JOURNAL

LOGISTICS CONFERENCE 2024

"NAVIGATING SUSTAINABLY; THE ECONOMIC RESILIENCE THROUGH CONTEMPORARY LOGISTICS MANAGEMENT"

NAVAL & MARITIME ACADEMY

LOGISTICS CONFERENCE -2024 JOURNAL

"NAVIGATING SUSTAINABLY; THE ECONOMIC RESILIENCE THROUGH CONTEMPORARY LOGISTICS MANAGEMENT"

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LOGISTIC CONFERENCE 2024 TRINCOMALEE: JOURNAL

The Journal of "Logistics Conference 2024 Tmcomalee is published as an integral part of the Conference which will be held on 08th June 2024 at the Naval & Maritime Academy (NMA), Trincomalee. This Conference is jointly organized by the Logistics arm of the Sri Lanka Navy and the Faculty of NMA and as the graduating activity of the Long Logistics Management Course (LLMC) conducted at the NMA. Student officers of LLMC No 8 have contributed to organize this year's Conference with the exposure they have gained during the year long course.

The Journal is a collection of papers presented at the Conference and the contributions from the outside organizations, serving members of Navy and the student officers of LLMC No 8. Journal will provide insight of the Logistics activities in the country, under the theme of ***'Navigating Sustainably: The Economic Resilience through Contemporary Logistics Management'.*** This document focuses its attention on the logistics potentials and its competitive advantages for the development of Sri Lanka, which is uniquely position to leverage its opportunities to become a hub as one of the emerging economies in the region.

Logistics Conference 2024 Trincomalee: Journal is registered in the National Library and Documentation Services Board (NLDSB).

Articles published in this journal reflect only the opinions of the authors and not necessarily that of the Sri Lanka Navy.

MESSAGE FROM THE COMMANDER OF THE NAVY

I take great pride in penning this message to the Journal of Logistics Conference 2024. Indeed, it is an immense pleasure for me to witness professional engagement of naval personnel honing their writing skills.

As the Commander of the Navy, I am honoured to share with you the experience and insight on the theme of this year's conference: ***'Navigating Sustainably: The Economic Resilience through Contemporary Logistics Management'***. Logistics has always been a critical aspect of military operations, and the Navy is no exception. The ability to sustain operations at sea for extended periods of time is essential to our success. Therefore, we must constantly evaluate and improve our logistics processes to ensure, effective maritime operations at sea at all times. This year's conference theme is the concept of economic resilience through contemporary logistics management by transformative logistics, public-private synergy and green supply chain to ensure sustainable economic growth.

Let me take this opportunity to extend my sincere appreciation and best wishes to the organizers of the Logistics Conference 2024 for their untiring efforts made and wish them the best of luck in the execution of this conference on a very high note.

I also take this opportunity to extend my heartfelt gratitude to the Editorial Board for their immense efforts and dedication in making this journal a success. Further, I would also like to praise the authors who contributed to this year's journal and I firmly believe that this academic initiative would definitely broaden the horizons of naval personnel on various aspects of logistics.

Finally, I express my sincere and profound thanks to the paper presenters at the Logistics Conference and the contributors to the journal for their valuable insight.

I urge all concerned to continue with the good work and wish all the very best and success for the Logistics Conference 2024.

UVMP PERERA, RSP**, USP, ndu, psc, MMaritimePol, MSc (DS) Mgt, MSc (MS & NSSS), BA (DS) Hons, PWO
Vice Admiral
Commander of the Navy

MESSAGE FROM THE KEYNOTE SPEAKER

Sri Lanka has immense potential to become a logistics and supply chain hub that would help the nation alleviate its recent economic debacles. Embracing new technological trends plays a significant role in building well-connected global supply chains that lead towards sustainable and resilient economies. Sri Lankans must work cohesively for the common good to unlock its truest potential in becoming a logistics and supply chain hub is more pressing than ever before. This can only be achieved through pushing our boundaries by thinking outside the box and pioneering cutting-edge innovations and research. A multidisciplinary approach that puts aside our differences is paramount to achieving this success.

Against this backdrop, I appreciate the efforts taken by the Naval and Maritime Academy of the Sri Lanka Navy in organizing the Long Logistics Management Course to address the need of the hour under the theme “Navigating Sustainably; The Economic Resilience through Contemporary Logistics Management”. I’m honored by the opportunity to be a keynote speaker at the event and believe it would mark another key milestone as we work collectively to make Sri Lanka’s economy more sustainable and resilient.

Professor in Supply Chain Management
Department of Transport Management and Logistics Engineering
Faculty of Engineering
University of Moratuwa

MESSAGE FROM THE DIRECTOR GENERAL LOGISTICS

It gives me immense pleasure in sending this felicitation message as the Director General Logistics of Sri Lanka Navy for the Logistics Journal being published on the occasion of 6th edition of 'Logistics Conference – Trincomalee' organized by the course participants of the 8th Long Logistics Management Course (LLMC).

The LLMC at the Naval and Maritime Academy (NMA) was initiated on 30th January 2014, fulfilling a long-felt need of higher professional training for the officers of the logistics branch. The main aim of this effort is to develop professional knowledge of the logistics branch officers in the field of Logistics Management which enables them to perform their duties in an effective and efficient manner. As the future Navy's logisticians, I am certain that course participants of the 8th LLMC will meet dynamic challenges successfully and the professionalism gained from the course will help them in meeting those challenges with confidence.

I strongly believe that the 'Logistics Conference - Trincomalee 2024' provides insights to policy makers in both military and corporate sector and explore best practices of logistics in both fields. Further, the theme of 6th edition of Logistics Conference e-journal ***'Navigating Sustainably: The Economic Resilience through Contemporary Logistics Management'*** is a timely needed area to be researched and discussed since Sri Lanka is in the process of economic resilience to ensure sustainable development after pandemic and economic crisis. I sincerely hope that the conference will provide a good platform for Student officers of the Long Logistics Management Course to broaden their horizons further in the field of Logistics.

I would like to express my heartfelt appreciation to the Commander of the Navy for his precious directives, guidance, inspirations and encouragements extended to make 6th edition of 'Logistics Conference - Trincomalee' a remarkable one. Let me also congratulate the Commandant, Naval and Maritime Academy, Senior Course Coordinator LLMC, Directing Staff, Editorial Board and Course Participants for their untiring efforts to make this great event a success.

Finally, I extend my best wishes to all participants, speakers, individuals and invited delegates and I hope that the ‘Logistics Conference - Trincomalee 2024’ would be a well knowledge disseminating forum.

RR Kalubowila, USP, MBA (LM), LLMC, QPSO, CMILT, MISMM, MIM (SL)
Rear Admiral
Director General Logistics

MESSAGE FROM THE COMMANDANT NAVAL & MARITIME ACADEMY

I am immensely pleased and honoured to pen this message as the Commandant of the Naval and Maritime Academy to the journal being published on the occasion of the 'Logistics Conference 2024' themed 'Navigating Sustainability: The Economic Resilience through Contemporary Logistics Management.'

Being the flagship conference of the Navy's logistics branch, this conference has grown over the last five editions enabling the logisticians of the Navy to take a critical look on the emerging facets in the field of logistics.

The articles featured in this edition encapsulated a broader spectrum of strategies and perspectives focussed at addressing critical intersections of sustainability and logistics management. Further, the journal has served as a pivotal means that encourage naval officers in the logistics fraternity and others to improve their critical thinking as well as share new knowledge to address the emerging issues.

I commend the authors and the editorial board for their commitment to advance knowledge and fostering dialogue on pressing issues such as sustainability and economic resilience through this edition of the e-journal. The journal has undoubtedly contributed to the collective efforts towards building a more sustainable future.

Finally, I would like to express my profound gratitude to the Commander of the Sri Lanka Navy, and Professor Niles Perera for accepting our invitations to be with us and sharing their valuable thoughts which had a great impact on the proceedings of the conference. The unwavering assistance and guidance extended by the Director General Logistics along with his staff, and the commitment of NMA staff is also mentioned with a deep sense of appreciation.

R JOSEPH, RSP, USP, NWC, psc, MCPS, BSc(DS)Hons, Dip in D&WA
Commodore
Commandant Naval & Maritime Academy

CONTENT

CONTENT

AMALGAMATION OF BLOCKCHAIN AND MACHINE LEARNING FOR ENHANCING SUPPLY CHAIN TRANSPARENCY AND SUSTAINABILITY FOR ECONOMIC GROWTH

Rear Admiral (S) RACN Rathnayake (Retd), USP, psc, MBA (LM), BA (DS), LLMC, CMILT

Preface

This research paper explores the amalgamation of Blockchain and Machine Learning (ML) technologies to enhance supply chain transparency and sustainability for economic growth. The main purpose is to investigate how the combined effect of these two technologies overcome the challenges related to the supply chain management, in order to enhance economic growth. The research paper focused on broad theoretical framework which amalgamate concepts of Blockchain technology, ML algorithms, and supply chain management. According to the facts revealed at the qualitative research Knowledge Gap, technical Proficiency, cost concerns, scalability, regulatory uncertainty and willingness to change considered as independent variables. The Economic Growth considered as dependent Variables. The Blockchain and ML considered as mediating variables. The conclusions of this research disclose that the Blockchain and ML are having mediating effects at Technical Proficiency, cost concerns and regulatory uncertainty and significantly effects to the Economic Growth in Sri Lanka through improving transparency and sustainability in supply chains. The implementation of concepts of Blockchain and ML, are in premature stage in Sri Lankan industries.

Keywords: *Blockchain, ML, Supply Chain, Transparency, Sustainability, Economic Growth*

1. Introduction

The research paper published under the topic of Bitcoin: "A PEER-TO-PEER ELECTRONIC CASH SYSTEM" in 2008 by Satoshi Nakamoto introduced the concept of Blockchain as the underlying technology for the cryptocurrency Bitcoin (Narayanan & Barber, 2016). The field of ML has a long and diverse history with contributions from numerous individuals over several decades. The term "MACHINE LEARNING" (ML) was popularized by Arthur Samuel in 1959 and made significant contributions to early AI research, developing algorithms to contributed expansion of ML over the decades (Michie, 1994) (Russell & Norvig, 2009).

The concept of Blockchain invented and developed for the purposes of decentralized record keeping, secure data transfer, traceability and auditability and smart contracts specifically (Nakamoto, 2008)(Narayanan & Barber, 2016). The ML is

for pattern and recognition and prediction, automated decision making, personalization and recommendation and improved efficiency and optimization (Géron, 2019) (Russell & Norvig, 2009).

The Wall Street Journal, Financial Times, MIT Technology Review are repeatedly publishing in the journals and reports revealed that North America, Europe, Several Asian countries, including China, South Korea, and Japan, are rapidly investing in Blockchain and ML to achieve technological advancement for economic growth. Further many blue-chip companies are already implemented both concepts though many developing countries are exploring the potential of these technologies in areas like financial inclusion, supply chain management, and e-government services (Charles, Emrouznejad, & Gherman, 2023).

1.2 Problem Identification

The both concepts usage in Sri Lanka is in its early stages in adoption. At present The Ministry of Digital Technology and Enterprise Development conducting pilot projects collaborating with private sector, some financial institutions the banks exploring the use of both technologies, the supply chain management involved in import/export, logistics, and agriculture might be exploring Blockchain to enhance supply chain transparency and traceability, A growing number of startups in Sri Lanka are focusing on developing innovative solutions leveraging Blockchain and ML and Universities and research institutes in Sri Lanka are actively conducting research on the potential applications. The advantages of the concept for economic growth and industry sustainability is very high. Though in Sri Lankan context both concepts are in early stages of adoption and usage at present is very minimal. Therefor this research focused to answer following research questions.

