Indian government websites (central and state) related to the Dairy sector such as the Department of Animal Husbandry and Dairying, National Dairy Research Institute (NDRI), National Dairy Development Board (NDDB), Pradeshik Cooperatives Dairy Federation, Uttar Pradesh, have been consulted in order to collect secondary data. Additionally, numerous libraries such as the Central Library of BHU and Faculty libraries of Institute of Management Studies (IMS-BHU), IIT-Delhi, IIM-Ahmadabad, IITM-Gwalior, and online journal websites such as sciencedirect.com, emerald.com and jstor.org, sage.org, were referred for literature review.

5. ANALYSIS AND RESULT

Multiple regression analysis, in stepwise selection mode, was carried out to identify key predictors for dependent variables, using SPSS software. Predictor variables for the analysis were as per the questions of the questionnaire. Dependent variables were the question statements in the performance metrics of the questionnaire. Based on multiple regression model summaries, inferences about predictors were deduced for each of the dependent variables. Cronbach's alpha for adoption continuum questionnaire was calculated as .872 which exceed the recommended Cronbach's $\alpha > 0.7$, high loadings > 0.5 , (Hair et al., 2006), indicating high reliability of scale. Further, it explores the association between adopted ICT tools and techniques on supply chain performance parameters as shown from *table 2 to table 10*.

5.1. Summary of Multiple Regression Analysis of dependent variable, "Transportation Cost", is given in the *table 2*.

Table 2. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.612	4.098	.000	.375	.353	16.795	.000

For the dependent variable 'transportation cost, one variable Information and Communication Technology (ICT) is found significant predictors as verified by F- value ($F=16.795$, $p=0.000$). At step I, "information and communication technology (ICT)", entered into the regression analysis. The value of adjusted R^2 ($=.353$) indicates that 35.3 percent of the variance in response has been attributable to Information and Communication Technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameters i.e., transportation cost. It is described by the value of Standardized Beta coefficients (β

= 0.612) and the t value is 4.098 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is presenting the significant impact of adopted ICT practices on the dependent variable i.e., transportation cost.

5.2. Summary of Multiple Regression Analysis of dependent variable, “order fulfilment cycle time”, is given in the *table 3*.

Table 3. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.476	2.868	.002	.227	.199	8.223	.002

For the dependent variable ‘order fulfilment cycle time’, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=8.223$, $p=0.002$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R² (=0.199) indicates that 19.9 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., order fulfilment cycle time. It is described by the value of Standardized Beta coefficients ($\beta = 0.476$) and the t value is 2.868 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.002 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive effect of adopted ICT practices on the dependent variable i.e., order fulfilment cycle time.

5.3. Summary of Multiple Regression Analysis of dependent variable, “on time delivery”, is given in the *table 4*.

Table 4. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.452	5.827	.000	.866	.850	55.773	.000

For the dependent variable ‘on time delivery’, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=55.773$, $p=0.000$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R² (=0.850) indicates that 85.0 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., on time delivery’. It is described by the value of Standardized Beta coefficients ($\beta = 0.452$) and the t value is 5.827 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., on time delivery leading to the accepting the proposed hypothesis.

5.4. Summary of Multiple Regression Analysis of dependent variable, “frequency of stock out”, is given in the *table 5*.

Table 5. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.575	5.414	.000	.861	.839	38.810	.000

For the dependent variable ‘frequency of stock out’, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=38.810$, $p=0.000$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R^2 ($=.839$) indicates that 83.9 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., frequency of stock out. It is described by the value of Standardized Beta coefficients ($\beta = 0.575$) and the t value is 5.414 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., frequency of stock out leading to the accepting the proposed hypothesis.

5.5. Summary of Multiple Regression Analysis of dependent variable, “backorder rate”, is given in the *table 6*.

Table 6. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.808	5.431	.000	.767	.740	28.537	.000

For the dependent variable ‘backorder rate’, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=28.537$, $p=0.000$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R^2 ($=.740$) indicates that 74.0 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., backorder rate. It is described by the value of Standardized Beta coefficients ($\beta = 0.808$) and the t value is 5.431 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., backorder rate, leading to the accepting the proposed hypothesis.

5.6. Summary of Multiple Regression Analysis of dependent variable, “cash to cash cycle”, is given in the *table 7*.

For the dependent variable ‘cash to cash cycle’, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=34.212$, $p=0.000$). At step

Table 7. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.383	4.463	.000	.846	.821	34.212	.000

I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R² (= .821) indicates that 82.1 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., cash to cash cycle. It is described by the value of Standardized Beta coefficients ($\beta = 0.383$) and the t value is 4.463 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., cash to cash cycle, leading to the accepting the proposed hypothesis.

5.7. Summary of Multiple Regression Analysis of dependent variable, “return on assets to firm”, is given in the *table 8*.

