أكاديمية السادات للعلوم الإدارية

مجلة السادات للبحوث الإدارية و المالية

Sadat Journal of Administrative and Financial Research

المجلد الثالث - العدد الأول - يناير 2025

Volume 3 | Issue 1 | Jan. 2025

sjsaf.journals.ekb.eg

الترقيم الدولي ISSN
2974-3370

الترقيم الدولي الإلكتروني Online ISSN
2974-3389

رقم الإيداع بدار الكتب المصرية
24426

Exploring the Impact of Using Block chains in Supply Chain Management on Organizations' Operational Performance

دراسة تأثير استخدام سلسلة الكتل في اداره سلاسل التوريد والامدادات على الأداء التشغيلي للمنظمات

Presented by :
Dina Ramadan Moawad
Tel: 01119333026
Email: dinaramadan171290@gmail.com
Affiliation: Teaching Assistant at Production & Operations Management, Sadat Academy for Management Sciences

Exploring the Impact of Using Block chains in Supply Chain Management on Organizations' Operational Performance

Abstract:

Digitalization has emerged as an essential technology across all industries, driving significant changes. Corporations and consultancies have come to recognize its potential in Supply Chain Management.
Despite its importance, there is a delay to adopt the Digital Supply Chain in many organizations in Egypt.

The reason behind this lack of implementation studies is due to insufficient information about the way by which the DSC implementation can be done and what are the numerous advantages which can be provided by the digital technology.

Therefore, this research aims to investigate the relationship between using the block chain technology in supply chain and organizations' operational performance to encourage the top management to invest in DSC.

This relation is validated empirically by conducting a survey among three companies for complete acceptability. The survey has been applied to three Egyptian companies in the food & beverages sector.
A statistical analysis is performed based on the survey responses to find the impacts on different organization's operational performance factors.

Key Words: Digital Supply Chain (DSC)-Block Chain-Digital Technology-Organizations' operational Performance.

لقد ظهرت الرقمنة كتكنولوجيا أساسية عبر جميع الصناعات، مما أدى إلى تغييرات كبيرة, كما بدأت أيضا الشركات والاستشارات في إدراك إمكانياتها في إدارة سلسلة الإمداد.

على الرغم من أهميتها، هناك تأخير في اعتماد سلسلة الإمداد الرقمية في العديد من المنظمات في مصر, والسبب وراء هذا النقص في دراسات التنفيذ يعود إلى عدم كفاية المعلومات حول الطريقة التي يمكن من خلالها تنفيذ سلسلة الإمداد الرقمية وما هي المزايا العديدة التي يمكن أن توفرها التكنولوجيا الرقمية.

لذلك، يهدف هذا البحث إلى دراسة العلاقة بين استخدام تقنية سلسله الكتل في سلسلة الإمداد وأداء المنظمات التشغيلي، لتشجيع الإدارة العليا على الاستثمار في سلسلة الإمداد الرقمية.

تمت المصادقة على هذه العلاقة تجريبيًا من خلال إجراء استبيان بين ثلاث شركات للتحقق من القبول الكامل. تم تطبيق الاستبيان على ثلاث شركات مصرية في قطاع الأغذية والمشروبات و تم إجراء تحليل إحصائي استنادًا إلى استجابات الاستبيان للعثور على التأثيرات على عوامل الأداء التشغيلي المختلفة للمنظمات.

الكلمات داله: سلسله الكتل - سلسلة الإمداد الرقمية – الأداء التشغيلي للمنظمات - التكنولوجيا الرقمية

1- Research Outline:

In the upcoming section we will mention the research objectives, research problem, research hypothesis, research limitations, then the research methodology.

1-1 Research Objectives:

This research fills the gap in past research because it focuses on the relationship between using the block chain as a digital technology in the supply chain and operational performance in terms of quality, productivity, and cost reduction.
This research seeks to identify a framework showing this relation to speed up the implementation of DSC in Egyptian companies.

This main objective branches out into three sub-objectives:
1. Identification of Block Chain as a digital transformation technology
2. Identification of the main operational performance factors of any company.
3. Development of structural framework showing the impact of using block chain in the supply chain management on Egyptian Companies.

1-2 Research Problem:

There is a delay to adopt the Digital technologies in Supply Chain in many organizations in Egypt, The reason behind this lack of implementation studies

is due to insufficient information about the way by which the DSC implementation can be done.

What makes the situation more difficult is the shortage of studies on Digital supply chains and its impact on the operational performance of the organization. Though there are a lot of studies about supply chain and its influences on organization's operational performance, studies on digital supply chain implementation and its relationship with operational performance are few.

Therefore, this research aims to investigate the relationship between digitalization of supply chain through using the block chain technology and organization operational performance to encourage the top management to invest in DSC.

1-3 Research Hypothesis:

The present research will test the following hypothesis:

There is a relationship between DSC technology of Blockchain, and the organizations' operational performance.

1-4 Research Limitations:

- The research findings and results cannot be generalized as the questionnaire will focus only on a specific sector, so it won't encompass the other different sectors.
- The questionnaire will address only one Digital supply chain technology which was mentioned in the research hypotheses.
- The questionnaire will be applied to three companies in the food and beverage industry which have local factories in Egypt; those companies are : Edita-juhayna-Domty) (
- The time of the analysis period will be limited to the interval of thesis.
- The research findings and results cannot be generalized for other countries since it is limited to Egypt.

1-5 Research Methodology:

The research methodology will combine both of the qualitative & quantitative approaches by taking the following steps:
- A literature review on Digital Supply Chain (DSC) and organization operational performance.
- Identification of the most important DSC new technologies based on an extensive literature review.
- Identification of the main important measures of an organization operational performance.
- Proposing a structural model relating the DSC new technologies and organization operational performance.
- Design of a survey (questionnaire) for data gathering concerning both DSC new technologies and organization operational performance
- Application of survey on food and beverage sector (industry).
- Use of different statistical analysis models to check the data validity and reliability, and to find the impact of the block chain technology on organization operational performance in the proposed structural model.
- Deduction of the verified structural model that shows the relationship between the DSC new technologies (as independent variables) and the organization operational performance measures (as dependent variables)
Discussions, conclusions, findings, and recommendations. -

2- Introduction:

Technology has advanced exponentially in recent years, with the phenomenon of digitalization being a necessity for all industries. The digitalization of supply chains is expected to grow and play a crucial role within the supply chain management (SCM) context.
Numerous companies seek to be more ‘digital’ as a result of their own observations of the relevance and usefulness of digital technology for business development .They are compelled to adapt, or they will be left behind (Lozić, J. 2023).

According to (Bumblauskas, D., A. Mann, B. Dugan, and J. Rittmer. 2020), the digitalization of the supply chain is still a complex topic and requires a clear understanding of its impact and benefits on operational performance . Furthermore, as supply chain digitalization is still in its infancy in terms of development, there is still considerable room for further research in the future.

The need for research that can provide empirical evidence to support the impact of the digital supply chain on operational performance is therefore urgent.