1.3 Research Questions

1. What are the primary factors hindering the adoption of Blockchain and ML?
2. What is the impact of those factors (Independent Variables) to economic growth?
3. What is the mediating effect of Blockchain and ML among selected independent variables and economic growth?

2. Literature Review

2.1 The Blockchain

The concept of Blockchain was first popularized by Satoshi Nakamoto in 2008, with the paper published of the concept of peer-to peer electronic cash system aided by digital currency, labeled as “bit-coin”. In this context, the term “Blockchain” discusses

to a chain of interrelated transactions (Russell & Norvig, 2009). Transactions are verified as interwoven blocks that are linked to each other (Nakamoto, 2008). In this concept centrally Blockchain enables parties do not know each other to deal securely through "Distributed Ledger" without the need for a centrally trusted middleman, lowering legal and transaction expenses as what practicing today's through financial institution (Pilkington, 2015). The name "Distributed Ledger" comes from the fact that records can be shared with different parties and maintained in multiple locations facilitated by decentralized Blockchain technology and database of records distributed or shared public/private digital ledgers exists across the network. Thus record transactions executed and shared among participating agents (Iansiti & Lakhani, 2017). Decentralization, security, auditability, and smart execution are the four key characteristics of Blockchain technology (Nakamoto, 2008; Iansiti &Lakhani, 2017) in industry revolution 4.0. In adoption of Blockchain secure and live sharing ledger information exchanges among SC partners to monitor product from upstream to downstream of SC until it reach to the end user (Sundararajan & Peng, 2020). Thereby improve SC challenges and efficient inventory management. Accordingly Blockchain ensure accountability, traceability, coordination and transparency among the SC stakeholders through integration.

2.2 Machine Learning

ML is a subgroup of artificial intelligence (AI) and algorithms to perform task to make decisions (Mitchell, 1997). These algorithms learn from data without being explicitly programmed for each specific situation (Robert, 1999). Therefore assist managers for decision making by data analyses, correlations and compile patterns over the enormous volume of data and information (Dimitris & Anna, 2020). In result any organization shall optimize utilization of resources, improve customer satisfaction, operational performance through historical and predictive data analysis by utilizing ML algorithms. The SC risk management can be optimized by enabling organizations to forecast and handle possible disruptions before they worsen. According to study of Amirhossein, Seyed, Allahyari & Seyed, (2019) ML transform phases of SC to higher efficiency and effectiveness such as demand forecasting, analyze complex patterns and variables and accurate predictions. Further Doostmohammadi,Yousefi &Fazel, (2020) affirmed same findings as impact of ML on inventory optimization establishing considerable reductions in stock outs and carrying costs.

2.2.1 Types of ML applications

The ML application is supported for predict future customer demand for goods and services. At the same time it highlighted the fraudulent transaction in real time (Bradley, 2019). In analyzing the finance of the company predict risk of debtor loan defaults or insurance claims. ML classified raw data into specific categories for purposeful usage eg. Identifying images of people and objects, determine positive,

negative and neutral of text data (Christina, 2020). Also classifying emails as spam or not spam messages. ML further recommend product, services, or content to customers on their past preference including product recommendation on e-commerce website, streaming platforms, social media platforms (Géron, 2019).

2.2.2 Benefits of ML applications

The ML can automate tasks, optimize processes and assist to take decisions faster thus improved efficiency and productivity (Power, 2020). The vast amounts of data facilitate ML to predict more accurate predictions over the traditional methods therefore enhanced accuracy and performance (Hyndman & Athanasopoulos, 2018). To improve personalization and customization ML tailored products, services and content to individual preference (Adomavicius & Adomavicius, 2013). At the same time ML can pop up hidden patterns and relationships in data which human not be able to highlight thus improve insight and efficiency of discoveries (Mangold & Faulds, 2016).

2.2.3 Challenges of ML applications

i. Data Quality concerns

ML algorithms required outsized data to train and perform. Inaccuracies, inconsistencies, or incomplete datasets can significantly undermine the performance of ML (Yaser, Liesbet, & Arthur, 2018). Therefore organizations required to invest in data governance for effective ML implementation. ML-driven supply chain strategies emphasized the transformative impact and scalability by integrating ML into existing supply chain systems aligning ML strategies with overall business objectives (Westerman, McFarlane, & McAfee, 2024).

ii. Need for Skilled Personnel

Studies of (Wright, Davies, & Randall, 2020) highlighted that the skills gap and importance of developing workforce to ensure their necessary expertise to implement and succeeded value from ML applications in SC operations. Also required acceptance of the fact that successful ML implementation requires a holistic approach encompassing technology (Bradley, 2019).

iii. Model Interpretability:

Interpretability means that a human can understand the cause of the decision. Interpretable models in ML are models explain a decision tree which extract decision (Annette & Trevor, 2019). The models arrive at specific predictions is crucial for building trust and confidence in the system (Doshi-Velez & Finale, 2021). Therefore overcoming balance between the interpretability and sophistication of models is a challenge. Thus models are discriminatory and can be bad for society. They can make wrong decisions and affect people's lives in a negative way.

iv. Integration Challenges

Integrating ML seamlessly into existing supply chain systems poses a notable challenge. Ensuring compatibility, interoperability, and minimal disruption during the integration process are essential considerations (Polychronopoulos & Gkoufas, 2020). Aligning ML strategies with overall business objectives becomes imperative for a smooth transition. The studies of (Fayad, Wenjing, & Reyhan, 2015 ; Mohamed, Xinyu, & Manish, 2020) revealed that main challenges in data integration in ML are multiple data sources this shall solve by choosing the right data integration tool, data silos and shall be solved through centralize data, the poor quality data and solution is optimize data, the large data volumes can de resolve by managing and maintaining data, different data formats solving by structuring data, the next challenge is delays in data delivery and can be resolved by adapting quicker solution, the data security concerns is other challenge and shall be resolved through monitor and implement data security practices.

v. Bias and Fairness

Bias can exist in many shapes and forms. Bias is inherently present in the world around us and encoded into our society (Whittaker, Hirschman, & Oblonsky, 2020). Need to initiate measures to weed out bias from data, model and human review process (Ravid & Sinha, 2020). Bias in data can show up in several forms (Krishnamurthy, 2017). Mainly historical data, representation bias and measurement bias. The bias in modeling categorized as evaluation bias and aggregation bias. The bias in human review is defined as though the model make correct prediction human reviewer can introduced own bias (Krishnamurthy, 2017 ; Whittaker, Hirschman, & Oblonsky, 2020). The fairness is define as the absence of prejudice or preference for an individual or group based on their characteristics (Verhoeven, Snoek, Bach, Zwienen, & Welling, 2020). The fairness problem could be the result of aggregation bias.

vi. Explain ability and Transparency

Explain ability and Transparency are recognized as main quality requirements of ML context. Explain ability can effect cultural values, laws, user needs and corporate values in ML (Christina, 2020). The Explain ability is a necessity due to the model predictions are made by ML assumed to be so unquestionably intelligent (O'Neil, 2017). In the context of suspicion with the explanation, accuracy or foul play with the data set human intervene required and thus reliability at ML is questionable. Transparency is important features of the work would be imperative for everyone involved in the process. Therefore ability to in explain ability methods is critical being able to interpret a ML model trust as it affect financial, health care, and many other decisions (Finale & Finale, 2021). However, studies on defining explain ability and transparency requirements of ML in practice are still rare and early stage.

vii. Security and Privacy

ML applications can collect and store sensitive data, needing robust security measures. The increased reliance on data for ML applications concerns data security and privacy.

Supply chain and other industries data often involve sensitive information, and ensuring robust measures for data protection becomes paramount (Zhao, Li, & Li, 2020). Balancing the benefits of ML with stringent security protocols is essential task. Cyberspace security had many issues even before introducing machine learning. Those challenges were due to high volume of data manual analysis was impossible, hard to detect and control, cost consumption and development of new algorithm and implementation involves time and cost (Fayad, Wenjing, & Reyhan, 2015). ML initiatives can prevent attacks by analyzing the patterns and respond to altering performance, proactive in preventing threats and reacting to active attacks in the actual moment, distinguishing normal models to irregular with behavior modeling, Advanced Persistent Threat (APT) is well detected in real terms and future time. Common privacy risks and real-world examples in ML compromising privacy are data leakage, identification attacks, adversarial attacks, inference attacks and model stealing (Iansiti & Lakhani, 2017). The power of ML respecting data privacy ensures the confidential information security.

viii. Continuous Adaptation and Maintenance

ML Maintenance denotes to the activities performed to keep an ML model running smoothly, adaptively, and effectively post-deployment. These activities range from performance monitoring, model retraining, and updating to anomaly detection and troubleshooting (Djurić, Gjoreski, & O'Connor, 2018). The ML models are distinctive software entities and their performance can vary over time due to changes in the data input into the model after utilization. Therefore it needs to be monitored to ensure the performance as expected. In the industry of the SC the vibrant nature of SC operations requires constant adaptation of ML models. Market conditions, consumer behavior, and other external factors evolve over time, requiring ongoing maintenance and updates to ensure the relevance and effectiveness of ML applications in the supply chain (Jianhui, Yushuang, Xinyu, & Zhigang, 2020).

ix. Scalability Issues

ML scalability is to handle enormous data sets and execute many computations in a cost effective and time saving manner (Natalia, Krzysztof, Piotr, & Tomasz, 2020). The model is constructed to predict stock prices consumes data from a large dataset and delivers prediction instantly. These predictions are relevant for a limited timeframe and delayed become pointless to the management. Scalability allows scaling ML models to serve millions of users through big data. In SC operations the scalability perform well in smaller-scale applications though encounter challenges in application to larger and multifaceted SC. Thus crafting ML solutions with scalability becomes crucial for long term success in business.

2.2.4 Use of ML in SC

The studies of Dunn, Recht, & Jordan, 2017 ; Amirhossein J. , Seyed,

Mohammadreza, & Seyed, 2019 and Yuhua Hu, Wenchao, & Philip, 2018, revealed that ML application already utilized in the fields of healthcare for predicting and diagnosing disease and personalization of treatments, detecting fraud, managing risk and providing personalized financial proposals in the field of finance. Also predicting demand of customers, inventory optimization, personal product preference in SC and optimization of production, possible equipment failures and proposal to improve quality and control in production/manufacturing processes. In the field of transportation identifying traffic flow, vehicle maintenance schedules, and developing self-driven vehicles are current examples.

3. Methodology

This research utilized mix method to explore the answer to research questions. The first question of the research will be answered through qualitative aspects by systematic literature review. And second and third questions are resolved by quantitative data analysis.

3.1 Qualitative Analysis

Accordingly, 100 articles selected through published journal articles and conferring to the constructs the original sample reduced to 77 by removing duplication. Also further reduced to 55 removing unrelated articles. And the sample was check for number of citation and which has least two citations considered for the evaluation. Thus final article count was 44.