Table 8. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.462	2.756	.000	.213	.185	7.593	.000

For the dependent variable “return on assets to firm”, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=7.593$, $p=0.000$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R² (= .185) indicates that 18.5 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., return on assets to firm. It is described by the value of Standardized Beta coefficients ($\beta = 0.462$) and the t value is 2.756 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., return on assets to firm, leading to the accepting the proposed hypothesis.

5.9. Summary of Multiple Regression Analysis of dependent variable, “procurement cost”, is given in the *table 9*.

Table 9. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R ²	F	Sig. (p)
I	ICT	.607	4.040	.000	.368	.346	16.324	.000

For the dependent variable “procurement cost”, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=16.324$, $p=0.000$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R^2 ($=.346$) indicates that 34.6 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., procurement cost. It is described by the value of Standardized Beta coefficients ($\beta = 0.607$) and the t value is 4.040 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., procurement cost, leading to the accepting the proposed hypothesis.

9.1.10. Summary of Multiple Regression Analysis of dependent variable, “production cost”, is given in the *table 10*.

Table 10. Multiple regression analysis summary table

Step No.	Predictor Variables Entered	Standardized Beta Coefficients	t	Sig. (p)	R	Adjusted R^2	F	Sig. (p)
I	ICT	.618	4.164	.000	.382	.360	17.342	.000

For the dependent variable “production cost”, one variable information and communication technology (ICT) is found significant predictors as verified by F- value ($F=17.342$, $p=0.000$). At step I, “information and communication technology (ICT)”, entered into the regression analysis. The value of adjusted R^2 ($=.360$) indicates that 36.0 percent of the variance in response has been attributable to information and communication technology (ICT). Further, the mentioned hypothesis examines the relationship significance between adopted ICT tools and techniques and supply chain performance parameter i.e., production cost. It is described by the value of Standardized Beta coefficients ($\beta = 0.618$) and the t value is 4.164 which was found to be more than 1.960 ($t > 1.960$). Moreover, it is supported by the significant value found as 0.000 which was less than 0.05 ($p < 0.05$). Therefore, it can be concluded that the value is showing the positive outcome of adopted ICT practices on the dependent variable i.e., production cost, leading to the accepting the proposed hypothesis.

Through the above analysis which is executed by applying multiple regression technique, it can be concluded that supply chain performance parameters i.e., transportation cost ($\beta = 0.612$, $p < 0.05$), order fulfilment cycle time ($\beta = 0.476$, $p < 0.05$), on time delivery ($\beta = 0.452$, $p < 0.05$), frequency of stock out ($\beta = 0.575$, $p < 0.05$), backorder rate ($\beta = 0.808$, $p < 0.05$), cash to cash cycle ($\beta = 0.383$, $p < 0.05$), return on assets to firm ($\beta = 0.462$, $p < 0.05$), procurement cost ($\beta = 0.607$, $p < 0.05$), production cost ($\beta = 0.618$, $p < 0.05$), are being significantly impacted by predictor variable i.e., adopted ICT tools and techniques.

Hence, alternate hypothesis (H1) proposed is accepted. Consequently, information and communication technology (ICT) has a positive influence on enhancing supply chain performance of Indian dairy industry.

6. CONCLUSIONS AND PRACTICAL IMPLICATION

Findings acclaim that information and communication technology (ICT) tools and techniques play a crucial role in enhancing the performance of the dairies companies in the form of an increase in performance matrix indicators i.e., procurement cost, production cost, transportation cost, order fulfilment cycle time, on-time delivery, frequency of stock out, backorder rate, cash to cash cycle,

