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Impact of Blockchain Technology on Operational Performance of Warehousing (Logistics) Industry in Sri Lanka

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ABSTRACT

Blockchain is a next-generation technology evolvement in most industries in the world, such as logistics, financing, food, supply chain, etc. According to the literature, it was identified that warehousing companies face issues such as documentation, lengthy process lead time, intermediary involvement, lesser transparency in the processes, and bullwhip effect (demand and supply forecasting errors). Therefore, to reduce these risks it could adapt to the latest technologies, such as Blockchain technology organization-wise. The primary objective behind this research is to identify the significant factors/ antecedent affecting the operational performance of Sri Lanka's warehousing industry. Two latent variables that affect the operational performance of Sri Lankan warehouses have been discovered based on the literature review. The Independent Variable of this study is attributes of Blockchain technology and there are three dimensions identified: Decentralization (peer-to-peer network), Transparency (verified), and Computation logic (smart contracts). The warehouse's operational performance serves as the dependent variable. This study's population consists of employees who work at the warehouse/ transport service providing organization that is practicing blockchain technology local and multinational, employees, who work at the warehouse/ transport service providing organization that is not practicing the said technology local and multinational. A sample of three hundred and seventy (370) with a confidence level (95%) and margin of error (5%) has been utilized for analysis. This survey applied simple random sampling. The operation performance of the warehouse was significantly influenced by the variable network decentralization, despite the explanatory power of information transparency being rejected.

Introduction

1.1. Background of the blockchain technologies

In recent years, the accessing of multimedia data or digital data has become very easy because of the fast development of the Internet. In other words, this development makes unauthorized distribution of multimedia data. For the protection of multimedia data, a solution known as watermarking is used. After the approximate 20 years' research, different kinds of watermarking algorithm based on different theory concepts were introduced [1-3]. A digital watermark encodes the owner's license information and

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embeds it into data. Watermarking may be used to identify the image of owners' license information and to track illegal copies. The rest of the paper is organized as follows. Proposed embedding and extraction algorithms are explained in section II. Experimental results are presented in section III. Concluding remarks are given in section IV.

The world trade revolution is faster than industry reflects, and innovative technologies are major contributors to logistics, transport, and supply chain sectors. The Blockchain is a game changer that would be crucial in the logistics industry soon. The Blockchain introduces to the world by Satoshi Nakamoto in 2008 as a transaction platform or well-known financial application named cryptocurrency bitcoin. (Swanson, 2014). The blockchain technology has been described as "the core system that underpins bitcoin, computers of separately owned entities follow a cryptographic protocol to constantly validate updates to a commonly shared ledger" (Casey, 2017). The world logistics companies already started to work with Blockchain technology and in Sri Lanka, there are no companies that get the advantage by working with Blockchain technology. Most of the warehouses in Sri Lanka are not using this technology so far and there are more Blockchain technology users in the world in the logistics sector. a result, digitalization would be a useful tactic to increase the productivity of the labour pool and reduce the amount of human involvement in warehousing activities (Karunarathna, Wickramarachchi, & Vidanagamachch, 2019). According to (Kückelhaus & Heutger, 2018) this technology is still in its early stages of development all around the world, with many challenges to get past before it can be effectively applied to the logistics sector. The issue will be ensuring successful industry adoption through different level of partnerships and competitiveness among different supply chain stakeholders with legacy approaches and varying interests. The main objective of this research is to identify the key factors influencing the operational performance of Sri Lanka's warehousing industry. By using the Blockchain technology within the warehousing companies, most of the companies acquire lots of advantages such as less documentation, faster services, security of the cargo, etc. also mainly it allows to track the final product throughout of the supply chain. "However, the fast-changing economy requires that companies work more closely together to have efficient processes and improve not only their own but the overall supply chain performance." (Soosay, 2015)
In Sri Lanka warehousing companies faces many challenges such as documentation, storage, tracking, information security, and relationship among supply chain partners, transparency, quality of information, documentation sharing in importation and exportation, etc. i.e., handling Letter of Credits - a process that currently takes between a few days and a few weeks (LC) (Huang, Jie, & Qi, 2016). And most of the aforesaid processes do involve a long lead time. Therefore, this study planning to identify the most influencing factor for the operational performance of a warehouse.

2. Relevant Literature

2.1. Dimensions and items of attributes of blockchain

To identify the suitable Constructs, Dimensions, and related items it was done a literature survey, and the summary of the Literature review is below Table 1.