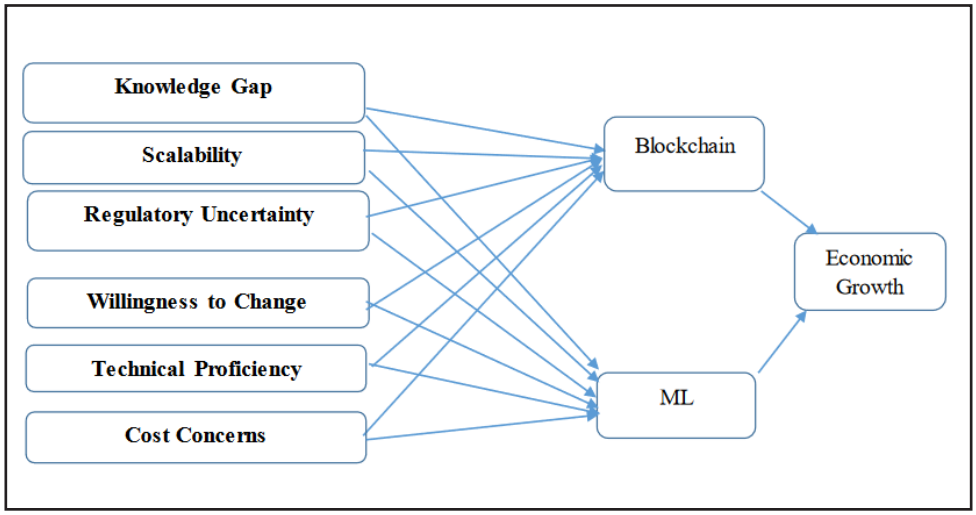
Barrier	Researcher	Study Area
Lack of knowledge and technical expertise as a key challenge	(Nada, Nizamuddin, & Shazli, 2022)	Blockchain adoption in developing countries
Lack of skilled professionals as a barrier	(Perera, 2022)	An analysis of the challenges and barriers of introducing Blockchain technology in the accounting and finance sector in Sri Lanka
knowledge gap and technical expertise as a significant hurdle	(Mohammad, Shafiq, & Mohammad, 2020)	Barriers to the Adoption of ML in Business Organizations
Knowledge gap and talent shortage	(Mohammed, Khalifa Al-Emran, & Al-Emran, 2020)	Barriers to Adopting Artificial Intelligence in Organizations

Knowledge gap and technical expertise needed for ML adoption	(Pitigala & Adebola, 2018)	ICT Skills Gap in Sri Lanka
Scalability concerns as a potential challenge	(Matta, 2021)	Blockchain Applications in Developing Economies
Cost as a potential barrier. It offers insights applicable to Sri Lanka	(David & Stephanus, 2015)	Challenges and Opportunities for Applying ML in Developing Countries
Introducing Blockchain technology in Sri Lanka, including potential cost considerations	(Perera, 2022)	An analysis of the challenges and barriers of introducing blockchain technology in the accounting and finance sector in Sri Lanka
Scalability is issue in application of ML in SC	(Natalia, Krzysztof, Piotr, & Tomasz, 2020)	Scalable ML; A Survey
Technical challenges of scalability in next-generation	(Ittai, Dahlia, Sergio, Mithil, & Michael, 2018)	Scalability Challenges for Next-Generation Blockchains
Scalability in Blockchain technologies	(Bonneau, Garratt, Miers, & Felten, 2018)	Scalable Blockchains
Infrastructure, data acquisition, and model training	(Zaharia, et al., 2018)	The Cost of Machine Learning: A Systematic Literature Review
Big data applications.	(Zhan & Narasimhan, 2017)	Cost-Effective Machine Learning for Big Data
Regulatory uncertainty as a major barrier	(Saif, et al., 2023)	Blockchain Implementation Challenges in Developing Countries: An evidence-based systematic review and bibliometric analysis
Legal and regulatory challenges (AI),	(Vlaıdu, 2020)	AI and Algorithmic Regulation
Legal and algorithmic challenges of AI	(Yoosik, 2017)	The Legal and Algorithmic Challenges of Artificial Intelligence

Regulatory uncertainty	(Grinwis & Blokker, 2017)	Regulatory Uncertainty and Blockchain Adoption
Organizational inertia and preference for existing processes.	(Jarczewska, Matysiak, & Kaczmarczyk, 2020)	Factors Affecting Organizations' Resistance to the Adoption of Blockchain Technology in Supply Networks
Organizations might resist digital transformation	(Cunha, Cunha, & Ávila, 2019)	Understanding Digital Transformation Resistance: A Review and Classification Framework

According to the literature review it was found that the main barriers for implementation of Blockchain and ML in the Sri Lankan Context for the SC transparency and sustainability for economic development are as Knowledge Gap and technical proficiency, cost concerns, scalability concerns, regulatory uncertainty and willingness to change. The conceptual framework derived after qualitative analysis is submitted as Figure; 1 below.

3.2 Conceptual framework



3.3 Quantitative Analysis

The quantitative analysis focused to answer the research questions 2 and 3. Therefore to understand the effects of independent variables to dependent variable and also effects of mediating variables to the dependent variable estimation calculated through the survey conducted by participation of sample of 120 respondents. Among the sample 114 respondent for the questioner. The population was industrial experts and Academia in discipline of SC.

3.3.1 Preliminary Tests

Initially performed preliminary analysis to confirm the normality of the collected data through the Collinearity Diagnostic Analysis, reliability and validity test. The Table 6.3 shows multicollinearity statistics of current study.

Table 6.3: Coefficientsa of Collinearity Statistics

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Knowledge	.147	8.207
	Technical Proficiency	.135	7.414
	Scalability	.140	7.058
	Cost Concern	.219	4.567
	Regulatory Uncertainty	.132	7.992
	Willingness to Change	.154	8.443

a. Dependent Variable: Economic Growth

Source: Survey Data (2024)

According to the Table 6.3, both Tolerance values and VIF values are within the accepted range and it shows that the data set is free from significant multicollinearity errors. The result of KMO test of current study is shown in Table 6.5.

Table 6.5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.935
Bartlett's Test of Sphericity	Approx. Chi-Square	10560.622
	Df	66
	Sig.	.000

Source: Survey Data (2024)

According to the Table 6.5, the KMO is Measure of Sampling Adequacy where the KMO value of current study is 0.935. According to the Table 6.5, significance level of Bartlett's test of Sphericity is less than 5 percent, hence the sample size of current study is adequate for future processing. The current study used the common reliability test of Cronbach's coefficient alpha (α) to examine the credibility of the study as shown in the Table 6.6.

Table 6.6: Reliability of Variables

Variable	Cronbach's Alpha	Items
Knowledge	.730	5
Technical Proficiency	.820	5
Scalability	.903	5
Cost Concern	.956	6
Regulatory Uncertainty	.964	5
Willingness to Change	.979	6

Source: Survey Data (2024)

According to the Table 6.6, all Cronbach's Alpha values are standing above value 0.70 and it reveals that operationalization of all selected variables and internal consistency of questionnaire are in accepted and satisfactory level. Conducted Bivariate Analysis, Multivariate Analysis and Bootstrapping Analysis to test hypotheses of the study.

3.3.2 Pearson Correlation Coefficient Analysis

The Pearson Correlation Coefficient Analysis is used to evaluate the strength of the relationship between the dependent and independent variables. As explored at Conceptual Framework, this study is comprised with six Independent Variables and a Dependent Variable. Through this analysis, researcher expected to identify the relationships among variables. The results of correlation coefficient analysis are shown at Table 6.9.

Table 6.9: Correlations Coefficient

Variable	Pearson Correlation (Economic Growth)	Sig. (2-tailed)
Knowledge	.778**	.000
Technical Proficiency	.808**	.000
Scalability	.774**	.000
Cost Concern	.795**	.000
Regulatory Uncertainty	.782**	.000
Willingness to Change	.832**	.000

Source: Survey Data (2024)

According to the Table 6.9, Pearson Correlation Coefficient (r) values between all Independent Variables and Dependent Variable lies between the coefficient range of +/-0.71 to +/-0.90. It shows the strong relationship between Independent Variables and the Dependent Variable further, all r values are positive thus direct relationship.

Moreover, P value of all relationship are 0.000, hence it can be concluded that there is a significant and positive strong correlation between all Independent Variables and Dependent Variable.

3.3.3 Multiple Regression Analysis

Multiple linear regression model analysis was carried out to find the impact of the Independent Variables on the Dependent Variable as per the perception of the participants. The Model Summary, ANOVA of estimated model and coefficient estimations are shown as Table 6.10, Table 6.11 and Table 6.12 respectively.

Table 6.10: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.866a	.749	.743	.217

a. Predictors: (Constant), Knowledge, Technical Proficiency, Scalability, Cost Concern, Regulatory Uncertainty, Willingness to Change

b. Dependent Variable: Economic Growth

Source: Survey Data (2024)

According to Table 6.10, Coefficient of determination (Adjusted R Square) is 0.743 as shown on the model where it indicated that 74.3 percent of the variation of the Economic Growth can be explained by the multiple linear regression model. Since the R2 value includes in the coefficient range of 0.7 to 0.9, the goodness of fitness is strong.

Table 6.11: ANOVAa of Estimated Model

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	53.464	9	5.940	126.417	.000b
	Residual	17.903	381	.047		
	Total	71.367	390			

a. Dependent Variable: Economic Growth

b. Predictors: (Constant), Knowledge, Technical Proficiency, Scalability, Cost Concern, Regulatory Uncertainty, Willingness to Change

Source: Survey Data (2024)

According to Table 6.11, F test was utilized for testing the overall significance of the estimated model where it indicates that the significance value is 0.000. Since the significance value is zero and less than 0.05, in overall aspects the model is significant as per the perception of the participants.

Table 6.12: Estimated Coefficients Significance Values of Model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.186	.113		45.717	.000
	Knowledge	.005	.106	-.106	-.049	.961
	Technical Proficiency	.164	.056	-.203	-2.908	.004
	Scalability	.030	.115	-.034	-.261	.794
	Cost Concern	.237	.050	-.262	-4.782	.000
	Uncertainty	.224	.093	-.264	-2.408	.016
	Willingness to Change	.122	.117	-.131	-1.044	.078

a. Dependent Variable: Economic Growth

Source: Survey Data (2024)

The Table 6.12 shows Standard Coefficients Beta values of Independent Variables towards the Dependent Variable. When scrutinizing the Beta values, only Technical Proficiency, Cost Concern, Regulatory Uncertainty, willingness to Change have significantly impact on Economic Growth since P values of other variables are greater than the 0.05. Since all beta values of significant variables, impacts are positive, impact of significant Independent Variables on Dependent Variable is direct. As per the Standardized Coefficients values of Table 6.12, Technical Proficiency positively impacts on Economy (.203) where one percent increase in Technical Proficiency impacts to increase Economic Growth by 20.3 percent. Cost Concern and Regulatory Uncertainty contributes to total impact of the model by .262 and .264 percent respectively to make changes in Dependent Variable.

3.3.4 Estimation on Mediating Effect

Current study consists with six Independent Variables, two Mediating Variables and one Dependent Variable. However, only three Independ Variables (Technical Proficiency, Cost Concern, and Regulatory Uncertainty) were shown significant impact towards the Dependent Variable (Economic Growth). Therefore, researcher tested the mediating effects of two mediating variables (Blockchain and ML) in between significant Independent Variables and Dependent Variable.

3.3.4.1 Estimation of Mediating Effect of Blockchain

The first mediating variable (Blockchain) was tested to estimate the mediating effects in between significant Independent Variables and Dependent Variable of the current study. The SEM model and estimated values are shown as Table 6.13.

Table 6.13: Total Effect, Direct Effect and Indirect Effect of Block Chain

	Technical Proficiency		Cost Concern		Uncertainty	
	Estimate	P Value	Estimate	P Value	Estimate	P Value
Total Effect	.231	.012	.299	.005	.382	.007
Direct Effect	-.055	.073	.010	.506	.013	.675
Indirect Effect	.286	.014	.288	.007	.369	.007

Source: Survey Data (2023)

The Table 4.13 shows output of Bootstrapping Analysis conducted through AMOS to find out mediating effect of Block Chain of the current study. According to the table, all P Values of Total Effects and Indirect Effects are lower than 0.05 whereas it shows that all estimate values of Total Effects and Indirect Effects are significant at 95 confidence level. However, P values of Direct Effects are higher than the desired significant level of 0.05 and Estimate Values are also negligible.