return on assets to the firm. ICT has come out to be an indispensable tool that helps in assisting and sustaining the business. The firm should adopt and implement ICT tools and techniques as their strategic weapon directly impacting the performance of the firm (Li et al, 2021, Hermawan et al, 2020). Dairy firms should shift their business from the traditional approach to ICT enabled supply chain system, enabling them to support prevailing business functions along with focusing on new business tactics (Bobb et al, 2011; Knight et al, 2011). Last many years, research has been carried out by many researchers revealing the influence of ICT on firm performance matrix (Kariuki, 2015, Wu et al., 2015, Shonubi et al, 2016). Additionally, ICT enhances the quality, reduction in various costs involved in the supply chain, increases profit margin, ROI, sales growth, and information sharing (Mohout et al, 2015; López et al, 2019). Information and communication technology (ICT) tools and techniques help in reducing procurement costs. The vital role played by technology in every field helps in empowering performance through improved effectiveness and efficiency. But procurement is at an inflection point which raises the alarm to turn digital transformation in order to ensure in reducing costs and adding value. The main problem that the Indian dairy industry is dealing with is inefficient systems leading to deterioration in the quality of dairy products, its pricing, weighing issues at the milk collection center, loss and pilferage during transit, adulteration, and involvement of too many intermediaries. So, in order to overcome these hurdles restructuring of dairy business process with the usage of smart low-cost technologies is the need of the hour. The use of technology will be enabling dairy businesses to make cleverer day-to-day decisions to stabilize milk procurement, production, and supply chain solutions. Furthermore, for procurement of the milk at the village level, the use of a mobile app installed with an internet connection will help in reducing the cost of Automated Milk Collection Units (AMCUs) along with raising the transparency and transaction between farmer and milk processing plants and also its stakeholders. Transparency in the dairy supply chain can be guaranteed by Smart Milk Procurement System (SMPS) along with declining the product processing time to ten percent less as compared with manual processing of bills of farmers. This technology-based software benefits in getting the entire supplier information on a real-time basis related to members, fat content, the volume of the milk procured, and the amount payable to the member. This process will bring a stable milk supply and dissuade intermediaries in disposing of milk locally during peak requirement seasons. Secondly, the production cost is dependent on Information and Communication Technology (ICT) practices. Dairy companies must use the updated ICT tools and techniques like enterprise resource planning (ERP), a useful software assisting in aligning business objectives with the latest technology solutions for optimum utilization of an organization's resources and assets. There are various important ERP modules that can be used as per requirement, such as modules for demand & supply chain forecasting, production planning system, material & process management, warehousing management system, transportation management system, order processing & tracking system, sales order information system, customer relationship management, human resource management system, financial and accounting system. Thirdly, transportation costs can be reduced as shown in the finding section through the adoption of ICT practices. Transportation cost includes those costs which are incurred during the transportation of goods from the supplier's end to the customer's end. Dairy companies need to reduce the level of safety inventory which will help them in minimizing the cost. Dairy companies need to develop an IT system that allows inventory management applications to link with production planning, smoothens the flow of information, and ultimately minimizes the transportation cost. Dairy companies must use the Transportation Management System (TMS) software program which automates many key transportation functions, using analytical capabilities. It is a complete system that includes everything from network design tools down to operational applications for tracking shipment, scheduling drivers, and determining the cost of shipment between two points. It also helps the transport manager in carrier management, vehicle routing, shipment tracking, delivery scheduling, tracking and tracing of shipment, and performance evaluation. Fourthly, on-time delivery, order fulfilment cycle time (time from customer authorization of a sales order to the customer receipt of the product), and frequency of stock out are also dependent

on ICT practices. ICT tools and techniques include Radio Frequency Technology (RFID), which is a data collection technique that passes product information via radio waves to a receiving unit and use of global positioning system (GPS) driven supply chain network which will help in stopping thefts of goods and fuel and increase savings. Order fulfilment cycle time is a key process in meeting customer requirements and improves the effectiveness of the supply chain. Radiofrequency identification techniques at the workplace will help the process automation in picking, shelving, cross-docking, implementing consolidation operations, and reducing costly logistics errors like transporting a product to the wrong place and not dispatching the right product to the right place. This process further leads to cost reduction in operations. Fifth, the backorder rate and cash to cash cycle time are influenced by the use of information and communication technology (ICT) practices. Dairy companies should use electronic modes of transaction and e-procurement for minimizing cash to cash cycle time. An online payment facility reduces the cash-to-cash cycle time. They need to develop a communication system to smoothen the continuous information exchange with their supply chain partners, which is also required for demand & supply forecasting, production planning, inventory management, and sharing knowledge of core business processes with supply chain partners. Consequently, ICT tools and techniques lessen costs related to dairy supply chain management, whilst enhancing transaction value. It enables the dairy firm to reduce inadequacies instigated by a lack of coordination among the dairy supply chain members and pacing the speediness and dependability of data processing. Though the above discussion shows the majestic practical implication for various practitioners such as dairy companies, academicians, retail organizations. Furthermore, the study findings pledge practitioners that ICT is an effective way of competing and impacting firm performance (BayoMoriones et al., 2013, Taruté et al, 2014; Wachira et al., 2014, Kariuki, 2015, Sabherwal et al, 2015; Mithas et al, 2016).

8. LIMITATION AND SCOPE FOR THE FUTURE RESEARCH

Since it was a descriptive study, its accuracy depends on correct information given by the respondents, i.e., the managers and executives of dairy companies. Respondents might have been reluctant to express their honest opinions on the attributes pertaining to the functioning of their respective departments. Resource constraint in terms of money, manpower and other resources to cover all the possible respondents. Even though the study included the responses of dairy supply chain members i.e., dairy plant (DP), operating in UP and Delhi NCR, its finding can't be generalized for pan India. The research study is limited to one specific geographical area i.e., Uttar Pradesh and Delhi-NCR and that, too, only registered dairy plants. In future research it could be interesting for any researcher to conduct research on a pan-India basis that too with the inclusion of time and small dairies also. Future research can expand the domain of SCM practices by considering additional dimensions such as geographical proximity, cross-functional coordination, logistics integration, green practices and agreed supply chain leadership, which have not been covered extensively in the present research. This kind of research not only provides a geographical comparison, but also provides intra-industry comparison between registered and non-registered milk processing units.

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