The digital supply chain can be defined as a new approach with innovative technology that is capable of changing the traditional supply chain operation so that improved and more efficient integration among supply chain members is achieved, considering the key technological innovations that have the greatest effect on the digital supply chain to be such as: Blockchain,Internet of Things,Robotics,Cloud Computing…in this paper we will focus on just one technology which is the Blockchain.
When measuring supply chain performance, a company needs to focus on financial metrics, for example cost, profitability, revenue and return on investment, and also non-financial metrics, including process quality and flexibility .
In addition, based on previous studies carried out by different authors such as (Allena, M. 2020 and Hobbs, J. E. 2020) , quality, productivity, and cost have been chosen as the performance factors.

3- Blockchain Technology:

Blockchain technology is seen as a potentially transformative force akin to the World Wide Web. It acts as a distributed database of shared public ledgers where digital transactions are executed and shared among participants.
Key characteristics of blockchain include decentralization, a consensus mechanism, resistance to tampering, transparency, and integrity (Lozić, J. 2023).

Unlike traditional digital technologies, blockchain operates on a peer-to-peer (P2P) structure, where all network participants maintain a complete copy of the transaction history .The consensus mechanism, which relies on decentralized protocols, is crucial for validating transactions . Blockchains can be categorized as either public, where all transactions are visible to network participants, or private, limited to selected members (Wong, L. W., Leong, L. Y., Hew, J. J., Tan, G. W. H., & Ooi, K. B. (2020).

With records stored on distributed ledgers, removing or altering these records is impractical. The decentralized nature of blockchain allows all parties to verify data integrity, eliminating the need for trust in intermediaries and enhancing anti-tampering, transparency, and integrity (Lozić, J. 2023).

3-1 Structure and Design:

(Kshetri, N., and J. DeFranco. 2020) have mentioned that a blockchain consists of a main chain made up of the longest series of blocks, starting from the genesis block to the latest one. Orphan blocks exist outside this main chain.

A blockchain is a decentralized, distributed digital ledger containing blocks that record transactions across numerous computers, ensuring that no single block can be retroactively altered without changing all subsequent blocks. This design allows participants to independently verify and audit transactions affordably. The blockchain is managed autonomously through a peer-to-peer network and a distributed timestamping server, relying on mass collaboration driven by shared interests. This architecture significantly reduces uncertainty regarding data security. Blockchain technology solves the issue of double-spending by ensuring that each unit of value is transferred only once and can also maintain title rights when set up correctly to reflect exchange agreements.

3-2 Using Block chains in Supply Chain Management:

With advancements in middleware and the adoption of Service-Oriented Architecture (SOA), integrating various frameworks into a cohesive enterprise system has become more feasible. As a result, it is anticipated that blockchain technology will continue to work alongside ERP and SCM systems to help organizations enhance processes and better track activities, transactions, and inventory.

Originally developed for Bitcoin as a public transaction ledger, blockchain provides immutable and fully traceable records applicable to supply chain management. It ensures authenticity in digitized data and serves as a global system to streamline all supply chain steps and data flow for improved management. Blockchain is an append-only list, meaning past transactions cannot be altered, only added to. As new data is generated, it is stored in new blocks that link to previous blocks, creating an irreversible and permanent record (Linde, L., Frishammar. J. & Parida, V. (2021).

Currently, blockchain is gaining traction for its applications in supply chain management, with researchers keen to explore the associated challenges and opportunities. There is no universal technology in this field yet, but a common system could foster healthy competition while ensuring transaction security and confidentiality for various companies. Effective supply chain management can significantly enhance industry efficiency by reducing order-to-delivery cycles, ensuring optimal resource use, and enabling early problem detection.

Blockchain offers a compelling solution for tracking information as it comprises a permanent record that acts as a decentralized ledger shared among a network of computers ("nodes"). Once operational, a standard layer integrates transactions and becomes integral to any enterprise blockchain project. The ability of blockchain to maintain permanent blocks of data creates a secure, transparent, and reliable source for recording relevant business information, such as invoices, organizational structures, accounting entries, and supply chain traceability (Lozić, J. & Fotova Čiković, K. 2023).

Although initially conceived as an open-source public platform, blockchain can also be implemented privately, integrated with an organization's digital systems. This creates a tamper-proof and immutable environment for recording company information. However, challenges remain in integrating block chain with existing ERP systems, especially given the variety of ERP solutions available today, which may complicate the integration process across an organization's digital landscape.

Table 1: Summary of the challenges and opportunities of using block chain in supply chain management.

Challenges	Opportunities
Globalization	Block chain may add auditability and transparency to an association's or organization's records
Adjustment to Change	Security of information records
Data Innovation	Speed and enhancement to the association's or organization's processes
Human Factors Related Issues	Block chain supports visibility and traceability to the system
Implementation	Block chain could before long turn into a widespread "supply operating system"
Testing	Supply chain organizations must/can accomplish critical advantages from block chain in center territories of supply chain operations

Source: Tanwar, S., Parekh, K., & Evans, R. (2020). Block chain-based electronic healthcare record system for healthcare 4.0 applications. Journal of Information Security and Applications, 50, 102407.

According to (Surender, K. & Goel, A. 2022), Various initiatives have been undertaken to implement blockchain technology in supply chain management:

- Mining of Precious Commodities: Block chain has been utilized to trace the origins of gemstones and other valuable commodities. In 2016, The Wall Street Journal reported that Everledger, a block chain technology company, collaborated with IBM's block chain tracking service to trace diamond origins and ensure ethical sourcing. By 2019, the Diamond Trading Company (DTC) was actively developing a diamond trading supply chain product named Tracr.
- Food Supply Chain: As of 2018, Walmart and IBM were testing a block chain-based system to monitor the supply of lettuce and spinach, with all block chain nodes managed by Walmart on the IBM cloud.

- Fashion Industry: The fashion industry suffers from a lack of transparency among brands, distributors, and consumers, hindering sustainable development. Block chain can address this issue by providing transparency, thus facilitating sustainable growth in the industry.

3-3 Adoption of Block chain in Food Supply Chains:

Block chain technology can significantly impact key supply chain management goals such as cost, quality, speed, reliability, risk mitigation, sustainability, and flexibility. Its capability to ensure the accuracy, traceability, and authenticity of information, alongside smart contracts in a trustless framework, is particularly relevant in the food supply chain due to rising demands for trustworthy suppliers and food safety (Linde, L., Frishammar. J. & Parida, V. 2021).

Specifically, block chain can transform traditional supply chains into block chain-based systems. Each product is assigned an information tag linking it to its virtual identity on the block chain. Certified participants, including manufacturers, retailers, and consumers, can access product profiles directly.
Before transferring a product, both parties may fulfill smart contract requirements to verify the exchange. Smart contracts can facilitate real-time monitoring of temperature, logistics, and automatic transactions when product ownership changes, based on pre-established conditions (Tanwar, S., Parekh, K., & Evans, R. 2020).

In addition to theoretical studies on block chain in food supply chains, practical applications have also been explored. A traceability system for the agri-food supply chaindeveloped utilizing RFID and block chain technology, addressing safety issues in China's agri-food logistics and enabling effective tracking and tracing to ensure the reliability of food safety information (Linde, L., Frishammar. J. & Parida, V. 2021).

3-4 Benefits and Challenges of Block chain in Food Supply Chains:

This section outlines the advantages of block chain in enhancing food safety and quality and its potential to address significant challenges in food supply chains. It also discusses operational efficiencies and sustainability benefits, followed by an examination of the challenges associated with block chain adoption and implementation.