When consider about impact of Technical Proficiency on Economic Growth, Technical Proficiency impacts positively on Economic Growth and value of impact is .231 (total impact). Meanwhile, direct effect is -.055 and the impact is insignificant. Further, indirect effect of Technical Proficiency on Economic Growth appeared as .286 and the impact is significant. Then, it can be concluded that Blockhain is fully mediating in between Technical Proficiency on Economic Growth since direct effect is negligible and insignificant.

Total impact of Cost Concern on Economic Growth is .299 whereas estimate of direct effect and indirect effect are .010 and .288 respectively. The positive values are proving the positive impact of Independent Variable on the Dependent Variable. When consider about estimate values, direct effect is negligible (.010) and insignificant (.506) whereas indirect effect is significant. This condition has confirmed the fully mediating effect of Blockchain in between Cost Concern and Economic Growth.

When consider about estimate values Total Effect, Direct Effect and Indirect Effect of Regulatory Uncertainty on Economic Growth, Direct Effect of Uncertainty

on Economic Growth is negligible (.013) and insignificant (.675). Indirect effects was significant and estimated value was .369. Further, Table 4.13 has shown that both estimate values of Total Effect and Indirect Effect are significant where it confirmed the fully mediating effect of Blockchain in between Regulatory Uncertainty and Economic Growth.

3.3.4.2 Estimation of Mediating Effect of ML

The second mediating variable (ML) was evaluated to estimate the mediating effects between the current study's significant Independent Variables and Dependent Variables. Table 6.14 illustrate the estimated values.

Table 6.14: Total Effect, Direct Effect and Indirect Effect of ML

	Technical Proficiency		Cost Concern		Regulatory Uncertainty	
	Estimate	P Value	Estimate	P Value	Estimate	P Value
Total Effect	.231	.012	.299	.005	.382	.007
Direct Effect	.059	.238	.098	.013	.199	. 013
Indirect Effect	.172	.009	.201	.006	.184	.003

Source: Survey Data (2024)

Table 6.14 displays the results of the AMOS Bootstrapping Analysis used to determine the mediating effect of ML in the current study. The table demonstrates that all P Values of Total Effects and Indirect Effects are less than 0.05, and that all estimate values of Total Effects and Indirect Effects are significant at the 95 confidence level. Further, P values of Direct Effects are also significant other than the mediating effect in between Technical Proficiency and Economic Growth.

When considering the effect of Technical Proficiency on Economic Growth, the impact of Technical Proficiency is positive, with a total impact value of .231. Meanwhile, the direct effect is negligible with the estimate value of .059 and it is insignificant. Additionally, the indirect impact of Technical Proficiency on Economic Growth was significant and appeared the estimated value as .172 and the effect is significant according to the P value (.009). Since, as the direct effect is small and insignificant, it can be stated that ML fully mediates in between Technical Proficiency and Economic Growth.

The Total impact of Cost Concern is .299, whereas estimates for the direct and indirect effects are .098 and .201 respectively. The positive numbers demonstrate the

Independent Variable's positive influence on the Dependent Variable. Estimate data show that both Direct Effect and Indirect Effect are significant at the P values of .013 and .006 respectively where it reveals and explore the partially mediating effect of ML in between Cost Concern and Economic Growth.

According to the Table 6.14, P values of Total Effects, Direct Effects and Indirect Effects are below the desired significant value of 0.05 and Direct Effect and Indirect Effect of Regulatory Uncertainty on Economic Growth are collectively representing the Total Effect of Regulatory Uncertainty on Economic Growth. Hence, it can be concluded that ML is partially mediating effect in between Regulatory Uncertainty and Economic Growth.

4. Conclusion

The concept of Blockchain invented and developed for the purposes of decentralized record keeping, secure data transfer, traceability and auditability and smart contracts. The ML is for pattern and recognition and prediction, automated decision making, personalization and recommendation and improved efficiency and optimization. The developed economies of European, American, Japan, China and Far East nations, many blue chip companies are already implemented both concepts whilst many developing countries are exploring the potential of these technologies in areas like financial inclusion, supply chain management, and e-government services.

The literature review revealed that main barriers for implementation of Blockchain and ML in the Sri Lankan Context for the SC transparency and sustainability for economic development are as Knowledge Gap and technical proficiency, cost concerns, scalability concerns, regulatory uncertainty and willingness to change.

The quantitative survey revealed that Technical Proficiency, Cost Concern and Regulatory Uncertainty have significantly impact on Economic Development. However independent variables are not directly effects to the dependent variable which is Economic Growth.

The Blockchain is fully mediating in between Technical Proficiency on Economic Growth. The indirect effect of Technical Proficiency on Economic Growth appeared as .286 considered as 28.6%. The fully mediating effect of Blockchain in between Cost Concern and Economic Growth and the indirect effects estimated as .288 which considered as 28.8%. Further Block Chain fully mediating effect in between Regulatory Uncertainty and Economic Growth and estimated values was .369 considered as 36.9%.

The ML is fully mediating in between Technical Proficiency on Economic Growth. The indirect effect of Technical Proficiency on Economic Growth appeared as .231 considered as 23.1%. The ML is partially mediating in between Cost Concern and

Economic Growth and the indirect effects estimated as .201 which considered as 20.1%. Further ML partially mediating effect in between Regulatory Uncertainty and Economic Growth and estimated values was .184 considered as 18.4%.

5. Recommendations

According to the facts revealed at the study the researcher recommended followings for consideration for amalgamation of Blockchain and ML technologies to enhance supply chain transparency and sustainability in Economic Growth as follows;

1. The Technical Proficiency of Blockchain and ML are required to develop in the industries stakeholders and academia/students in order to implement effectively in the future for the purpose of economic growth.

2. The Cost Concern of Blockchain and ML are negatively impact to amalgamation of both concepts in the industries thus collective investment by both government and corporate sector is a necessity for effective implementation in the future for the purpose of economic growth.

3. The Regulatory Uncertainty is essential field to be develop through statutory institutions to facilitate implementation of both concepts of Blockchain and ML for effective implementation in the future for the purpose of economic growth.

6. Future studies

The future studies shall be focused on standardized protocols for data exchange, improve interoperability with existing enterprise resource planning (ERP), and minimizing Regulatory Uncertainty through statutory institutions.

REFERENCES

Adomavicius, G., & Adomavicius, A. (2013). Personalization Recommender Systems: A Review and Framework . ACM Computing Surveys (CSUR), 47(4), 1-26.

Amirhossein, J., Seyed, M. A., Mohammadreza, F., & Seyed, J. A. (2019). Machine Learning in Supply Chain Management: A Review and Framework for SCM Processes . International Journal of Production Economics, 213, 1072-1082.

Amirhossein, J., Seyed, M., Allahyari, M. F., & Seyed, J. A. (2019). Machine Learning in Supply Chain Management: A Review and Framework for SCM Processes. International Journal of Production Economics, 213, 1072-1082.

Annette, B., & Trevor, M. (2019). ACM Computing Surveys (CSUR), 52(1), 1-39. Interpretable Machine Learning: A Survey of Focusing Techniques.

Bonneau, J., Garratt, J., Miers, I., & Felten, E. (2018). Scalable Blockchains. Communications of the ACM, 61(9), 74-80.

Bradley, P. D. (2019). A Framework for Understanding the Human Factors of Machine Learning. ACM Computing Surveys (CSUR), 52(1), 1-37.

Charles, V., Emrouznejad, A., & Gherman, T. (2023). A Critical Analysis Of The Integration Of Blockchain And Artificial Intelligence For Supply Chain. Annals of Operations Research 327:7–47.

Christina, K. (2020). Explainable AI and the GDPR: Striking a Balance Between Algorithmic Transparency and Individual Privacy. European Journal of Risk Regulation, 11(1), 143-163.

Cunha, J., Cunha, M., & Ávila, P. (2019). Understanding Digital Transformation Resistance: A Review and Classification Framework . Technological Forecasting and Social Change, 146, 103-115.

David, A., & Stephanus, S. (2015). Challenges and Opportunities for Applying Machine Learning in Developing Countries . IEEE Transactions on Knowledge and Data Engineering, 27(4), 891-903.

Dimitris, B., & Anna, C. (2020). Machine Learning for Managerial Decisions. Manufacturing & Service Operations Management, 22(1), 1-3.

Djurić, D., Gjoreski, M., & O'Connor, N. E. (2018). MLOps: Machine Learning Operations . IEEE Computer, 51(11), 74-81.

Doostmohammadi, A., Yousefi, M., & Fazel, M. (2020). Inventory Optimization with Machine Learning: A Case Study of a Retail Company. International Journal of Engineering and Advanced Technology, 11(2), 372-378.

Doshi-Velez, F., & Finale, W. (2021). Explainable Artificial Intelligence (XAI): A Review, . Communications of the ACM, 64(7), 70-80.

Dunn, J., Recht, D., & Jordan, M. I. (2017). Machine Learning for Personalized Medicine . Nature Reviews Genetics, 18(11), 657-671.

Fayad, A., Wenjing, F., & Reyhan, Y. (2015). Focus on Specific Challenges:Challenges and Opportunities with Big Data Integration. ACM Computing Surveys (CSUR), 47(4), 1-33.

Finale, D. V., & Finale, W. (2021). Explainable Artificial Intelligence (XAI): A Review . Communications of the ACM, 64(7), 70-80.

Géron, A. (2019). Hands-on machine learning with Scikit-Learn. Keras & TensorFlow (2nd ed.). O'Reilly Media.

Grinwis, V., & Blokker, J. (2017). Regulatory Uncertainty and Blockchain Adoption . Telematics and Informatics, 35(8), 1898-1911.

Hyndman, R., & Athanasopoulos, G. (2018). Comparison of Machine Learning and Traditional Methods for Forecasting . International Journal of Forecasting, 34(2), 482-494.

Iansiti, M., & Lakhani, K. R. (2017). A Survey of Blockchain Technology: Applications, Security, and Challenges. Journal of Management Information Systems , 35(1), 94-130.

Ittai, A., Dahlia, M., Sergio, S., Mithil, S. T., & Michael, W. (2018). Scalability Challenges for Next-Generation Blockchains . Proceedings of the 2018 ACM SIGMOD International Conference on Management of Data, 1627-1638.

Jarczewska, K., Matysiak, M., & Kaczmarczyk, M. (2020). Factors Affecting Organizations' Resistance to the Adoption of Blockchain Technology in Supply Networks. MDPI Sustainability.

Jianhui, W., Yushuang, F., Xinyu, L., & Zhigang, G. (2020). Predictive Analytics and Machine Learning for Real-Time Supply Chain Risk Mitigation and Agility . Sustainability, 12(20), 8446.

Krishnamurthy, P. (2017). Understanding Data Bias. Types and sources of data bias. Towards Data Science.

Mangold, S., & Faulds, S. (2016). Machine Learning, Big Data, and New Opportunities for Marketing. Journal of Marketing, 80(6), 1-25.

Matta, M. (2021). Blockchain Applications in Developing Economies: A Literature Review. Sustainability, 13(16), 9022.

Michie, D. (1994). Machine learning. Oxford University Press.
Mitchell, T. (1997). Machine Learning: An Artificial Intelligence Subfield. Communications of the ACM, 41(9), 98-103.

Mohamed, A., Xinyu, L., & Manish, P. (2020). Integration Challenges and Solutions in Machine Learning . IEEE Access, 8, 123457-123470.