Table 1 Summary of literature review

Author	Definition	Dimensions
Kückelhaus & Heutger, 2018)	In their journal, they define blockchain as a distributed ledger technology that can safely and permanently record transactions between participants.	Distributed ledger Secure and permanent
Marten & Spohrer, 201	Blockchain is defined as "a decentralized, encrypted electronic distributed ledger that serves as an immutable, incorruptible linear event database of information and transactions shared by networked members."	Decentralized distributed ledger. Immutable Information/ transactions shared in networked members
Cole, Stevenson, & Aitken, 2019 Tijan, Aksentijevi´c, Ivani´c, & Jardas, 2019	Blockchain characteristics consist of information distribution and synchronization, peer-to-peer networks and consensus, payments and smart contracts, and data immutability.	Data immutability Information distribution and synchronization P2P network and consensus Payments and smart contracts

Author	Definition	Dimensions
Niels Hackius, 2017	There are three main properties of Blockchain including Decentralized, Verified, and Immutable.	Decentralized Immutable Verified
Berke, 2017	Blockchain is a modern technology designed to provide decentralization, real-time peer-to-peer operation, anonymity, transparency, irreversibility, and integrity in a universally applicable manner.	Anonymity Decentralization Integrity Irreversibility The real-time p2p operation Transparency
Francisco & Swanson, 2017 Seebacher & Schüritz, 2017	A distributed database, blockchain, is a peer-to-peer network that uses public-key cryptography to secure transactions. It consists of a sequence of blocks, each holding time-stamped data. The network community verifies these transactions, making blockchain an immutable record of past activity.	Consists of a linked sequence of blocks Distributed database Immutable It cannot be altered. Secured by public-key cryptography
Hackius & Petersen, 2017	The three important properties of blockchain are decentralization, verification, and immutability, which make it a crucial mechanism for ensuring secure and efficient operations.	Decentralized Immutable Verified
Kückelhaus & Heutger, 2018	Trend research highlights the importance of four key features in blockchain, Asset management, Data transparency, Security and Smart contracts.	Asset management Data transparency Security Smart contracts
Dobrovnik, Herold, Fürst, & Kummer, 2018	said that there are five Blockchain principles such as Distributed Database, Peer-to-peer Transmission, Transparency with Pseudonymity (fabricated name), Irreversibility of Records, Computational Logic	Computational Logic Distributed Database Irreversibility of Records Peer-to-peer Transmission Transparency in Pseudonymity
Bartling & Fecher, 2016	Blockchain systems are decentralized, spread out, unchangeable, and open and transparent.	Decentralized Distributed Immutable Transparent
Makridakis & Christodoulou, 2019	The blockchain's distinctive value lies in its trust, immutability and transparency, disintermediation, and substantial improvements.	Disintermediation Immutability and Transparency Substantial Improvements Trust
(Gaur & Gaiha, 2020)	A blockchain is a decentralized digital system that securely records transactions among multiple parties, ensuring verifiability and tamper proofness.	Distributed/ Decentralized ledger, verifiable. Tamperproof wat
(Yiannas, 2017)	Blockchain networks, with their unique elements, are revolutionizing the promotion of trust and transparency in food.	Consensus Decentralized Democratic Immutable

Based on the results of the literature survey, identified the main three dimensions, and related to each dimensions developed items accordingly. The table 2 shows the dimensions and items of attributes of blockchain and table 3 shows the items identified for dependent variable – operational performance of warehouse.

Table 2 Dimensions and items of attributes of blockchain

Dimension	Definition	Items	Authors
Decentralization	Decentralization can be considered as the ability to transfer control and decision-making from a centralized system to a distributed system. This aims to create a trustless environment. This approach reduces the level of trust that each participant has and by doing that it enhances the functionality of the network. This process can help to reduce vulnerabilities, as an example over use/ outages of resources. advantages of decentralization are harmonization and optimization of data.	Level of trust that participants Ability to exert authority/ control over one another. Reduce the point of weakness in the system. Improve data reconciliation, Optimize resource distribution.	(aws.amazon.com, 2021)
Information Transparency (verified)	Blockchain technology promotes transparency and accountability, by enabling the public to track and access all data stored on blockchain database. This transparency prevents data manipulation and makes sure that all information is accessible to all authorized people. This technology also allows users to trace anything throughout the supply chain.	It is a critical element, Ability to communicate with partners in the supply chain. Prevent data manipulation. Enable consumers to track anything	Invalid source specified.
Computation logic (smart contracts)	Smart contracts, or in other words, computerized transaction protocols, provide a wide range of speed, trust, and accuracy in transactions. They can be used to upgrade the claim processing speed and reduce issues in manual system.	Critical element Accuracy Speed Security Fostering trust. Increase claim processing speed. Reduce manual processing costs and mistakes	Invalid source specified. Invalid source specified. Invalid source specified./ Invalid source specified.