3-4-1 Benefits of Block chain in Food Supply Chains:

- Food Safety and Quality: Current food supply chains lack visibility regarding product status as they move through the system. The increasing complexity of these chains necessitates greater trust, security, and transparency. A recent survey found that consumers seek transparency in food products, including complete ingredient breakdowns and sourcing information, with 94% indicating they would be more loyal to brands offering such transparency. Block chain delivers unprecedented visibility and traceability in sourcing and certifying fresh produce, benefiting businesses and enhancing consumer safety. It helps trace food origins and improves safety and quality through enhanced transparency, addressing major issues like traceability, food fraud, recalls, and waste.
- Operational Benefits: Various innovative technologies, such as RFID, telematics, and IoT, are currently used to track food products and gather supply chain data. However, access to this data is often limited due to competitive and trust issues, leading to inefficiencies. Block chain can overcome these barriers by digitally connecting the entire supply chain, creating a secure, shared, and permissioned transaction record that enhances visibility, security, and efficiency throughout the food supply chain.
- Sustainability Benefits: Block chain is an effective tool for promoting sustainability within food supply chains.
  It aids environmental, economic, and social sustainability by reducing food waste and resource consumption, tracking carbon footprints, and supporting fair trade practices.
- Environmental Sustainability: Block chain can help lower greenhouse gas emissions by closely monitoring environmental data. Food supply chains contribute significantly to global carbon emissions, with approximately 13.7 billion metric tons emitted annually.

- Economic Sustainability: It can enhance economic sustainability by minimizing costs associated with food waste and recalls, leveraging the traceability and transparency inherent in block chain.
- Social Sustainability: To achieve social sustainability, food supply chains must address consumer concerns regarding product origins and quality. Block chain's transparency can alleviate worries about food sourcing, quality, and environmental impact, while also supporting fair-trade practices by providing insights into how much of the purchase price benefits farmers and addressing consumer interests in social welfare and environmentally friendly practices in developing countries (Bumblauskas, D., A. Mann, B. Dugan, and J. Rittmer. 2020).

3-4-2 Challenges of Block chain Adoption in Food Supply Chains:

According to (Akyuz, G. A., & Gursoy, G. ,2020 and Cant, J. 2019). Many businesses in food supply chains are showing interest in adopting blockchain technology, leading to various pilot projects worldwide.

Despite this interest, blockchain adoption faces uncertainty due to its nascent stage and several challenges.

Technology Challenges:

- Acceptance and Complexity: The acceptance of blockchain technology and its technical complexity present significant hurdles.
- Data Volume: The vast amounts of data processed by blockchain can create technical difficulties.
- Supportive Technologies: Companies may lack the supportive technologies necessary for blockchain implementation. For example, Nestlé encountered challenges in creating interfaces to manage food ingredient data sourced from thousands of farms and processing plants.
- Interoperability: The ability to share and transact across different blockchain platforms can be technically demanding, though it is seen as a promising area for future innovation.
- Complex Supply Chains: The intricate nature of food supply chains can hinder traceability. For instance, in the dairy sector, milk sold in stores often comes from multiple farms, complicating tracking efforts.

Cost Challenges:

The costs associated with acquiring, customizing, and learning to use blockchain may impede its adoption, particularly for small and medium-sized enterprises. Implementing blockchain requires substantial investments in infrastructure and skills. Companies with strong IT capabilities are better positioned to implement blockchain, as larger organizations can leverage their financial and technological resources to automate data collection at various supply chain stages. Additionally, high transaction costs can burden smaller suppliers within a blockchain network created by a larger entity. The complexity of food supply chains also adds to the costs of blockchain implementation, given the variety of ingredients and suppliers involved.

Governance Challenges:

The absence of regulations concerning data management, ownership, and retention complicates block chain governance in the food sector. Each supply chain participant typically has established policies regarding data handling, which may conflict with block chain's transparency requirements, making data sharing challenging. Companies may be reluctant to disclose sensitive information, such as production methods or costs.

Regulatory Challenges:

Navigating regulations in the global food industry has always been complex. Furthermore, most nations have yet to adequately develop regulations pertaining to block chain technology.

Awareness and Education Challenges:

Block chain remains in its early stages, and many stakeholders lack awareness and understanding of the technology and its economic implications.
Only four out of 49 projects in the agri-food sector have fully implemented block chain, while the rest are either pilot studies or intended for visibility.

4- Digitalization and Organizational Performance:

Literature indicates that digital technologies influence firm performance through various factors, enhancing both product offerings and operational processes . These technologies encompass ICTs and advanced manufacturing systems.

A framework is proposed linking value creation to ICTs, highlighting variables such as product improvements, process standardization, and responsiveness. They demonstrated that ICTs significantly impact value creation. Other studies also

identified a positive correlation between ICT use and performance. The relationship between ICT adoption and productivity growth appears positive across various industrial sectors . However, while evidence suggests a strong link between ICT and performance, establishing clear causality remains challenging.

Advanced manufacturing technologies involve the use of mechanical, electronic, and computer systems for production control (e.g., CAD, robotics, flexible systems, and numerical control). These technologies allow for both standardization and customization, and their effective implementation is recognized as a means to achieve sustainable competitive advantage (Astill, J., R. A. Dara, M.Campbell, J. M. Farber, E.D.G. Fraser, S. Sharif, and R. Y. Yada. 2019).

5- Factors Influencing Organizational Operational Performance:

As previously noted, organizations assessing operational performance should focus on both financial metrics—such as costs, profitability, revenue, and return on investment—and non-financial metrics like process quality and flexibility (Allena, M. 2020 and Hobbs, J. E. 2020).
Past researches highlight quality, productivity, and cost as key performance factors, which are also the three dependent variables in our thesis model. These factors will be discussed in detail in the following sections.

5-1 Quality:

Quality is a subjective term, often described as being in the "eye of the beholder." Its interpretation varies depending on individual perspectives and contexts. For instance, in manufacturing, quality may differ from its definition in service organizations (Marr, B. 2023).

Understanding Quality:

Quality can be defined as providing a product that meets design and functionality standards. A product is considered to have the minimum expected quality if it operates as intended.

In manufacturing, quality is often characterized by doing things right the first time, where processes are designed to meet specific standards and requirements. Likewise, in service delivery, quality may be assessed in terms of the speed of service, reflecting customer satisfaction regarding timely fulfillment.

From the customer’s viewpoint, quality measures how well a product or service meets expectations. High customer satisfaction indicates that a product or service meets the defined quality standards.

Operationally, reducing costs and minimizing waste are considered quality performance indicators, as they relate to efficiency. Effective operations that minimize waste contribute to higher quality performance.

Quality can also be evaluated based on adherence to policies, procedures, and standards. Complying with required specifications is essential for achieving expected quality levels.
In summary, quality encompasses product and service excellence, operational efficiency, and adherence to standards, reflecting the pursuit of perfection in performance (Sarkis, J., Cohen, M. J., Dewick, P., & Schröder, P. 2020).