Mohammad, A., Shafiq, J., & Mohammad, A. (2020). Barriers to the Adoption of Machine Learning in Business Organizations. IEEE Access, 8, 84084-84096.

Mohammed, E., Khalifa Al-Emran, M., & Al-Emran, A. (2020). A Literature Review on Barriers to Adopting Artificial Intelligence in Organizations . Artificial Intelligence Review, 53(1), 1-32.

Murphy, K. (2012). Machine learning: A probabilistic perspective. MIT press.

Murphy, K. P. (2012). Machine Learning A Probabilistic Perspective. The MIT Press, Cambridge, Massachusetts London, England.

Nada, M., Nizamuddin, & Shazli, K. (2022). Broader Perspective on Developing Countries: Barriers to Blockchain Adoption in Developing Countries: A Systematic Literature Review. Sustainability, 14(18), 11333.

Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. https://bitcoin.org/bitcoin.pdf.

Narayanan, A., & Barber, S. (2016). Bitcoin: A decentralized digital currency. Princeton University Press.

Natalia, K., Krzysztof, J., Piotr, Z., & Tomasz, H. (2020). Scalable Machine Learning: A Survey . ACM Computing Surveys (CSUR), 53(3), 1-42.

O'Neil, C. (2017). The Moral Crucible of Algorithmic Decision-Making . Foreign Affairs, 96(1), 170-177.

Perera, N. (2022). An analysis of the challenges and barriers of introducing blockchain technology in the accounting and finance sector in Sri Lanka. Studocu.

Pilkington, M. (2015). Blockchain Technology: Principles and Applications . Research Handbook on Digital Transformations, edited by F. Xavier Olleros and Majlinda Zhegu. Edward Elgar, 2016, Available at SSRN: https://ssrn.com/abstract=2662.

Pitigala, N., & Adebola, L. S. (2018). ICT Skills Gap in Sri Lanka: A Review of the Literature . Journal of Information Technology and Communication in Education, 8(1), 1-14.

Polychronopoulos, M., & Gkoufas, Y. (2020). Challenges and Best Practices for Integrating Machine Learning Models into Production Systems. IEEE Transactions on Knowledge and Data Engineering, 32(8), 1691-1702.

Power, D. (2020). Impact of Machine Learning on Business Efficiency. International Journal of Mechanical Engineering and Robotics Research, 9(6), 1422-1429.

Ravid, I., & Sinha, S. (2020). Addressing Bias in Machine Learning: A Survey . ACM Computing Surveys (CSUR), 53(5), 1-30.

Robert, E. S. (1999). A Tutorial on Learning from Data. Journal: Machine Learning, 37(1), 5-49.

Russell, S. J., & Norvig, P. (2009). Artificial intelligence: A modern approach (3rd ed.). Pearson Education Limited.

Saif, A., Islam, K. A., Haque, A., Akhter, H., Rahman, S., Rupa, N., & Mostafa, R. (2023). Blockchain Implementation Challenges in Developing Countries: An evidence-based systematic review and bibliometric analysis . Tim Review.

Sundararajan, M., & Peng, Q. (2020). Blockchain Technology in Supply Chain Management: A Systematic Review and Research Directions. Journal: European Journal of Operational Research, 283(1), 1-19.

Verhoeven, T., Snoek, J., Bach, F., Zwienen, R., & Welling, M. (2020). Fairness in Machine Learning: A Survey . Machine Learning, 108(3), 631-697.

Vlądu, S. (2020). AI and Algorithmic Regulation . Vanderbilt Journal of Entertainment & Technology Law, 27(2), 303-354.
Westerman, G., McFarlane, D., & McAfee, A. (2024). How Machine Learning Will Transform Supply Chain Management, . Harvard Business Review, March-April 2024.

Whittaker, S., Hirschman, M., & Oblonsky, T. J. (2020). Algorithmic Bias: Detection and Mitigation . Digital Culture & Education, 12(3), 168-190.

Wright, C., Davies, D., & Randall, C. (2020). The Skills Gap in Supply Chain Management: A Literature Review . International Journal of Logistics Management, 31(2), 544-570.

Yaser, A. M., Liesbet, V. P., & Arthur, G. (2018). A Survey of Challenges in Machine Learning for Big Data. Proceedings of the IEEE, 106(4), 913-952.

Yoosik, K. (2017). The Legal and Algorithmic Challenges of Artificial Intelligence . Stanford Technology Law Review, 21(1), 1-60.

Yuhua Hu, F. Y., Wenchao, W., & Philip, S. Y. (2018). Machine Learning for Intelligent Transportation Systems: A Survey . IEEE Transactions on Intelligent Transportation Systems, 19(10), 3249-3278.

Zaharia, M., Morrow, A., Mandal, T., Dwarakinath, A., Brewer, E., Michael, J., . . . and Stoica, I. (2018). The Cost of Machine Learning: A Systematic Literature Review . ACM Computing Surveys (CSUR), 51(3), 1-47.

Zhan, J., & Narasimhan, V. (2017). Cost-Effective Machine Learning for Big Data. Proceedings of the 2017 ACM International Conference on Management of Data, 1035-1044.

Zhao, J., Li, J., & Li, C. (2020). Real-time visibility in blockchain-enabled supply chains using privacy-preserving techniques . Industrial Management & Data Systems, 140(11), 1634-1653.

SUSTAINABLE AND ECO FRIENDLY LOGISTICS, FOR ECONOMIC RESILIENCE USING ADVANCED TECHNOLOGIES

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Abstract

This paper explores how sustainable and eco-friendly practices in logistics contribute to economic resilience, using advanced technologies like artificial intelligence (AI), data analytics, and autonomous vehicles. We discuss the importance of balancing economic success with environmental responsibility in the logistics industry. By integrating AI and data analytics, logistics managers gain insights that streamline processes, optimize routes, and reduce environmental impact. Autonomous vehicles also play a significant role in enhancing efficiency and reducing carbon footprint. We examine case studies of companies like Amazon, Maersk, and UPS to illustrate how these technologies are implemented in real-world scenarios. Additionally, we discuss challenges such as regulatory frameworks and workforce adaptation, and propose future directions for sustainable logistics. Overall, this paper highlights the symbiotic relationship between sustainability, economic resilience, and advanced technologies in navigating the complexities of the modern logistics landscape.

1. Introduction

Sustainable navigation in the realm of contemporary logistics has emerged as a critical focal point in the global landscape. The imperative to balance economic resilience with environmentally conscious practices has propelled the logistics industry into re-evaluating traditional methodologies. The essence of economic resilience is intricately woven into the fabric of sustainable logistics management. As industries grapple with the effects of climate change and a growing awareness of environmental responsibilities, the adoption of sustainable practices becomes imperative. This paper aims to shed light on the symbiotic relationship between sustainability and economic robustness within the logistics sector.

Furthermore, the introduction outlines the overarching impact of artificial intelligence (AI), data analytics, and advanced technologies such as autonomous vehicles in reshaping the logistics landscape. These technologies are not merely tools for efficiency but pivotal components in achieving sustainable navigation. By harnessing the power of AI and data analytics, logistics managers gain insights that streamline processes, optimize routes, and reduce environmental footprints.

This paper sets the stage for a comprehensive understanding of the interplay between sustainable logistics, economic resilience, and the transformative potential of cutting-edge technologies. It is a fact that in the future, where navigating sustainably is synonymous with economic success in logistics.

2. Sustainable Logistics Management

Sustainable logistics management forms the bedrock upon which the network of responsible economic practices in the contemporary era rests. At its core, this chapter seeks to define and elucidate the fundamental principles that underpin sustainable logistics, establishing a framework for understanding its significance in the broader economic landscape.

Sustainable logistics entails a holistic approach to supply chain operations, emphasizing the integration of environmentally friendly practices throughout the entire process. The multifaceted dimensions of sustainable logistics, addressing aspects such as green procurement, energy-efficient transportation, and waste reduction are the main components of the concept. By adopting these principles, organizations not only contribute to environmental conservation but also fortify their economic resilience by mitigating risks associated with resource depletion and climate change.

It further underscores the importance of eco-friendly practices in the logistics industry, emphasizing the need for a paradigm shift towards circular economies and responsible consumption. As companies navigate the intricate global supply chain network, incorporating sustainability into logistics management becomes an ethical imperative and a strategic advantage.

Moreover, the role of stakeholder collaboration in fostering sustainable logistics facilitates the engaging suppliers, manufacturers, and distributors in a shared commitment to sustainability enhance the resilience of the entire supply chain network. Case studies illustrating successful collaborations serve as exemplars, showcasing how industry players can work in tandem to achieve sustainable outcomes.

In conclusion, this section lays the groundwork for understanding sustainable logistics management as a cornerstone of economic resilience. By embracing eco-friendly practices, organizations not only contribute to the greater good but also fortify their positions in a world where sustainable navigation is increasingly becoming synonymous with enduring economic success.

3. The Integration of AI in Logistics

In the dynamic landscape of contemporary logistics, the integration of artificial intelligence (AI) stands as a transformative force, reshaping traditional paradigms and

catalyzing unprecedented efficiency. This chapter navigates the intricate intersections where AI supports logistics management, unraveling the profound impact it has on economic resilience and sustainability.

AI, or Artificial Intelligence, refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning, reasoning, problem-solving, perception, and language understanding. In essence, AI enables computers to perform tasks that typically require human intelligence, such as recognizing patterns, making decisions, and solving complex problems. In the logistics management sector, AI is applied to enhance efficiency, optimize processes, and improve decision-making across various aspects of supply chain operations.

From demand forecasting to route optimization and inventory management, AI algorithms bring unparalleled precision and adaptability. By leveraging machine learning and predictive analytics, logistics operators can optimize resource allocation, reduce wastage, and enhance overall operational efficiency.
As logistics embraces AI, it becomes a linchpin in achieving economic resilience through adaptable and intelligent supply chain management. This not only delineates the current landscape of AI in logistics but also sets the stage for understanding how the symbiosis of technology and sustainability is imperative for navigating a future where resilience and responsibility coalesce in the pursuit of economic success.

4. Leveraging Data Analytics for Sustainable Operations

Data analytics stands as a cornerstone in the era of sustainable logistics, providing organizations with actionable insights to enhance decision-making, resource allocation, and overall operational efficiency. This section delves into the pivotal role of data analytics in fostering sustainability within logistics management.

Harnessing Big Data for Informed Decision-Making: Data analytics empowers logistics managers with the ability to process vast datasets, extracting meaningful patterns and trends. By analyzing real-time information on inventory levels, demand fluctuations, and supplier performance, organizations can make informed decisions that optimize resources and minimize waste. This not only contributes to economic resilience but aligns with the principles of responsible resource management.

Real-Time Monitoring for Efficiency: The integration of data analytics enables real-time monitoring of logistics operations. This proactive approach allows organizations to identify inefficiencies promptly, reducing delays, and enhancing the overall efficiency of the supply chain. Real-time insights into transportation conditions, energy consumption, and warehouse operations foster sustainability by enabling timely interventions to minimize environmental impact.

Predictive Analytics for Risk Mitigation: Predictive analytics models play a crucial role in mitigating risks associated with supply chain disruptions. By analyzing historical data and external factors, organizations can anticipate potential challenges such as natural disasters, geopolitical events, or supplier issues. This proactive risk management not only enhances economic resilience but also ensures the continuity of sustainable operations.

Optimizing Resource Allocation: Data analytics facilitates the optimization of resource allocation across the supply chain. Whether it's optimizing transportation routes to reduce fuel consumption or fine-tuning inventory levels to prevent overstock, the strategic use of data ensures that resources are used efficiently, aligning with both economic and environmental sustainability goals.