Blockchain technology and smart contracts enhance data accessibility and efficiency. The transparency in technology is important factor in enhancing the functionality of a network, ensuring data integrity, and preventing data and information manipulation.

Table 3. Items identified for dependent variable – operational performance.

Operational Performance	Items	Authors
This tool enhances lead time reduction, planning, and flexibility, while also providing effective forecasting and highlighting efficient utilization of an organization's resources, routines, and capabilities.	Reduce lead time for all the processes. On-time delivery to meet clients' requirements	(K.S. Hald, 2019), (Kshetri, 2018), (M. Mylrea, 2018), (M.M. Queiroz, 2019), (Javed Aslama, 2021)
Supply chain management (SCM) aims for integration to improve operational performance. This also helps to reduce demand uncertainty, supplier inefficiencies, and changeover delays, and to lower the level of uncertainty in the business environment.	Accuracy in inventory forecast (Bullwhip effect) Accurate planning on the total process Growth of service performance. Performance of the supplier	(Javed Aslama, 2021)

2.2. Conceptual framework

Based on the literature survey details and objectives of the study, there are few tentative variables have been identified as below. The research conceptual framework consists of independent variables and dependent variables. Each latent variable is contained with dimensions as below. Independent Variable in Blockchain Application are Decentralized Network, Information Transparency and Smart Contracts. The Dependent Variable is Warehouse

Performance specifically in Operation Performance.

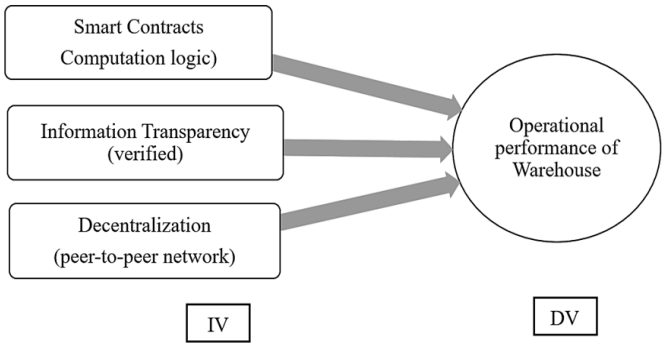

Figure 1. Detailed conceptual framework – 1.

2.3. Hypotheses for the study

The hypothesis of the study was developed based on the summarized literature survey. Blockchain technology significantly impacts operational performance in warehouses, with Computation logic as an independent variable. The study hypothesizes that the warehouse's operational performance, influenced by factors like decentralized networks, verified information, and smart contracts, is the dependent variable.

- H1 = Network Decentralization has a positive impact towards the operational performance of warehouses in Sri Lanka.
- H2 = Information Transparency has a positive impact towards the operational performance of warehouses in Sri Lanka.
- H3 = Smart Contracts have a positive impact towards the operational performance of warehouses in Sri Lanka.

3. Methodology

3.1. The study design

This study has been applied a quantitative survey design directed by three hypotheses. It was conducted literature survey to identify the main dimensions and items that belong to each dimension. and developed the conceptual framework accordingly. This study's independent variable is the attributes of blockchain technology, and three aspects have been established such as, Decentralization (peer-to-peer network), Information Transparency (verified), and Computation logic (smart contracts). The warehouse's operating performance has used as the dependent variable of the study.