5-2 Productivity:

Productivity in a production process refers to the efficiency with which goods and services are produced. It is typically measured by comparing total output to a single input or total input to total output over time. Essentially, productivity gauges how efficiently a person or organization completes tasks, often assessed based on the resources (labor, capital, energy) utilized to produce goods and services. In economic terms, productivity reflects the output per unit of input and serves as a key driver of economic growth and competitiveness. At the organizational level, productivity can be quantified by comparing the number of units produced or net sales to the labor hours invested (Setyowati, M. S., Utami, N. D., Saragih, A. H., & Hendrawan, A. 2020).

5-3 Cost:

Cost management is essential for organizational performance, as profitability is determined by both costs and revenues. Organizations transition from loss to success by achieving profitability, which in turn provides the necessary funds for growth and sustainability during challenging times.

Organizations can enhance profitability through various management strategies, including effective planning, sourcing quality materials, optimizing technological processes for productivity, managing consumption and waste, maintaining equipment, producing quality products, training motivated staff, marketing effectively, managing finances, and making sound decisions (Surender, K. & Goel, A., 2022).

6- Data Analysis:

The upcoming part will includes data analysis by using some statistical methods and tests to verify the validity of the study's hypothesis stemming from the general objectives of the thesis, with the aim of measuring the relation between Digital Transformation of Supply Chain and Organizations' Operational Performance .It will end with the study results.

6-1 Preliminary analysis of the data:

When collecting primary data from the questionnaire list, data processing or preliminary data analysis is a key step required before conducting subsequent statistical analyses. Preliminary analysis of the data is critical to ensure that subsequent statistical analyses will be carried out correctly.

The preliminary analysis of the data was established based on the following stages:

1 Reliability and Validity tests

2 Identify the statistical methods used in data analysis

Reliability and Validity tests

Both Reliability and Validity tests are usually conducted with the aim of knowing the validity, soundness and cogency of the survey list for conducting subsequent statistical analyses, and the following is an explanation of each of the reliability and validity coefficients.

• Reliability test:

Reliability refers to the extent to which the statements (statements) of the survey list are stable and do not contradict themselves, that is, the survey list will give approximately the same results with a probability equal to the value of the reliability coefficient if it is re-applied to another sample of the same population and the same size.

To test the reliability of the statements in the survey lists, Cronbach's Alpha was used, a parameter that takes values ranging from zero to one. If there is no stability, then the value of this parameter will be equal to zero, while if there is complete stability in the data, then the value of this parameter will be equal to one.

That is, an increase in the value of Cronbach's alpha coefficient and its closeness to one means an increase in the level of data credibility to reflect the results of the sample on the population under study. Note that the lowest value of the reliability coefficient is 0.7, and more than 0.7 gives a strong indicator to judge the reliability of

the survey list, however, values greater than 0.6 are considered acceptable values as well.

The Cronbach's alpha coefficient is calculated using equation (1):

$$Alpha = \frac{n}{n - 1}(1 - \frac{\sum_{i=1}^{n} Vi}{Vt})$$

Whereas:

Alpha stands for Cronbach's alpha coefficient.

n stands for the number of statements in the survey list.

V_i stands for one-statement variance.

V_t stands for the variance of all statements in the poll list.

Validity test:

The validity of the survey list means that the statements in the survey lists represent the well-studied population, that is, the answers obtained from the survey lists give the information for which the statements are made (the survey list measures what they are supposed to measure).

The validity coefficient is measured by taking the square root of the reliability coefficient as shown in equation (2).

$$Validity = \sqrt{\text{Alpha}}$$

Table (2) shows the results of applying both the reliability and validity tests at the level of the study variables.

It is clear from Table (2) that the value of each of the reliability and validity coefficients exceeds 0.6, at the level of all variables, which indicates that there is stability in the statements for each variable, and the survey list measures what it was designed to measure and therefore it represents the study population in a good way. so the data of that list can be relied upon in the work of subsequent analyses and statistical tests.

Table (2): The results of applying the reliability and validity coefficients

Source: Developed by the researcher, 2024.

Variables	Dimensions	No. of statements	Reliability coefficients	Validity coefficients	
				$\sqrt{\text{Alpha}}$	r
DSC Technologies (X)	Blockchain Technology	11	0.990	0.995	0.984**
	IoT Technology	9	0.763	0.873	0.702**
	Robotics Technology	10	0.989	0.994	0.984**
	The variable as a whole	30	0.978	0.989	0.994**
Operational Performance Factors (Y)	Quality Performance	4	0.986	0.993	0.989**
	Productivity Performance	4	0.924	0.961	0.987**
	Cost Reduction	4	0.964	0.982	0.981**
	The variable as a whole	12	0.984	0.992	0.994**
The questionnaire variables as a whole		42	0.988	0.974	--

6-2 Confirmatory factor analysis (CFA) of study dimensions:

This type of analysis is used to test the existence or absence of a relationship between the items of each dimension, as well as evaluate the ability of the model to express the data set and the results were as follows:

6-2-1 Confirmatory factor analysis of independent variable DSC Technology (Block Chain):

The researcher performed the confirmatory factor analysis of the independent variables DSC Technology (Block Chain) to test the existence or absence of a relationship between this dimension and the items of this dimension, as well as evaluate the ability of the model to express the data set.

Block Chain Variable: (Independent Variable)

The following figure shows the confirmatory factor analysis of Block Chain variable:

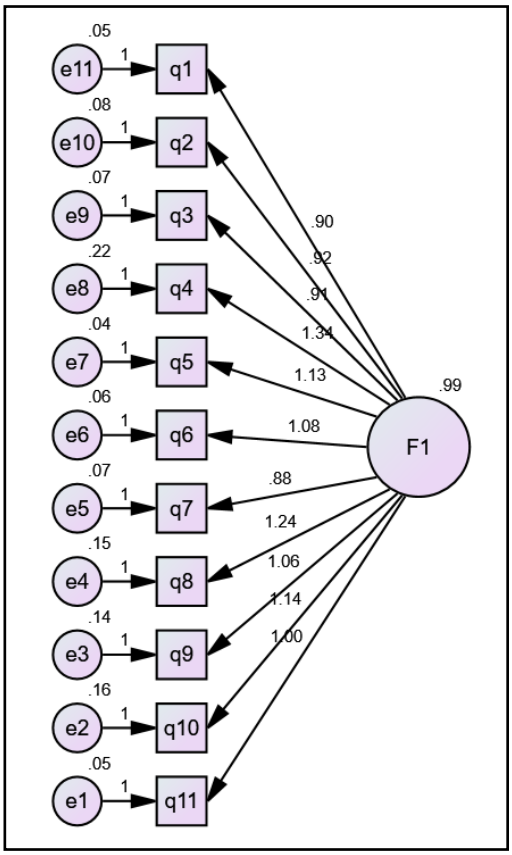

Figure (1): The Confirmatory Factor Analysis of Block Chain Variable

Source. Developed by the Researcher

We conclude from the previous figure the Model Fit Summary:

Table (3): The Quality Indicators of The Model Fit Summary

Measure	Estimate
CMIN	1062.420
DF	44
CMIN/DF	24.146
GFI	0.578
CFI	0.853
TLI	0.817
RMR	0.028

From the previous table:

The Goodness of Fit Index (GFI) is equal to (0.578) and these values close to 1 and a value of 1 indicates a perfect fit.