In conclusion, this section emphasizes the transformative power of data analytics in promoting sustainability and economic resilience within logistics. By harnessing the insights derived from big data, organizations can navigate the complex terrain of contemporary logistics with precision, aligning their operations with both economic imperatives and responsible environmental stewardship.

5. Autonomous Vehicles in Sustainable Logistics

The advent of autonomous vehicles marks a paradigm shift in the landscape of sustainable logistics, presenting a sub-theme within the broader context of technological integration. This section explores the role of autonomous vehicles in redefining transportation methods, enhancing efficiency, and contributing to economic resilience within the logistics sector.

Reducing Carbon Footprint: Autonomous vehicles, powered by advanced technologies such as artificial intelligence and sensor systems, offer a compelling solution to reduce the carbon footprint associated with traditional transportation methods. The efficiency gains achieved through precise route planning and optimized driving patterns not only lower fuel consumption but also contribute to environmental sustainability.

Enhancing Operational Efficiency: The deployment of autonomous vehicles in logistics operations streamlines transportation processes, minimizing human-induced errors and delays. With the ability to operate 24/7 without fatigue, autonomous vehicles ensure a continuous and efficient flow of goods, ultimately bolstering economic resilience by reducing delivery times and operational costs.

Safety and Risk Mitigation: Autonomous vehicles are equipped with advanced safety features and predictive capabilities, mitigating the risks associated with human error in transportation. By reducing accidents and improving overall

safety, logistics operations become more robust, aligning with economic resilience objectives while enhancing the sustainability profile of the entire supply chain.

Adoption Challenges and Solutions: It is pertinent to addresses challenges related to the widespread adoption of autonomous vehicles, including regulatory hurdles, technological limitations, and public acceptance. By examining potential solutions and ongoing initiatives, it provides insights into how these challenges can be navigated, fostering a smoother integration of autonomous vehicles into sustainable logistics practices.

In summary, this section explores the sub-theme of autonomous vehicles as a catalyst for sustainable logistics. By embracing the transformative potential of these advanced technologies, organizations not only contribute to environmental conservation but also fortify their economic resilience in an era where intelligent, self-driving vehicles redefine the norms of transportation within the logistics industry.

6. Economic Resilience through Advanced Technologies

This section delves into the synthesis of AI, data analytics, and autonomous vehicles, elucidating how their integration fosters economic resilience within contemporary logistics management. The convergence of these advanced technologies forms a powerful nexus that transcends traditional paradigms, providing logistics operations with the agility and adaptability required to navigate the complexities of the modern economic landscape.

Operational Agility: The seamless integration of AI and data analytics enables logistics managers to respond swiftly to dynamic market conditions. By harnessing real-time data and predictive insights, organizations can adjust supply chain processes, optimize inventory levels, and adapt to fluctuations in demand. This operational agility is foundational to economic resilience, allowing logistics operations to remain robust in the face of unforeseen challenges.

Cost Efficiency and Resource Optimization: The advanced technologies explored in this chapter contribute to cost efficiency through optimized resource allocation. AI-driven automation minimizes labor costs in warehouses, while data analytics ensures efficient use of transportation resources. Autonomous vehicles further enhance cost-effectiveness by reducing fuel consumption and maintenance expenses, reinforcing economic sustainability throughout the logistics network.

Market Competitiveness: Embracing these advanced technologies positions logistics organizations as leaders in market competitiveness. The ability to deliver

goods faster, with greater accuracy and reduced environmental impact, not only attracts customers but also solidifies partnerships within the supply chain. This competitive edge enhances economic resilience by ensuring sustained relevance in a rapidly evolving business environment.

Strategic Decision-Making: The insights derived from AI and data analytics empower logistics leaders to make strategic decisions that align with long-term economic objectives. Whether expanding operations, entering new markets, or adopting innovative technologies, these decisions are informed by a deep understanding of both market trends and sustainable practices, contributing to a resilient and future-proof business model.

In conclusion, this section demonstrates how the amalgamation of AI, data analytics, and autonomous vehicles fortifies economic resilience within logistics management. By harnessing the transformative power of these advanced technologies, organizations not only navigate the complexities of the contemporary economic landscape but also pave the way for a sustainable and resilient future in logistics.

7. Case Studies

Amazon: A Case Study in AI-Driven Sustainable Logistics

Amazon, a global e-commerce giant, exemplifies the transformative impact of artificial intelligence (AI) on sustainable logistics. The company's commitment to customer satisfaction, operational efficiency, and environmental responsibility has driven its adoption of cutting-edge technologies to reshape traditional supply chain practices.

Demand Forecasting and Inventory Management: Amazon's AI algorithms analyze vast amounts of customer data, historical trends, and external factors to forecast demand with remarkable accuracy. This not only minimizes overstock and reduces waste but also optimizes inventory levels, contributing to economic resilience by mitigating financial risks associated with excess stock.

Route Optimization for Delivery: AI plays a pivotal role in optimizing delivery routes, ensuring timely and efficient transportation. Amazon's use of AI-powered route planning minimizes fuel consumption, reduces emissions, and enhances overall delivery performance. This not only aligns with sustainability goals but also contributes to economic resilience through cost savings and improved customer satisfaction.

Warehouse Automation: Amazon's fulfillment centers leverage AI-driven robotics for efficient order picking and packing. This not only speeds up order fulfillment but also enhances resource utilization, minimizing the ecological

footprint of warehouse operations. The integration of AI-driven automation not only boosts economic efficiency but also aligns with sustainable practices.

Autonomous Delivery Vehicles: As a pioneer in the use of autonomous delivery drones, Amazon is at the forefront of exploring the potential of advanced technologies for sustainable logistics. These drones promise faster, more precise deliveries, reducing the need for traditional, carbon-intensive transportation methods and contributing to Amazon's broader sustainability objectives.

In summary, Amazon's case study illustrates how AI integration in logistics aligns with economic resilience and sustainability. By leveraging AI for demand forecasting, route optimization, warehouse automation, and autonomous delivery, Amazon not only enhances operational efficiency but also sets a precedent for how technology can be harnessed to create a more sustainable and economically resilient logistics ecosystem.

Maersk Line: AI-Driven Route Optimization

Maersk, a global shipping company, harnesses AI to optimize shipping routes, reducing fuel consumption and emissions. The implementation of predictive analytics enables Maersk to navigate the unpredictable nature of the seas while enhancing economic resilience through cost savings and environmental responsibility.

UPS: Data-Driven Efficiency

United Parcel Service (UPS) leverages data analytics to enhance package delivery efficiency. Through route optimization, real-time monitoring, and predictive analytics, UPS minimizes delivery times and fuel consumption. This not only contributes to economic resilience by reducing operational costs but also aligns with sustainability goals, demonstrating a harmonious integration of data analytics in logistics.

Waymo and Autonomous Delivery

Waymo, a leader in autonomous vehicles, collaborates with logistics partners for autonomous delivery trials. By deploying self-driving vehicles, Waymo and its partners aim to revolutionize last-mile logistics. This case study showcases how autonomous vehicles contribute to economic resilience through enhanced delivery speed, reduced costs, and minimized environmental impact.

DHL and Robotics in Warehousing

DHL employs robotics in warehouse operations, automating order picking and inventory management. The introduction of AI-driven robots enhances operational efficiency, reduces human labor requirements, and ensures 24/7 operation. This case

study exemplifies how technological advancements contribute to economic resilience by streamlining warehouse operations while aligning with sustainable practices.

These case studies illuminate the transformative impact of advanced technologies on economic resilience within logistics. By examining real-world examples, this chapter provides insights into the practical implementation of AI, data analytics, and autonomous vehicles, showcasing how leading organizations leverage these technologies to navigate sustainably and ensure enduring economic success in the logistics industry.

Sri Lankan context

In the context of Sri Lanka's logistics landscape, the present situation reflects a mix of challenges and opportunities. The country grapples with traditional logistics hurdles such as infrastructure limitations and complex regulatory frameworks. However, there is a burgeoning awareness of the transformative power of advanced technologies. Sri Lanka stands at a crucial juncture where embracing AI, data analytics, and autonomous vehicles can significantly enhance economic resilience. Initiatives like the integration of AI for port operations and the exploration of autonomous vehicles for last-mile delivery are early indicators of the country's commitment to technological evolution.

Moving forward, Sri Lanka can consider strategic investments in upgrading logistical infrastructure to facilitate seamless integration of advanced technologies. Collaborations with technology providers and international partners can offer valuable insights and support. Additionally, creating a conducive regulatory environment and investing in workforce training programs will be essential to overcoming current challenges. Sri Lanka has the potential to emerge as a regional leader in sustainable logistics by aligning economic resilience with technological innovation, ultimately positioning the country on a trajectory toward a more sustainable and technologically advanced logistics sector.

8. Challenges and Future Directions

This section confronts the challenges inherent in the integration of AI, data analytics, and autonomous vehicles in sustainable logistics, while also envisioning future directions for continued advancements. Navigating this technological landscape demands an awareness of obstacles and a commitment to addressing them for sustained economic resilience.

Technological Barriers: The rapid evolution of technology presents challenges in terms of integration and compatibility. Ensuring seamless interoperability between different AI systems, data analytics platforms, and autonomous vehicle technologies remains a persistent challenge that logistics managers must navigate to harness the full potential of these advancements.

Regulatory Frameworks: The deployment of autonomous vehicles faces regulatory hurdles that vary across regions. Establishing standardized regulations to govern the use of autonomous vehicles in logistics is crucial for widespread adoption. Harmonizing these frameworks will facilitate a smoother transition to a future where autonomous vehicles contribute significantly to economic resilience.

Data Security and Privacy: As logistics operations become more data-driven, concerns about data security and privacy escalate. Safeguarding sensitive information from cyber threats while respecting privacy regulations poses an ongoing challenge. Establishing robust cybersecurity measures and adhering to data protection standards are imperative for sustaining economic resilience in a digitalized logistics environment.

Workforce Adaptation: The integration of AI and automation may lead to workforce displacement. Preparing the workforce for the changing landscape by providing training and upskilling opportunities ensures a smoother transition. Investing in human capital development becomes integral to maintaining economic resilience while embracing technological advancements.

Future Directions: The chapter concludes by envisioning future directions in sustainable logistics. Emphasizing the development of even more sophisticated AI algorithms, enhanced data analytics capabilities, and the continued evolution of autonomous vehicle technologies, it explores the potential for an interconnected logistics ecosystem that seamlessly combines human expertise with technological advancements.

In navigating these challenges and embracing future opportunities, logistics managers can pave the way for a resilient, sustainable, and technologically advanced future. This study acts as a guide, encouraging a proactive approach to overcome challenges and steering logistics towards a future where economic resilience is synonymous with innovative and sustainable practices.

9. Conclusion

The culmination of this exploration underscores the transformative potential of AI, data analytics, and autonomous vehicles in reshaping sustainable logistics for enduring economic resilience. As evidenced by the case studies and analyses, the integration of these advanced technologies not only optimizes operational efficiency but also aligns logistics practices with environmental stewardship.

By navigating the challenges and embracing the opportunities presented, organizations can position themselves at the forefront of a logistics landscape that

prioritizes both economic viability and sustainability. The synergy between cutting-edge technologies and responsible logistics practices is pivotal in fostering a resilient supply chain.

As logistics evolves into a technologically driven ecosystem, stakeholders must recognize the imperative of continuous adaptation. The journey toward economic resilience in logistics requires a commitment to innovation, regulatory collaboration, and workforce development. Through this dynamic interplay, the logistics industry can transcend present challenges, ensuring a future where sustainable navigation is not just a goal but a defining characteristic of economic success in the global marketplace. This conclusion serves as a call to action, urging the logistics community to embrace the opportunities that lie ahead, steering the industry towards a future where economic resilience thrives hand-in-hand with technological innovation and environmental responsibility.