The target population of this analysis has been the employees who work at the warehouse/ transport service providing organization that is practicing blockchain technology local and multinational, employees who work at the warehouse/ transport service providing organization that is not practicing the said technology local and multinational. A sample of three hundred and seventy (370) with a confidence level (95%) and margin of error (5%) has been taken for analysis. This survey used simple random samples to gather data.
A confirmatory factor analysis (CFA) was used to analyses the validity and reliability of the questionnaire, including reliability, convergent validity, and discriminant validity analyses, to better understand the data set's behavior (Kim & Shin , 2019). A descriptive analysis was used to determine the demographic features of the respondents of the sample. Exploratory Factor analysis was carried out to identify a reduced amount of (Factors) using the twenty observable variables and to determine whether the hypothesised association between the response variable (Dependent) and the explanatory variables (Independent) is accurate. Using the operating performance as the dependent variable, iteratively adding each new variable gradually, regression analysis was conducted to identify the most influencing variable of the warehouse's operational performance and to augment the explanatory power of the model by adding variables one by one.

3.2. Methods of the analysis

This study has been applied a quantitative survey design directed by three hypotheses. It was conducted literature survey to identify the main dimensions and items that belong to each dimension. and developed the conceptual framework accordingly. This study's independent variable is the attributes of blockchain technology, and three aspects have been established such as, Decentralization (peer-to-peer network), Information Transparency (verified), and Computation logic (smart contracts). The warehouse's operating performance has used as the dependent variable of the study.

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4. Analysis

4.1. Descriptive Analysis

To understand the demographic outline of the selected sample it was conducted a descriptive analysis as below. Demographic characteristics of respondents is 370 (n=370).

Table 4. Summary of the descriptive data analysis

Characteristics	Frequency	Percentage (%)
Gender		
Male	212	57.3
Female	158	42.7
Age		
Below 20	19	5.1
21 – 30	101	27.3
31 – 40	113	30.5
41 – 50	60	16.2
51 - 60	51	13.8
Above 60	26	7.0
Income Level		
Less than 100,000	76	20.5
100,000 – 150,000	89	24.1
150,000 – 200,000	78	21.1
200,000 – 250,000	62	16.8
250,000 – 300,000	39	10.5
More than 300,000	26	7.0
Current Job Level		
Academic	45	12.2
Top-level management	145	39.2
Executive management	73	19.7
Middle-level management	54	14.6
Lower-level management	30	8.1
Other	23	6.2
Geographical Scope		
Local	296	80.0
Multinational	74	20.0
Awareness of Blockchain Technology		
Vast knowledge	60	16.2
Sufficient knowledge	265	71.6
Insufficient knowledge	36	9.7
Not at all.	9	2.4
How you know about Blockchain Tech		
Internet	135	36.5
Following a related course	98	26.5
from your higher education	58	15.7
Newspaper, Magazines, Journals	60	16.2
Other	19	5.1
Challenges face when you implement new tech in your company		
Reluctant to change by the employees	43	11.6
Top management decisions including budgets	36	9.7
Government interventions including rules and regulations	61	16.5
Awareness regarding the impact of modern technology on company operations	142	38.4
Support from other related partners of your company (Stakeholders)	44	11.9
Other	44	11.9
Challenges face when you implement blockchain tech in your company		
Reluctant to change by the employees	61	16.5
Top management decisions including budgets	48	13.0
Government interventions including rules and regulations	71	19.2
Awareness regarding the impact of modern technology on company operations	145	39.2
Support from other related partners of your company (Stakeholders)	41	11.1
Other	4	1.1

Characteristics	Frequency	Percentage (%)
Type of your workplace		
Warehouse only	172	46.5
Manufacturing and warehousing	89	24.1
Transport service provider	64	17.3
Other	45	12.2

According to the descriptive analysis, out of all respondents, 212 (57.3%) are male and 158 (42.7%) respondents are female. Also, the highest number of respondents is 113 (30.5%) in the age range of 31 – 40 years. Most of the employees (65.7%) have been responded to this questionnaire are in the income range of less than LKR 100,000 to 200,000. According to the respondents' details, more employees 145 (39.2%) are from the top-level management. Also, according to the data received, 296 (80%) employees are from the local context and 74 (20%) employees are from the multinational context. Out of 370 respondents there, about 325 (87.8%) respondents have stated that they have sufficient knowledge about Blockchain Technology.

The small percentage (36.5%/ 135 respondence) of employees learn about blockchain technology through online resources, and internet 98 (26.5%) employees have been followed a related course and 58 (15.7%) employees have been known about blockchain technology from their higher education. And 60 (16.2%) of employees get to know about blockchain technology via newspaper, magazines, journals. 19 (5.1%) of employees refer to other ways to discover about this technology.