The Comparative Fit Index (CFI) is equal to (0.853), which falls in the range from 0 to 1 and CFI values close to 1 indicate a very good fit.

The root mean square residual (RMR) is equal to (0.028), RMR values close to 0 indicate a good fit, which the value of (RMR) equal to zero indicates a perfect fit.

The Tucker-Lewis coefficient (TLI) is equal to (0.350), and the typical range of this coefficient is between zero and one. TLI values close to 1 indicate a very good fit.

The results show that:

There is a correlation between the Block Chain Variable and its items and all the quality indicators of the model achieved an acceptable level some came close to the required level.

6-2-2 Confirmatory factor analysis of dependent variable Operational Performance Factors (Quality Performance, Productivity Performance, Cost Reduction):

The researcher performed the confirmatory factor analysis of the dependent variables DSC Technologies (Quality Performance, Productivity Performance, Cost Reduction) to test the existence or absence of a relationship between the three dimensions and their items of this dimensions, as well as evaluate the ability of the model to express the data set.

Quality Performance Variable:

The following figure shows the confirmatory factor analysis of Quality Performance variable:

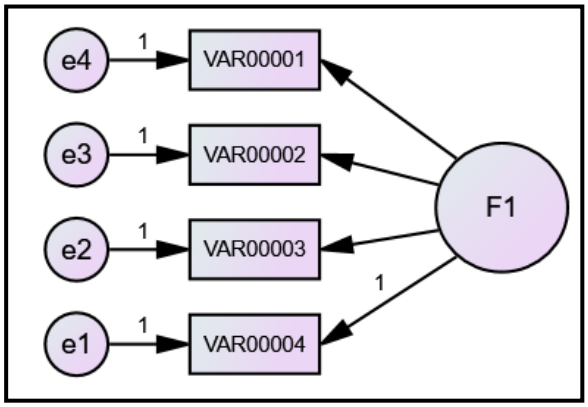

Figure (2): The Confirmatory Factor Analysis of Quality Performance Variable

Source. Developed by the Researcher

We conclude from the previous figure the Model Fit Summary:

Table (4): The Quality Indicators of The Model Fit Summary

Measure	Estimate
CMIN	10.515
DF	2
CMIN/DF	5.146
GFI	0.979
CFI	0.996
TLI	0.987
RMR	0.006

From the previous table:

The Goodness of Fit Index (GFI) is equal to (0.979) and these values close to 1 and a value of 1 indicates a perfect fit.

The Comparative Fit Index (CFI) is equal to (0.996), which falls in the range from 0 to 1 and CFI values close to 1 indicate a very good fit.

The root mean square residual (RMR) is equal to (0.006), RMR values close to 0 indicate a good fit, which the value of (RMR) equal to zero indicates a perfect fit.

The Tucker-Lewis coefficient (TLI) is equal to (0.987), and the typical range of this coefficient is between zero and one. TLI values close to 1 indicate a very good fit.

The results show that:

There is a correlation between the Quality Performance Variable and its items and all the quality indicators of the model achieved an acceptable level some came close to the required level.

Productivity Performance Variable:

The following figure shows the confirmatory factor analysis of Productivity Performance variable:

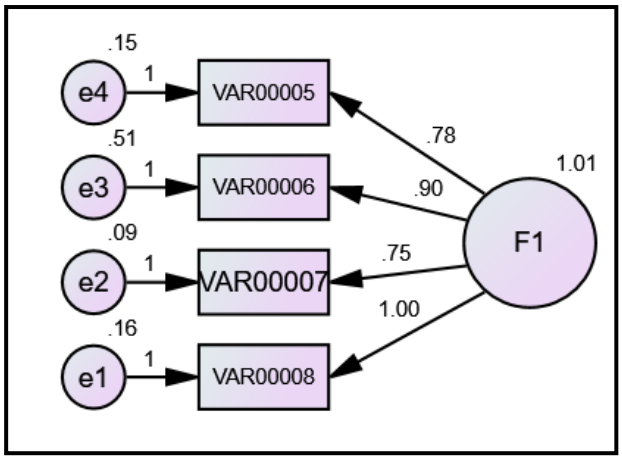

Figure (3): The Confirmatory Factor Analysis of Productivity Performance Variable

Source. Developed by the Researcher

We conclude from the previous figure the Model Fit Summary:

Table (5): The Quality Indicators of The Model Fit Summary

Measure	Estimate
CMIN	10.427
DF	2
CMIN/DF	5.213
GFI	0.980
CFI	0.991
TLI	0.972
RMR	0.015

From the previous table:

The Goodness of Fit Index (GFI) is equal to (0.980) and these values close to 1 and a value of 1 indicates a perfect fit.

The Comparative Fit Index (CFI) is equal to (0.991), which falls in the range from 0 to 1 and CFI values close to 1 indicate a very good fit.

The root mean square residual (RMR) is equal to (0.015), RMR values close to 0 indicate a good fit, which the value of (RMR) equal to zero indicates a perfect fit.

The Tucker-Lewis coefficient (TLI) is equal to (0.972), and the typical range of this coefficient is between zero and one. TLI values close to 1 indicate a very good fit.

The results show that:

There is a correlation between the Productivity Performance Variable and its items and all the quality indicators of the model achieved an acceptable level some came close to the required level.

Cost Reduction Variable:

The following figure shows the confirmatory factor analysis of Cost Reduction variable:

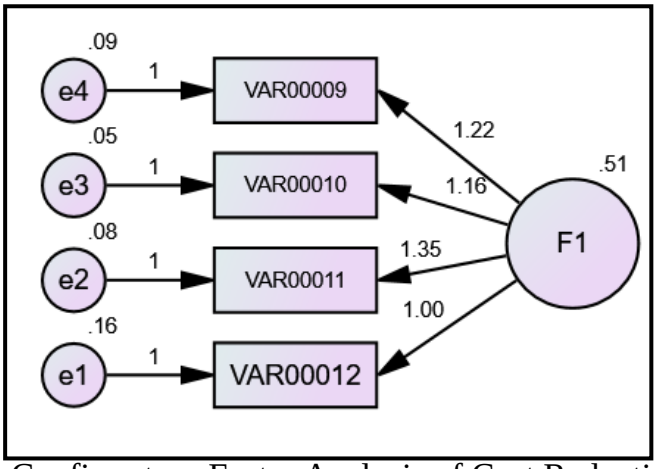

Figure (4): The Confirmatory Factor Analysis of Cost Reduction Variable

Source. Developed by the Researcher

We conclude from the previous figure the Model Fit Summary:

Table (6): The Quality Indicators of The Model Fit Summary

Measure	Estimate
CMIN	70.126
DF	2
CMIN/DF	35.063
GFI	0.873
CFI	0.951
TLI	0.852
RMR	0.018

From the previous table:

The Goodness of Fit Index (GFI) is equal to (0.873) and these values close to 1 and a value of 1 indicates a perfect fit.

The Comparative Fit Index (CFI) is equal to (0.951), which falls in the range from 0 to 1 and CFI values close to 1 indicate a very good fit.

The root mean square residual (RMR) is equal to (0.018), RMR values close to 0 indicate a good fit, which the value of (RMR) equal to zero indicates a perfect fit.

The Tucker-Lewis coefficient (TLI) is equal to (0.852), and the typical range of this coefficient is between zero and one. TLI values close to 1 indicate a very good fit.