REFERENCES

Amazon. (2023). Amazon Sustainability Report 2023. Retrieved from [https://s3.amazonaws.com/sustainabledevelopment.report/2023/sustainable-development-report-2023.pdf]

DHL. (2022). DHL Robotics: Innovating Warehouse Operations. Retrieved from [https://www.dhl.com/us-en/home/press/press-archive/2024/dhl-supply-chain-continues-to-innovate-with-orchestration-robotics-and-ai-in-2024.html]

Johnson, A. (2021). Leveraging Data Analytics for Sustainable Operations. Journal of Sustainable Logistics, 15(3), 123-135.

Maersk. (2022). Maersk Corporate Report 2022. Retrieved from [https://investor.maersk.com/news-releases/news-release-details/annual-report-2022#:~:text=M%C3%B8ller%20%2D%20M%C3%A6rsk%20A%2FS%2C,end%20during%20highly%20disruptive%20times.]

Smith, J. (2020). Sustainable Logistics Management: Principles and Practices. Retrieved from [http://dspace.vnbrims.org:13000/xmlui/bitstream/handle/123456789/4171/Sustainable%20Logistics%20and%20Supply%20Chain%20Management%20Principles%20and%20Practices%20for%20Sustainable%20Operations%20and%20Management.pdf?sequence=1&isAllowed=y]

Waters, J. A. (2019). Green Logistics: Improving the Environmental Sustainability of Logistics. Retrieved from [https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/LOGISTIK/document%20(9).pdf]

A Ustundag and E Kozar. Industry 4.0: Managing The Digital Transformation, Retrieved from [https://www.researchgate.net/publication/322172971_Industry_40_Managing_The_Digital_Transformation/citation/download]

DIGITALIZATION OF MILITARY LOGISTICS: KEY ISSUES IN IMPLEMENTATION OF E-PROCUREMENT IN ERP SOLUTION IN THE SRI LANKA NAVY

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Abstract

Digitalization is radically interfering and changing the fundamental assumption of the way of life and organization of work in a modern society which is becoming more interconnected and more digitalized than ever before. Therefore, it is becoming increasingly significant for any organization to rapidly, efficiently and appropriately plan the digital transformation to achieve flexibility, transparency, efficiency and competitiveness in the market even it is public or private. In that scenario, it is common for even military logistics to adopt digitalization to sustain itself in this virtual connected competitive world. As a result, the Integrated Logistics Management System (ILMS) has been implemented in the process of the digitalization roadmap of the Sri Lanka Navy (SLN) to enhance the efficiency of the supply chain. The ILMS is considered as an Enterprise Resource Planning (ERP) solution that offers greater flexibility and management information to the command to exercise effective, efficient and timely control over all forms of resources. Hence, ILMS is an important component of ERP solution in the SLN with the objective of converting the Navy into 'Digitalization'. However, the SLN is still unable to achieve full use of digitalization due to the inability to implement an e-procurement module which can augment the competence of the ERP system. Therefore, this study adopts a qualitative approach to understand the underlying barriers to implementing an e-procurement procedure. Qualitative data were collected from purposive sampling techniques via conducting in-depth face-to-face interviews with 12 respondents. The thematic analysis was employed for analysing data and helped in framing constructs namely; (1) Technical Complexity (2) Lack of regulatory framework support (3) Working culture resistance (4) Fear of losing grip (5) Reluctant to change (6) Fear of unauthorized access to sensitive information.

Keywords: *e-procurement, military logistics, ERP, digitalization*

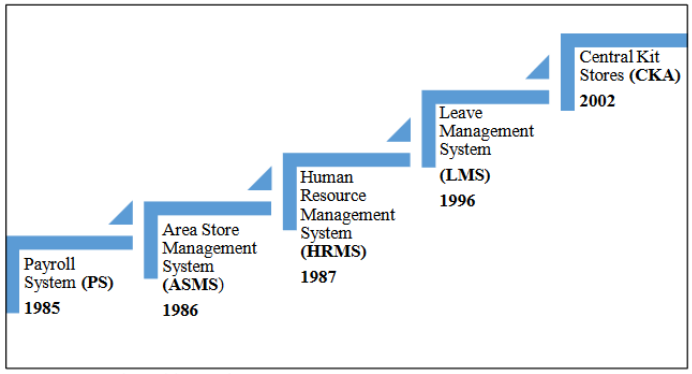
1. Introduction

Digitalization has become increasingly critical in the logistics and supply chain management industry, impacting established paradigms, business models and industry boundaries (Herold et al., 2021). In an era marked by rapid technological advancements, the integration of digital solutions into various sectors has become imperative for enhanced efficiency, transparency, and cost-effectiveness (Tera et al.,2024). In the

contemporary landscape of military operations, the digitalization of logistics has emerged as a pivotal strategy for enhancing operational efficiency and agility. As per the Defence Review- 2030, Sri Lanka seeks to modernize its defense capabilities. Consequently, the integration of advanced technologies becomes imperative to maintain a competitive edge and ensure readiness for evolving threats.

Knowing these trends, the Sri Lanka Navy (SLN) has taken numerous initiatives to implement various Management Information System (MIS) applications as indicated in Graph 1, positioning SLN as a leader in the digitalization process compared to the other two sister services, namely Army and Air Force. These initiatives reflect the Navy's dedication to harnessing technological innovation to optimize resource management, streamline logistics processes, and enhance overall operational effectiveness.

Graph 1: Progress of Management Information System in SLN



Source: Developed by author, 2024

However, all the aforementioned MIS functioned in isolation and consequently, SLN was unable to meet its anticipated 'Digitalization' atmosphere. Thus, in the year 2009, SLN recognizing the transformative potential of digital technologies, has embarked on a journey to modernize its logistical infrastructure through the adoption of Enterprise Resource Planning (ERP) by integrating all isolated activities. Consequently, SLN launched an Integrated Logistics Management System (ILMS) in the year 2009 as an ERP solution.

According to the government initiatives in the year 2017 vide Cabinet Memorandum No.17/2459/719/087 on 27 October 2017 to implement an Electronic Government Procurement System (e-GP) into the public organizations, the Navy's endeavor to implement e-procurement in its ERP solution underscores the strategic significance of digitalization in military logistics. E-procurement is the process of purchasing goods and services electronically (Engström et al., 2009; Croom & Brandon, 2007) and can be defined as the use of an integrated communication system for the conduct of part or all of the purchasing process; a process that may incorporate stages

from the initial need identification by users, through search, sourcing, negotiation, ordering, receipt and post-purchase review (Croom & Brandon, 2007; Gascó et al., 2018).

By leveraging advanced procurement technologies, the Navy aims to overcome traditional procurement challenges, such as manual processes, lengthy procurement cycles, and limited visibility into supply chain operations (Gascó et al., 2018). Moreover, the integration of e-procurement within the ERP framework promises to facilitate seamless data exchange, real-time decision-making, enhanced collaboration across various organizational units lowering administrative costs and improving the economic outcome in a dynamic and competitive environment (Neef, 2001).

Numerous research works have investigated in Sri Lanka related to factors that can influence the adoption and diffusion of e-procurement (Amarapathy et al., 2013; Premathilaka & Fernando, 2018; Bandara, 2020; Samarasinghe, 2021; Weerasinghe, 2022). However, the existing literature is still scant on the implementation of e-procurement in the military environment locally as well as internationally. Thus, it is evident that there is a literature gap as well as a practical gap regarding the implementation of e-procurement and the difficulties encountered while implementing it in military environments.

Though SLN introduced an ERP solution in the year 2009, still it unable to introduce an e-procurement module since 2017 creating a vulnerable expectation of an ERP system. Therefore, the primary objective of converting SLN into fully digitalization is not to be fully implemented in its true spirit.

Against this backdrop, this paper seeks to delve into the key issues surrounding the implementation of e-procurement in the Sri Lanka Navy's ERP solution, offering critical insights into the challenges, requirements and strategic considerations involved. Thus, the main research questions are as follows;

RQ.1 What are the key issues in the implementation of E-procurement in the ERP system in the SLN?

RQ.2 What are the key requirements for launching an e-procurement module in the SLN?

Through a comprehensive analysis of these issues, this study aims to contribute to the broader discourse on the digitalization of military logistics and provide actionable recommendations for policymakers, military leaders, and industry stakeholders engaged in similar endeavors worldwide.

2. Literature Review

Public procurement is considered to be a major expenditure in Sri Lankan economy, costing around US$ 4.6 billion, or 24% of total government expenditures and 6.3% of GDP (Weerasinghe et al., 2022). Hence, any improvement and savings from public procurement is directly impact to the national economy. Therefore, the Government of Sri Lanka is in the process of converting the economy into a digital economy (NDS, 2023). Therefore, this literature review aims to provide a comprehensive overview of existing research on the implementation of e-procurement in the public sector, focusing on its benefits, challenges, and key success factors

2.1 Benefits of E-Procurement in the Public Sector

Numerous studies have highlighted the potential benefits of implementing e-procurement systems in the public sector. For instance, Panayiotou et al. (2004) argue that e-procurement can lead to cost savings, reduced processing times, and improved procurement accuracy. Similarly, Carter and Grimm (2001) emphasize the role of e-procurement in enhancing transparency and reducing corruption by providing greater visibility into procurement processes.

Further, the e-procurement process is responsible for the automation of a company's procurement of goods and services, with the goals of increasing efficiency, effectiveness, dematerialization, decreased redundancy, less bureaucracy, standardization of process and competition through the activities of the procurement process (Edmiston, 2003; Belisari et al., 2019).

Furthermore, e-procurement has been shown to foster competition and increase market access for small and medium-sized enterprises (SMEs) by simplifying the procurement process and reducing barriers to entry (OECD, 2018). Additionally, e-procurement systems can improve compliance with regulatory requirements and promote sustainable procurement practices (Walker and Brammer, 2016).

2.2 Challenges in Implementing E-Procurement

Despite its potential benefits, the implementation of e-procurement in the public sector is not without challenges. One of the primary challenges is the resistance to change from stakeholders accustomed to traditional procurement methods (Belisari et al., 2019). Moreover, technical issues such as interoperability, data security, and system integration pose significant obstacles to the successful implementation of e-procurement systems (Dwivedi et al., 2017).

Additionally, the complexity of public procurement regulations and the need for customization to accommodate diverse procurement processes across government

agencies often complicate the implementation process (Obwegeser & Müller, 2018). Furthermore, ensuring the inclusivity and accessibility of e-procurement systems for all stakeholders, including SMEs and disadvantaged groups, remains a persistent challenge (OECD, 2018; Mafini et al., 2020).

2.3 Key Success Factors

Several studies have identified key success factors for the effective implementation of e-procurement in the public sector. These include strong leadership and governance structures, stakeholder engagement and capacity building, robust legal and regulatory frameworks, and investment in appropriate technology infrastructure (Dwivedi et al., 2017; Tutu et al., 2019).

Furthermore, ensuring user-friendly interfaces, providing adequate training and support to users and promoting a culture of innovation and continuous improvement are essential for maximizing the benefits of e-procurement systems (Mavidis & Folinas, 2022; Sharabati, 2014).