All respondents, 142 (38.4%) respondents have been stated that awareness regarding the impact of innovative technology on company operations is a challenges face when implementing recent technology in an organization. Out of 370 respondents, 145 (39.2) respondents have been stated that awareness regarding the impact of modern technology on company operations is a challenges face when implementing blockchain technology in an organization.

There are about 172 (46.5%) employees who work for warehousing-related organisations, 89 (24.1%) work for manufacturing and warehousing organisations, 64 (17.3%) employees work for transport service providing organisations, and the rest of the respondents are working for other types of business organisations.

4.2. Measurement model assessment (Reliability and Validity)

Assessing Questionnaire Validity and Reliability few analyses were conducted as below. Cronbach's Alpha (α) values of 0.70 or higher indicate acceptable reliability, 0.80 or higher indicate good reliability, and 0.90 or higher indicate excellent reliability. Convergent Validity is defined as statistically significant item loadings that surpass 0.70, composite reliability (CR) of the variables that exceed 0.70, and average variance extracted (AVE) that exceeds 0.50 (Fornell & Larcker, 1981,).

Table 5. Measurement model results (descriptive statistics, factor loadings, and reliability)

Construct	Items	Mean	SD	Factor Loadings
Decentralization	D1	3.39	1.258	0.778
(α) = 0.824	D2	3.39	1.162	0.619
AVE = 0.5350	D3	3.61	1.074	**0.516**
CR = 0.8477	D4	3.55	1.182	0.873
	D5	3.54	1.138	0.811
Transparency	IT1	3.53	1.296	0.834
(α) = 0.830	IT2	3.58	1.245	0.851
AVE = 0.5511	IT3	3.51	1.219	0.811
CR = 0.8563	IT4	3.33	1.231	**0.535**
	IT5	3.85	1.065	0.626
Smart Contracts	SC1	3.92	1.049	0.706
(α) = 0.848	SC2	3.85	1.165	0.885
AVE = 0.6115	SC3	3.72	1.140	0.700
CR = 0.8862	SC4	3.72	1.107	0.735
	SC5	4.01	1.067	0.864
Operational Performance	OP1	3.74	1.037	0.819
	OP2	3.69	1.068	0.896
(α) = 0.847	OP3	3.40	1.328	**0.551**
AVE = 0.6168	OP4	3.74	1.052	0.740
CR = 0.8870	OP5	3.69	1.106	0.871

(α)- Cronbach's Alpha value, CR – Composite Reliability, AVE- Average Variance Extracted, SD- Standard Deviation.

Table 5 displays the measurement model findings. The questionnaire's reliability has been verified with Cronbach's Alpa (α) values ranging from 0.824 to 0.848, indicating acceptable variable consistency. The convergent validity was confirmed by factor loadings ranging from 0.516 to 0.896, which are greater than 0.5, composite reliability ranging from 0.8477 to 0.8870, which is expected to surpass 0.70, and average variance derived from a latent variable gained a value ranging from 0.5350 to 0.6168, which is expected to surpass 0.50. All the analysis findings indicate a strong convergent validity of the measurement constructs related to certain latent variables.

Table 6. Convergent and discriminant validity results

	CR	AVE	D	IT	SC	OP
Decentralization	0.8477	0.5350	(0.7314)			
Network Transparency	0.8563	0.5511	0.415*	(0.7424)		
Smart Contracts	0.8862	0.6115	0.331*	0.185*	(0.7820)	
Operation performance	0.8870	0.6168	0.397*	0.276*	0.446*	(0.7854)

To evaluate discriminant validity, the square root of an AVE (bolted numbers displayed in bracket in the tables) value was calculated and compared to the value of the correlative coefficients of the remaining latent variables (Fornell and Larcker, 1981.). In this analysis, all correlations are satisfied Table 6.

4.3. Factor Analysis

Factor analysis is a data reduction technique used to identify latent variables that are represented in observed variables. Factor analysis was used to find the components that were associated with twenty (20) questions/observable variables. Prior to evaluating the factor analysis, the sampling adequacy was checked using KMO and Bartlett's sphericity tests. The KMO and Bartlett's to sphericity measures were used to assess the sampling adequacy for factor analysis. The KMO showed an adequate fit of 0.823, while the Bartlett's to sphericity was significant at the 0.000 level, indicating that a sample size of 370 was adequately fit for the analysis Table 7.