The results show that:

There is a correlation between the Cost Reduction Variable and its items and all the quality indicators of the model achieved an acceptable level some came close to the required level.

6-3 Statistical methods used in data analysis:

The following statistical methods and tests were used :

Conducting descriptive statistics by calculating the arithmetic mean to measure the average opinions of the respondents and calculating the standard deviation (SD) to measure dispersion and weight percentile to measure the Opinions.

Calculating the Pearson correlation coefficient to find out whether there is a relationship between the independent variable dimensions and the dependent variable or not. Note that the correlation coefficient is denoted by the symbol r, and its value is limited between -1 and +1. On the other hand, the sign of the correlation coefficient describes whether the relationship is positive or negative. If the sign is negative (-), this indicates that the relationship between the two variables is negative, that is, an increase in one of them leads to a decrease in the other, and if the sign is positive (+), this indicates that the relationship between the two variables is positive, meaning that an increase in one of them leads to an increase in the other (i.e. the two variables move in the same direction).

Application of Simple Linear Regression and Multiple Linear Regression to study the impact of the independent variable dimensions on the dependent variable.

6-4 Exploring the characteristics of the study sample:

The frequencies and percentage of demographic variables and basic data expressing the study sample of 250 individuals were calculated, in order to explore the characteristics of the study sample (Gender, Age, Educational level, Work Experience, Role Function at Work and Job Level in your organization) as shown in table (7):

Table (7): Frequencies and percentage of demographic variables (N=250)

Source: Developed by the researcher

Variables	Category	Frequency	Percentage
Gender	Male	161	64.4
	Female	89	35.6
Age group	20 years old	5	2.0
	20 - 30 years old	79	31.6
	30 - 40 years old	83	33.2
	40 - 50 years old	72	28.8
	More than 50 years old	11	4.4
Educational level	Diploma	43	17.2
	Bachelor's Degree	151	60.4
	Master's Degree	45	18.0
	Ph.D. or higher	11	4.4
Work Experience	5 years or less	31	12.4
	6-10 years	55	22.0
	11-15 years	36	14.4
	16-20 years	73	29.2
	21 -25 years	45	18.0

Variables	Category	Frequency	Percentage
	more than 25 years	10	4.0
Role Function at Work	Project Administration	49	19.6
	Project Policies and standards	47	18.8
	Project Management	33	13.2
	Knowledge exchange and education	43	17.2
	Data Assessment and Monitoring	40	16.0
	Information Security	38	15.2
Job Level in your organization	Strategic	8	3.2
	Managerial	6	2.4
	Consultant	37	14.8
	Specialist (Expert)	47	18.8
	Team Lead	22	8.8
	Project Management	101	40.4
	Coordinator Level	20	8.0
	Staff	9	3.6

The frequencies and percentage of organization variables and basic data expressing the study sample of 250 individuals were calculated, in order to explore the characteristics of the study sample as shown in table (8):

Table (8): Frequencies and percentage of organization variables (N=250)

Source: Developed by the researcher

Variables	Category	Frequency	Percentage
How old is your organization?	0 - 2 years	114	45.6
	3 - 6 years	27	10.8
	7 - 15 years	20	8.0
	16 - 50 years	82	32.8
	More than 50 years	7	2.8
Number of empolyees	1 - 10	135	54.0
	10 – 199	90	36.0
	200 - 1.000	7	2.8
	more than 1.000	18	7.2
Financial resources	Optimization/Automation of existing processes	107	42.8
	Optimization/Automation of existing processes	143	57.2
Type of investments is your organization making to transform itself to a digital business	Formed a taskforce	43	17.2
	Hired a consultant	129	51.6
	Appointed a CDO (Chief Digitization Officer)	78	31.2
	Established a data sciences business function	0	0
	Developed a data strategy	0	0
	Hired, or trained, a significant	0	0

Variables	Category	Frequency	Percentage
	number of data scientists		
	Moved one or more of your products/services to the cloud	0	0
	Established one or more new touch points with customers electronically	0	0
How many years has your firm been working towards digitization?	0 - 1 years	12	4.8
	1 - 3 years	106	42.4
	3 - 5 years	102	40.8
	5 - 10 years	28	11.2
	More than 10 years	2	0.8

The frequencies and percentage of Company Name expressing the study sample of 250 individuals were calculated as shown in table (9):

Table (9): Frequencies and percentage of Company Name

Source: Developed by the researcher

Variables	Frequency	Percent
ADHOC (initial state,no concerted efforts on digitalization strategic imperative)	17	6.8
DEFINED (organization makes digitization a behavior; their goal is to institutionalize the new model)	169	67.6
LEVERAGED (Synergies occur, company involves competencies/people from outside the organization)	59	23.6
OPTIMIZED (New business model is fully internalized; results are repeatable and predictable)	5	2.0
Total	250	100.0

6-5 Conducting descriptive statistics for the study variables:

Descriptive statistics were conducted for the study variables by calculating the arithmetic mean and standard deviation, in order to know the general trend of opinions and the extent of the respondents' awareness of those variables. In addition, the t-test was applied to confirm the general trend of those opinions.

Table (10) presents the mean value, standard deviation and Weight Percentile result at the level of the study variables.

The independent variable (DSC Technologies):

First of all the test examines the existence of the independent variable of (DSC Technologies) as a whole and the results show that the average opinion is (4.12), so the samples agree on its existence at the company with a percentage of (5.01/5 = 82.4%) with SD (0.81).

Accordingly, the (DSC Technologies) variable exists with a percentage of (82.4%).

Table (10): Descriptive statistics for the Blockchain Technology variable

Source: Developed by the researcher

Statements	Descriptive Statistics		Degree of Agree	
	Mean	SD	Weight Percentile	Opinion
Our organization currently implementing– or does it plan to implement– Blockchain Technology	4.32	0.92	86.4	agree
Our organization defines a clear standards and policies for implementing Blockchain applications	4.23	0.96	84.6	agree
Our organization established a dedicated group to support a Blockchain initiative	4.30	0.94	86.0	agree
Our organization developed a budget for its Blockchain efforts	3.71	1.42	74.2	agree
There is a specified team will take the lead on our organization 's Blockchain initiatives	4.13	1.15	82.6	agree
Our customers, suppliers and/or competitors are discussing or working on Blockchain solutions in the current challenges of our supply chain	4.19	1.10	83.8	agree

Statements	Descriptive Statistics		Degree of Agree	
	Mean	SD	Weight Percentile	Opinion
Blockchain improves traceability of products in the supply chain.	4.25	0.92	85.0	agree
Exchange of information in supply chain with customers and suppliers is easier through the application of Blockchain.	3.86	1.30	77.2	agree
There are procedures for evaluating Blockchain's projects in your organization	4.22	1.12	84.3	agree
Blockchain will enable new businesses functionalities and new revenue streams in our organization	3.79	1.21	75.8	agree
Well organizational planning is existed for the future recommendations of your organization's supply chain regarding Blockchain	4.24	1.02	84.9	agree
The variable as a whole	4.11	1.06	82.3	agree

Table (10) shows the following:

The average opinion is for answering the statement (Our organization currently implementing– or does it plan to implement– Blockchain Technology) (Agree) with (4.32/5 = 86.4%).