Table 7. KMO and Bartlett's test result

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	3738.941
	df	171
	Sig.	.000

The Table 8 displays the rotated factor loadings obtained by a factor analysis followed by a Promax rotation of four 04 constructs that compose the questionnaire. One weak item, IT5, was deleted because it was heavily loaded into another component, and the findings show a verified factor structure, with the nineteen items placed on four factors that were theorised to have loadings of 0.50 or above.

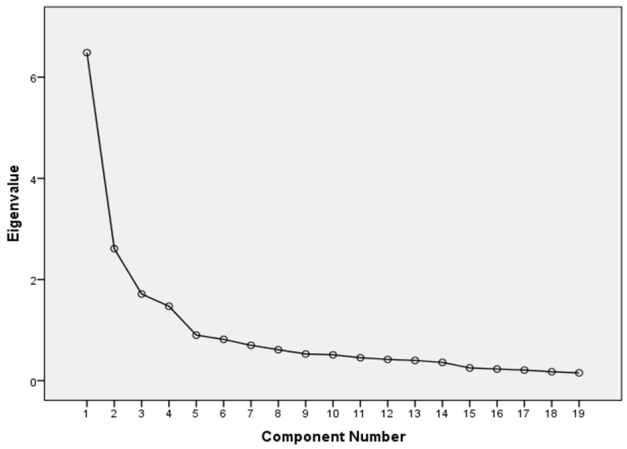
Table 8.Rotated Component Matrix – Factor Analysis

Rotated Component Matrix					
	Variable Used	Component			
		1	2	3	4
1	D1- Trustless environment	\		0.778	
2	D2 - Reduce the point of weakness			0.619	
3	D3 - Data reconciliation			0.516	
4	D4 -Increase the transport efficiency			0.873	
5	D5 - Increase the inventory efficiency			0.811	
6	IT1- Critical element to transport efficiency				0.834
7	IT2 -Critical element to inventory efficiency				0.851
8	IT3 -Firm would be willing to further investments				0.811
9	IT4 - Technology is extremely suitable for our firm and may be used for coordination with partners.				0.535
10	SC1 - Critical element to increase the efficiency of transportation		0.706		
11	SC2 - Critical element to increase the efficiency of warehouse inventory		0.885		
12	SC3 - It could maximize the efficiency of inventory through coordinating partners		0.700		
13	SC4 - Remove human judgment in transactions		0.735		
14	SC5 - Helpful including agreement terms, fraud protection, record keeping, payments, cash flow		0.864		
15	OP1 - Increase in growth of service performance	0.819			
16	OP2 - Increase of accuracy in inventory forecast (demand and supply forecast) to eliminate bullwhip effect	0.896			
17	OP3 - Increase the accurate planning of the total process	0.551			

18	OP4 - Increase in on-time delivery to meet clients' requirements	0.740
19	OP5 - Increase in lead time for all the processes of the warehouse such as transport, payment, handling inventory, and documentation	0.871

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in five iterations.

The scree plot serves in determining the ideal number of components to include in the study. In this scree plot, four parameters must be considered because the scree plotline is nearly flattened soon after these factors. It indicates that each successive component is responsible for a less and smaller proportion of the total variation. As a result, the scree plot Figure 2 only requires four parameters to be considered. Therefore, according to the scree plot four factors can be considers as important.



4.4. Regression analysis

Several assumptions were observed before regressions analysis. The sample was taken after removing two observations (190, 270) according to the results received from the standardized residual scatter plot. Therefore, sample size was reduced from 370 to 368. Pearson Correlation results (Table 9) indicate the Decentralization, Information Transparency, and Smart Contract with Operational performance levels were 0.444**, 0.411**, and 0.289** respectively. The correlation coefficients were all statistically significant within the 0.05 percent error level. Hence the Pearson correlation coefficients show that every single independent variable possesses a positive moderate relationship.

Table 9. Correlation analysis

Variables	Operation Performance	Decentralization	Information Transparency	Smart Contract
Operation Performance	1.000			
Decentralization	0.444**	1.000	.	
Information Transparency	0.411**	0.331**	1.000	
Smart Contract	0.289**	0.168**	0.412**	1.000

**Correlation is significant at the 0.01 level(two-tailed)

An iteratively by adding one variable after another, regression analysis was carried out to find the most influencing variable of warehouse operational performance (Table 10). The accuracy of the modal was checked with the Durbin Watson value, and it indicates 1.658 which the values are independent and not related or the independent variable is not correlated with the residuals which are statistically significant in-between 1.7 - 2.3, proving that there is no indication of heteroscedasticity within the dataset.

Further, to check the accuracy and multicollinearity issue it was taken the VIF (Variance Inflation Indicator) value and tolerance value. In this analysis, VIF and Tolerance values indicate that there is no multicollinearity issue since all VIF values are located less than 5, which are 1.310, 1.208, and 1.127, respectively. And tolerance values are located within the range of .25 and .10 which is.763, .828, and .887, respectively. (Hair, 1998)

The regression standardised residuals of the model were both symmetric and normally distributed. Therefore, the statistical qualities are generally advantageous, indicating that the estimation results have been credible. The adequacy of the model has been checked with the value of R2 and the R2 -value was 0.288 which equals 30%, suggesting that this model can help explain the variability of the dependent variable. Only by 30%. Since this is study explains about Y variable by 30% it is enough to continue this analysis.

The ANOVA has a p-value less than 0.001. Thus, the model was sufficiently capable to forecast the linear relationships between warehouse's operational performance and independent variables. According to (Table 10), regression coefficients of the smart contract and decentralization were 0.334 and .245 accordingly and the statistical significance thresholds were less than 0.05. Hypotheses 1 and 3 were therefore confirmed by the study. Thus, the study concluded

that the two variables listed above had statistically significant effects on the operation performance of Sri Lankan warehouses. In addition, a unit change in the Smart Contract and Decentralization will lead to changes in the Operational performance of respective warehouse by 0.334, and and0.245 units.

However, the variable of Information Transparency was eliminated from the model as it gives out a statistically insignificant i.e. (0.011) explanatory powers on operation performance of the warehouse. Thus, the study rejected Hypothesis 2. Even after conducting a proper literature survey then this factor also may be influencing the dependent variable. Finally, the Network Decentralization factor was identified as the strongest predictor.

Table 10. Stepwise regression analysis

$\mathbf{R^2}$ = 30%		Adjusted R^2 = 30%	ANOVA significance = 0.000		Durbin Watson = 1.658			
		Unstandardized Coefficient		Standardized Coefficients			Collinearity Statistics	
Model		B	Standard error	B	t	Sig	Tolerance	VIF
3	(Constant)	.013	.044		.301	.764		
	SC	.334	.046	.339	7.211	.000	.887	1.127
	D	.245	.050	.248	4.900	.000	.763	1.310
Excluded Variable								
3	IT	.122	.048	.124	2.542	.011	.828	1.208

Conclusion

As the second objective, a descriptive analysis has been conducted to understand the demographic characteristics of a selected sample. A sample of three hundred and seventy (370) a margin of error of 5% and a confidence level of 95% have been chosen for the analysis. Out of all respondents, 212 (57.3%) are male and 158 (42.7%) are female. Also, the highest number of respondents is 113 (30.5%) in the age range of 31 – 40 years. 65.7% of employees who have been responded to this questionnaire are in the average income range of less than 100,000 to 200,000. Most importantly as the respondents' details, more employees 145 (39.2%) are from the top-level management, 296 (80%) employees are from the local context and 74 (20%) employees are from the multinational context. There are about 325 (87.8%) respondents who have stated that they have sufficient knowledge about blockchain technology. The internet served as the primary source of knowledge for 135 (36.5%) employees on blockchain technology, followed by 98 (26.5%) from a related course and 58 (15.7%) from their higher education and 60 (16.2%) through journals, magazines, and newspapers. Respondents expressed two main concerns when implementing new technology in an organisation: 142 (38.4%) stated that there are challenges in raising awareness of how new technology will impact operations, and 145 (39.2%) stated that there will be challenges in raising awareness of how new technology will affect operations when using blockchain technology. There are about 172 (46.5%) employees who work for warehousing-related organizations, 89 (24.1%) work for manufacturing and warehousing organisations, 64 (17.3%) employees work for transport service providing organisations, and the rest of the respondents are working for other types of business organisations. Measurement Model Assessment (The Questionnaire's Validity and Reliability): To complete the first objective of the study was conducted Reliability and Validity test was and the results of each are as below. The questionnaire's evaluation results confirmed its reliability (item consistency), with a Cronbach's Alpa (α) value which ranged from 0.824 to 0.848, representing a satisfactory degree of consistency among the measuring items Table 5. The convergent validity confirmation based on the Factor loadings from 0.516 to 0.896, were above 0.5, Composite reliability (CR) ranging from 0.8477 to 0.8870, was expected to exceed 0.70 and A latent variable's Average Variance Extracted (AVE) value ranged from 0.5350 to 0.6168, which is expected to exceed 0.50. The measurement constructs related to certain latent variables have good convergent validity, as seen by the measurement findings. The square root of an AVE value was calculated and compared to the total value of the correlative coefficients of the other latent variables to assess discriminant validity (Fornell & Larcker, 1981,). Every correlation in this study is met. As a result, it was recommended to perform further research.