The average opinion is for answering the statement (Our organization defines a clear standards and policies for implementing Blockchain applications) (Agree) with (4.23/5 = 84.6%).

The average opinion is for answering the statement (Our organization established a dedicated group to support a Blockchain initiative) (Agree) with (4.30/5 = 86.0%).

The average opinion is for answering the statement (Our organization developed a budget for its Blockchain efforts) (Agree) with (3.71/5 = 74.2%).

The average opinion is for answering the statement (There is a specified team will take the lead on our organization 's Blockchain initiatives) (Agree) with (4.13/5 = 82.6%).

The average opinion is for answering the statement (Our customers, suppliers and/or competitors are discussing or working on Blockchain solutions in the current challenges of our supply chain) (Agree) with (4.19/5 = 83.8%).

The average opinion is for answering the statement (Blockchain improves traceability of products in the supply chain) (Agree) with (4.25/5 = 85.0%).

The average opinion is for answering the statement (Exchange of information in supply chain with customers and suppliers is easier through the application of Blockchain) (Agree) with (3.86/5 = 77.2%).

The average opinion is for answering the statement (There are procedures for evaluating Blockchain's projects in your organization) (Agree) with (4.22/5 = 84.3%).

The average opinion is for answering the statement (Blockchain will enable new businesses functionalities and new revenue streams in our organization) (Agree) with (3.79/5 = 85.2%).

The average opinion is for answering the statement (Well organizational planning is existed for the future recommendations of your organization's supply chain regarding Blockchain) (Agree) with (4.24/5 = 84.9%).

The results show that existence of the variable of (Blockchain Technology) as a whole with average opinion is (5.00), so the sample agree on its existence with a percentage (4.11/5 = 82.3%).

Secondly: The dependent variable (Organizations' Operational Performance):

The test examines the existence of the Organizations' Operational Performance variable and the results show that:

The average opinion is (4.95) so the samples agree on the existence of Organizations' Operational Performance in with a percentage of (4.15/5 = 82.9%) with SD (0.97).

Accordingly, the dependent variable (Organizations' Operational Performance) exists with a percentage of (82.9%).

Table (11) Descriptive statistics for the Quality Performance variable

Source: Developed by the researcher, 2023

Statements	Descriptive Statistics		Degree of Agree	
	Mean	SD	Weight Percentile	Opinion
Our organization is able to produce consistent quality products with a low rate of defects.	3.80	1.29	76.1	agree
Our organization operates regular customer satisfaction surveys to monitor our product quality.	3.59	1.39	71.8	agree
Our organization is able to maintain a low number of customer complaints concerning product quality.	3.70	1.28	73.9	agree
Our organization is able to supply products based on conformance quality	3.60	1.20	72.1	agree
The variable as a whole	3.80	1.18	76.1	agree

Table (11) shows the following:

The average opinion is for answering the statement (Our organization is able to produce consistent quality products with a low rate of defects) (Agree) with (3.8/7 =76.1%).

The average opinion is for answering the statement (Our organization operates regular customer satisfaction surveys to monitor our product quality) (Agree) with (3.59/5 =71.8%).

The average opinion is for answering the statement (Our organization is able to maintain a low number of customer complaints concerning product quality) (Agree) with (3.70/5 = 73.9%).

The average opinion is for answering the statement (Our organization is able to supply products based on conformance quality) (Agree) with (3.6/5 = 72.1%).

the results show that existence of the variable of (Quality Performance) as a whole with average opinion is (3.80), so the sample agree on its existence with a percentage (3.80/5 = 76.1%).

Table (12) Descriptive statistics for the Productivity Performance variable

Source: Developed by the researcher

Statements	Descriptive Statistics		Degree of Agree	
	Mean	SD	Weight Percentile	Opinion
Our labor and machine productivity is performing better than in its intended function.	4.58	0.87	91.6	agree
Our organization is able to optimize our production defect/waste to acceptable levels.	4.13	1.15	82.6	agree
Our organization is able to provide short delivery times acceptable to our customers.	4.34	0.81	86.9	agree
Our organization is able to increase capacity utilization in our production when demand requires it.	4.03	1.08	80.6	agree
The variable as a whole	4.27	0.89	85.4	agree

Table (12) shows the following:

The average opinion is for answering the statement (Our labor and machine productivity is performing better than in its intended function) (Agree) with (4.58/5 = 91.6%).

The average opinion is for answering the statement (Our organization is able to optimize our production defect/waste to acceptable levels) (Agree) with (4.13/5 = 82.6%).

The average opinion is for answering the statement (Our organization is able to provide short delivery times acceptable to our customers) (Agree) with (4.34/5 = 86.9).

The average opinion is for answering the statement (Our organization is able to increase capacity utilization in our production when demand requires it) (Agree) with (4.03/5 = 80.6%).

The results show that existence of the variable of (Productivity Performance) as a whole with average opinion is (4.27), so the samples agree on its existence at the company with a percentage (4.27/5 = 85.4%).

Table (13) Descriptive statistics for the Cost Reduction variable

Source: Developed by the researcher

Statements	Descriptive Statistics		Degree of Agree	
	Mean	SD	Weight Percentile	Opinion
Our organization is able e to manufacture products at competitive prices while maintaining a profitable operational performance.	4.50	0.92	89.9	agree
Our organization is able to produce products from a low inventory of raw materials thereby minimizing production costs.	4.43	0.86	88.6	agree
Overall, our logistics costs (including distribution, transportation, and handling costs) can be reduced year on year through our supply chain management.	4.07	1.01	81.4	agree
The reductions in cost achieved are considerably better value than expected.	4.46	0.82	89.1	agree
The variable as a whole	4.37	0.86	87.3	agree

Table (13) shows the following:

The average opinion is for answering the statement (Our organization is able e to manufacture products at competitive prices while maintaining a profitable operational performance) (Agree) with (4.50/5 = 89.9%).

The average opinion is for answering the statement (Our organization is able to produce products from a low inventory of raw materials thereby minimizing production costs) (Agree) with (4.43/5 = 88.6%).

The average opinion is for answering the statement (Overall, our logistics costs (including distribution, transportation, and handling costs) can be reduced year on year through our supply chain management) (Agree) with (4.07/5 = 81.4).

The average opinion is for answering the statement (The reductions in cost achieved are considerably better value than expected) (Agree) with (4.46/5 = 89.1%).

The results show that existence of the variable of (Cost Reduction) as a whole with average opinion is (4.37), so the samples agree on its existence at the company with a percentage (4.37/5 = 87.3%).

6-5 Testing the study hypothesis:

H1: There is a positive relationship between DSC technology of Block chain and the organizations' operational Performance.

To test this hypothesis, it was relied on calculating the Pearson correlation coefficient to find out whether there is a relationship (correlation) between the DSC Technologies of Block chain and Organizations' Operational Performance or not.

Then simple linear regression analysis was applied to study the impact of the DSC Technologies of Block chain on Organizations' Operational Performance.

• The following are the statistical analysis that were carried out to test the hypothesis:

Table (14) shows the values of the regression coefficients, the result of the t-test to ascertain the significance of the independent variable that constitutes the model, in addition to the result of the (coefficient of correlation (r)), the (coefficient of determination (R^2), and the (Standard Error of the Estimate (SE), and (F-test) result on the ANOVA table to as certain the significance of the regression models.