The factorial analysis was used as a data reduction approach to identify the latent variables represented in the observed

variables to accomplish the third goal of this study. To find the factors associated with twenty (20) questions or observable variables, factor analysis was used (excluding demographic questions). The questionnaire derived from Factor analysis followed by a Promax rotation of four (04) constructs. The results show a verified factor structure, with nineteen items assigned into four factors that were theorised with loadings greater than or equal to 0.50. One weak item, identified as IT5, was eliminated since it had heavily loaded into another component Table 8. Also, the scree plot helps to understand the appropriate number of computer-generated components that should be in the analysis. This scree plot, there are four-factor to be considered since after those factors' scree plotline is completely flattened. It indicates that each following factor is taking into consideration progressively fewer accounts of the total variance derived. Therefore, it has been sufficient to consider four factors according to the scree plot Figure 2. The four (04) factors were classified as follows as the relationship hypothesized based on the summarized literature review.

- Factor 01 – Operation Performance (OP) - Est F1 (OP) – Z15+Z16+Z17+Z18+Z19
- Factor 02 – Smart Contract (SC) - Est F2 (SC) – Z10+Z11+Z12+Z13+Z14
- Factor 03 – Decentralization (D) - Est F3 (D) – Z1+Z2+Z3+Z4+Z5
- Factor 04 – Information Transparency (IT) - Est F4 (IT) – Z6+Z7+Z8+Z9

To accomplish the fourth goal of the research, a stepwise regression analysis was conducted with the primary objective of determining the most significant variable influencing the warehouse's operating performance. The Pearson Correlation results indicate the Decentralization, Information Transparency, and Smart contracts with Operational performance levels were 0.444**, 0.411**, and 0.289** respectively, and all correlation coefficients has been statistically significant within 0.05 percent error level. And Pearson correlation results indicate that each independent variable has a positive moderate relationship Table 9. The accuracy and the absence of a heteroscedasticity distribute within the modal's data collection were checked with the Durbin Watson value and it indicates 1.658 which the values are independent and not related or the independent variable is not correlated with the residuals which are statistically significant in-between 1.7 - 2.3 Table 10. To check the accuracy and multicollinearity issue it was obtained the VIF (Variance Inflation Indicator) value and tolerance value. In this analysis, VIF and Tolerance values indicate that there is no multicollinearity issue. The model's regression standardised residuals were normally distributed and symmetrical. As a result, the statistical properties are strong and prove the credibility of the estimation results. The adequacy of the model has been checked with the value of R2 and the R2 -value was 0.288 which equals 30%, suggesting that the dependent variable's variability can be explained by this model is only by 30%. Since this is study explains about Y variable by 30% it is enough to continue this analysis. ANOVA was statistically significant at a significance level beneath 0.001. Therefore, the model's predictive power for understanding the linear relationships of the independent variables and the operational performance of the warehouse was sufficient.

According to Table, regression coefficients of the smart contract and decentralization were 0.334 and .245 singly and their respective statistical significance levels has been lesser than 0.05. Accordingly, the study confirmed Hypothesis 1 – "Network Decentralization has a positive influence on operation performance of warehouses in Sri Lanka", and Hypothesis 3 – "Smart Contracts have a positive influence on the operation performance of warehouses in Sri Lanka". The study concluded that the two variables had statistically significant effects on the effectiveness with which operation performance of warehouses in Sri Lanka. However, the variable of Information Transparency was excluded from the model with statistically insignificant explanatory powers on operation performance of the warehouse. The study, therefore, rejected Hypothesis 2. Even though H2 has been rejected there can be literature support to this variable hence there is a significant level of 0.011. Finally, the Network Decentralization factor was identified as the strongest predictor.

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