Table (14): Summary of regression models impact of the DSC Technologies of Block chain on Organizations' Operational Performance

Source: Developed by the researcher, 2024

Variables	Regression Coefficients		t-test		(r)	(R^2)	ANOVA	
	β	SE	t-test value	p–value			F-test value	p–value
Constant	0.432	0.036	12.126	0.000	0.989	0.979	11562.379	0.000
DSC Technologies of Block chain	0.903	0.008	107.529	0.000				

It is clear from Table (14) that:

There is a statistically significant impact of the DSC Technologies of Block chainas a whole (X1) on Organizations' Operational Performance (Y) with a level of significance of 5%, where the probability value of the t-test is less than the value of

the level of significance (p-value = 0.000 < α = 0.05). Moreover, it was found that the regression model is a statistically significant model with a level of significance of 5%, where the probability value of the F-test is less than the level of significance (p-value = 0.000 < α = 0.05). The DSC Technologies of Block chainis related with Organizations' Operational Performance with a percentage of (98.9%), where the value of the correlation coefficient is (0.989).

It is also noted that the DSC Technologies of Block chainin impact positively on Organizations' Operational Performance with a percentage of approximately (97.9%) where the value of the determination coefficient is (0.979) while the remaining part (3.1%) may be due to random error or other factors that could have an impact on and were not covered in the current study.

As a final conclusion, it was found that: There is a positive relationship between DSC technology of Block chain and the organizations' operational Performance, therefore the hypothesis of the study was accepted.

7- Conclusion:

The following table summarizes the results of the statistical analysis in relation to the objectives of the study:

Objective	Results
1-To identify the existence of DSC Technology	The results proved that The initial dimension Blockchain Technology exists with a percentage of (82.3%)
2- To decide whether the existence of the Organizations' Operational Performance	The results proved that there is existence of the as Organizations' Operational Performance a whole system applied with a percentage of (82.9%)
	Concerning the sub dimensions that are constituting the Organizations' Operational Performance:
	The first dimension Quality Performance exists with a percentage of (76.1%)

Objective	Results
	The second dimension Productivity Performance with a percentage of (85.4%)
	The third dimension Cost Reduction exists with a percentage of (87.3%)
3- To investigate the impact of DSC Technology on Organizations' Operational Performance.	There is a relationship between the initial dimension of the DSC Technologies (Block chain) and Organizations' Operational Performance.
	The results of the regression analysis proved that the DSC Technology (Block Chain) has a significant impact on Organizations' Operational Performance as a whole in with a percentage of (94.6%)
	The result of the Multiple regression analysis proved that the DSC Technology (Block Chain) on Organizations' Operational Performance hass a significant impact on Organizations' Operational Performance in with a percentage of (97.9%)
4- To investigate the relationship of DSC Technology dimensions and Organizations' Operational Performance.	The results of the Pearson correlation analysis proved that a positive relationship between Block chain technology and the organizations' operational Performance as a whole in with a percentage of (98.9%)
5- To investigate the impact of DSC Technology dimension on Organizations' Operational Performance.	The results of the regression analysis proved that the Block chain technology has a significant impact on Organizations' Operational Performance as a whole in with a percentage of (98.9%)

8- References:

- Akyuz, G. A., & Gursoy, G. (2020). Transformation of Supply Chain Activities in Blockchain Environment. Digital Business Strategies in Blockchain Ecosystems, 153-175.

- Allena, M. 2020. "Blockchain Technology for Environmental Compliance: Towards a 'Choral' Approach." *Environmental Law Review* 50: 4.

- Astill, J., R. A. Dara, M.Campbell, J. M. Farber, E.D.G. Fraser, S. Sharif, and R. Y. Yada. 2019. "Transparency in Food Supply Chains:AReviewof Enabling Technology Solutions." *Trends in Food Science & Technology* 91: 240–247.

- Bumblauskas, D., A. Mann, B. Dugan, and J. Rittmer. 2020. "A Blockchain use Case in Food Distribution: Do you Know Where Your Food has Been?" *International Journal of Information Management* 52: 102008.

- Cant, J. 2019. "Study: Blockchain can Reduce Food Fraud by 31 BillionWithin 5 Years." November 30. Retried on June 22 2020. https://cointelegraph.com/news/study-blockchain-can -reduce-food-fraud-by-31-billion-within-5-years .

- Hobbs, J. E. 2020. "Food Supply Chains During the COVID- 19 Pandemic." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 68 (2): 171–176.

- Kshetri, N., and J. DeFranco. 2020. "The Economics Behind Food Supply Blockchains." *Computer* 53 (12): 106–110.

- Linde, L., Frishammar. J. & Parida, V. (2021). Revenue models for digital servitization: a value capture framework for designing, developing, and scaling digital services. IEEE Trans Eng Manage.; 1–16. doi:10.1109/

- Lozić, J. (2023). Digital transformation in dating industry: OnlyFans Platform. 97th International Scientific Conference on Economic and Social Development – "Modern technologies and innovative concepts in the function of promoting cultural heritage", pp., 162-175. ISSN 1849-7535.

- Marr, B. (2023). The Impact of Digital Transformation on Business Models: Opportunities and Challenges. Forbes. https://www.forbes.com/sites/bernardmarr/2023/10/12/the-impact-of-digitaltransformation-on-business-models-opportunities-and-challenges/?sh=28c57a7144f8. [15.12.2023.]

- Sarkis, J., Cohen, M. J., Dewick, P., & Schröder, P. (2020). A brave new world: Lessons from the COVID-19 pandemic for transitioning to sustainable supply and production. *Resources, Conservation and Recycling*, *159*, 104894. https://doi.org/10.1016/j.resconrec.2020.104894

- Setyowati, M. S., Utami, N. D., Saragih, A. H., & Hendrawan, A. (2020). Blockchain Technology Application for Value-Added Tax Systems. Journal of Open Innovation: Technology, Market, and Complexity, 6(4), 156.

- Surender, K. & Goel, A. (2022). A Perspective on Digital Transformation Among Indian Exporting Firms. FIIB Business Review 1–11. Fortune Institute of International Business. DOI: 10.1177/23197145221093499. 41. Tsai, J. C. A., Wu, X., Klein, G., & Jiang, J. J. (2022). Goal equivocality and joint account of meaning creation in an enterprise system program. Information Systems Management, 39(1), 82–97.

- Tanwar, S., Parekh, K., & Evans, R. (2020). Blockchain-based electronic healthcare record system for healthcare 4.0 applications. Journal of Information Security and Applications, 50, 102407.

- Lozić, J. & Fotova Čiković, K. (2023). Digital transformation: Impact of postmodern society on the revenue structure of the global music industry. 100th International Scientific Conference on Economic and Social Development – "Economics, Management, Entrepreneurship and Innovations" – Svishtov. Book of Proceedings, pp. 131-140. ISSN 1849-7535.

- Wong, L. W., Leong, L. Y., Hew, J. J., Tan, G. W. H., & Ooi, K. B. (2020). Time to seize the digital evolution: Adoption of blockchain in operations and supply chain management among Malaysian SMEs. International Journal of Information Management, 52, 101997.