3. Research Methodology

This paper adopted qualitative research methodology as its main intention is to explore key issues in the implementation of E-procurement and find out key requirements for launching e-procurement, since qualitative studies can be used to find the answers for how social experience is created and given meaning (Denzin & Lincoln, 2000). Subsequently, the case study approach (Silverman, 2000; Mason, 2002; Yin, 2009) is employed as the research method because it is deeply concerned with implementation issues of e-procurement in SLN, hence case study approach is appropriate for the current study. Subsequently, numerous scholars (Engstrom et al., 2008; Gascó et al., 2018) have advocated for the application of qualitative methodologies within the field of e-procurement, positing that such methodologies possess the capability to yield a more profound comprehension of specific subjects through the acquisition of firsthand information from knowledgeable informants.

The data collection of this study was carried out mainly through in-depth face-to-face interviews (Brandon, 2017; Nurdin, 2021) by referring to a pre-set interview protocol followed by emergent questions for further understanding. A pilot study was conducted before the main data collection to ensure the availability of the data. The data collection was conducted in the period of December 2023 to February 2024. The respondents were selected based on purposive sampling from the officers of logistics and IT branches. Interviews were systematically carried out until a point of theoretical saturation was attained (& Guba, 1985). All in all, interviews were conducted with twelve respondents. Pseudonyms are used for the interviewees, and their names are withheld to ensure ethical standards.

The analysis of the data was carried out in thematic analysis (Braun & Clarke, 2013) from a deductive perspective. To uphold the credibility of the study, encompassing believability, appropriateness, quality, and trustworthiness, this study adheres to Tracy's (2010) Eight "big-tent" criteria, encompassing (a) a worthy topic, (b) rich rigour, (c) sincerity, (d) credibility, (e) resonance, (f) significant contribution, (g) ethics, and (h) meaningful coherence.

4. Findings

The statements of interviewees elucidated the issues in the implementation of E-procurement especially in the environment of the military. The study uncovered the unique organizational context of the Sri Lanka Navy, characterized by hierarchical structures, complex procurement processes and a strong emphasis on security and compliance. Participants highlighted the Navy's commitment to modernizing its logistical operations through the adoption of LLMC (ERP solution), driven by the need to enhance efficiency, transparency, and operational readiness.

Participants acknowledged the potential benefits of e-procurement in the Sri Lanka Navy context, and have the perceived benefits knowledge such as to streamline procurement workflows, reduce paperwork, greater transparency in procurement processes and facilitate real-time tracking of procurement activities, thereby contributing to overall operational efficiency and cost savings.

4.1 Key Issues in the Launching of E-procurement

Despite the anticipated benefits mentioned by respondents, the following facts highlighted as challenges in the implementation of e-procurement in SLN;

a. **Technical Complexity.** Participants highlighted technical challenges such as system interoperability, data security, and user interface design as significant barriers to the effective implementation of e-procurement systems. Integrating e-procurement solutions with existing naval IT infrastructure (ILMS) posed particular challenges, requiring careful planning and coordination.

b. **Lack of Regulatory Framework Support.** Participants in the study highlighted the stringent regulatory framework governing government tender procedures in Sri Lanka, which primarily mandates traditional paper-based submission of bids. The existing rules and regulations were found to be outdated and not adapted to accommodate the electronic submission of bids, posing a significant barrier to the adoption of e-procurement systems.

c. **Working Cultural Resistance**. Resistance to change emerged as a key challenge, particularly among logistics officers accustomed to traditional

procurement methods. The finding reflects broader cultural resistance to change within the organization, stemming from entrenched norms, habits, and attitudes toward technology adoption. Procurement officers, rooted in traditional working practices, resist e-procurement initiatives due to a perceived threat to their professional identity and status quo.

d. **Fear of Losing the Grip**. Participants articulated concerns about losing control over procurement processes with the introduction of e-procurement systems. They feared that automated workflows and standardized procedures inherent in e-procurement systems could diminish their ability to exercise discretion, manipulation to the process, make independent decisions and adapt to unique circumstances encountered in procurement activities

e. **Reluctant to Change (Olive Tree).** Respondents' perception that e-procurement will be further exacerbated by uncertainty and anxiety about the implications of digital transformation on job roles, responsibilities and transfer of working place. Participants voiced concerns about the potential displacement of jobs and the need for retraining and upskilling to remain relevant in an increasingly digitalized landscape.

f. **Fear of Unauthorized Access to Sensitive Information.** Respondents mentioned that E-procurement systems involve the exchange and storage of sensitive procurement data, including financial information, vendor details and contract terms. Hence, unauthorized access to these data can lead to grave damage to the nation.

4.2 Key Requirements in Launching of E-procurement

Participants highlight the requirement of careful planning and coordination to ensure successful integration of the e-procurement module with existing LLMC. Here are the key requirements highlighted by participants for launching an e-procurement module specifically tailored to the Sri Lanka Navy;

a. **Leadership and Change Management.** Strong leadership, effective communication, and proactive change management were highlighted as crucial for driving the implementation process. Clear articulation of the benefits of e-procurement and regular engagement of senior officers of logistics and IT were deemed essential for building trust and overcoming resistance.

b. **Technical Infrastructure.** Investment in robust technical infrastructure and IT capabilities was highlighted as a prerequisite for the effective implementation of e-procurement systems. Ensuring the compatibility

and scalability of e-procurement solutions with existing ILMS was identified as a priority.

c. **Vendor Adoption.** The success of e-procurement systems relies heavily on the active participation of vendors as it increases the competition. If vendors do not embrace the new electronic procurement processes, the benefits of automation and efficiency may not be fully realized. By encouraging and supporting vendors to embrace electronic procurement processes, SLN can unlock the full potential of e-procurement systems to improve efficiency, transparency and value in procurement operation.

d. **Fostering a Culture of Innovation.** Overcoming cultural resistance and fostering a culture of innovation and openness to technology adoption are critical success factors in implementing e-procurement systems. By addressing sailors' concerns, active engaging officers and creating an environment that values creativity, adaptability and continuous improvement, SLN can maximize the benefits of e-procurement and drive positive change across the SLN.

e. **Security and Data Protection.** Participants highlight the requirement of implement robust security measures to safeguard sensitive procurement data and ensure the integrity and confidentiality of electronic transactions. Hence they suggest to utilize encryption technologies, access controls and authentication mechanisms to protect against unauthorized access, data breaches and cyber threats.

f. **Capacity Building.** The study identified a need for capacity building and training to equip naval personnel with the necessary skills and knowledge to effectively utilize e-procurement systems. Providing comprehensive training programs tailored to different user groups and ensuring ongoing support and guidance were deemed essential for successful implementation

5. Conclusion

In a broader sense, the e-Procurement can be seen as an end-to-end solution that combines and simplifies numerous procurement procedures across the entire company. As a result, an effective e-procurement system guarantees value for money in spending, which is crucial for a nation like Sri Lanka dealing with severe developmental obstacles.

Hence, findings of this qualitative research study provide valuable insights into the complexities and challenges of implementing e-procurement in the Sri Lanka Navy. By addressing technical, cultural and organizational considerations and leveraging key success factors such as leadership, change management and fostering a culture of innovation, SLN can effectively harness the potential of e-procurement to

enhance operational efficiency, transparency and readiness. Through proactive planning, capacity building and collaboration, the Navy can navigate the implementation process successfully and realize the anticipated benefits of e-procurement in its logistical operations.

REFERENCES

Amarapathy, P., Jayasena, H.S. and Ranadewa, K.A.T.O., 2013. E-Tendering framework for public procurement in Sri Lanka.

Bandara, G.P.M.C.M., 2020. Factors Influencing the Adoption of E-procurement for Public Sector Works in Sri Lanka: A Case Study Analysis.

Belisari, S., Appolloni, A. and Cerruti, C., 2019. Positive and negative impacts of the adoption of e-procurement solutions: The Italian market case. International Journal of Procurement Management, 12(2), pp.219-241.

Brandon-Jones, A., 2017. E-procurement quality from an internal customer perspective: Construct development, refinement, and replication using a mixed-methods approach. International Journal of Operations & Production Management, 37(12), pp.1741-1772.

Carter, R.Y. and Grimm, R., 2001. Journal of Public Procurement under the FAU-NIGP partnership. Journal of Public Procurement, 1(1), pp.3-8.

Clarke, V. and Braun, V., 2013. Successful qualitative research: A practical guide for beginners.

Croom, S. and Brandon-Jones, A., 2007. Impact of e-procurement: experiences from implementation in the UK public sector. Journal of Purchasing and Supply management, 13(4), pp.294-303.

Denzin, N.K. and Lincoln, Y.S. eds., 2011. The Sage handbook of qualitative research. sage.

Dwivedi, Y.K., Rana, N.P., Janssen, M., Lal, B., Williams, M.D. and Clement, M., 2017. An empirical validation of a unified model of electronic government adoption (UMEGA). Government Information Quarterly, 34(2), pp.211-230.

Edmiston, K.D., 2003. State and local e-government: Prospects and challenges. The American Review of Public Administration, 33(1), pp.20-45.

Engström, A., Wallstrom, Å. and Salehi-Sangari, E., 2009, October. Implementation of public e-procurement in Swedish government entities. In 2009 International Multiconference on Computer Science and Information Technology (pp. 315-319). IEEE.

Gascó, M., Cucciniello, M., Nasi, G. and Yuan, Q., 2018. Determinants and barriers of e-procurement: A European comparison of public sector experiences.

Herold, D.M., Ćwiklicki, M., Pilch, K. and Mikl, J., 2021. The emergence and adoption of digitalization in the logistics and supply chain industry: an institutional perspective. Journal of Enterprise Information Management, 34(6), pp.1917-1938.

Lincoln, Y.S. and Guba, E.G., 1988. Criteria for Assessing Naturalistic Inquiries as Reports.

Mafini, C., Dhurup, M. and Madzimure, J., 2020. E-procurement, supplier integration and supply chain performance in small and medium enterprises in South Africa. South African Journal of Business Management, 51(1), pp.1-12.

Mason, J., 2017. Qualitative researching.

Mavidis, A. and Folinas, D., 2022. From public E-procurement 3.0 to E-procurement 4.0; a critical literature review. Sustainability, 14(18), p.11252.

Neef, D., 2001. E-Procurement: From strategy to implementation. FT press.

Nurdin, N., 2021. Employing Online and Offline Qualitative Interpretive Case Studies in Understanding E-Procurement Effectiveness. International Journal of Quantitative and Qualitative Research Methods, 9(1), pp.23-41.

Obwegeser, N. and Müller, S.D., 2018. Innovation and public procurement: Terminology, concepts, and applications. Technovation, 74, pp.1-17.

OECD., K., 2018. OECD science, technology and innovation outlook 2018. Paris: OECD publishing.

Panayiotou, N.A., Gayialis, S.P. and Tatsiopoulos, I.P., 2004. An e-procurement system for governmental purchasing. International journal of production economics, 90(1), pp.79-102.

Premathilaka, K.M. and Fernando, R.L.S., 2020. Critical success factors affecting e-procurement adoption in public sector organizations in Sri Lanka. Vidyodaya Journal of Management, 6(2).

Samarasinghe, A.T.L.P., 2009. An Assessment on suitability of e-procurement for Sri Lanka Railways (Doctoral dissertation)

Sharabati, M.M., 2014. The Impact of E-procurement System Qualities and Trust on End-user Satisfaction. University of Malaya (Malaysia).

Silverman, D., 2021. Doing qualitative research.

Tera, A.A., Alzubi, A. and Iyiola, K., 2024. Supply chain digitalization and performance: A moderated mediation of supply chain visibility and supply chain survivability. Heliyon Tracy, S.J., 2010. Qualitative quality: Eight “big-tent” criteria for excellent qualitative research. Qualitative inquiry, 16(10), pp.837-851.

Tutu, S.O., Kissi, E., Osei-Tutu, E. and Desmond, A., 2019. Evaluating critical factors for the implementation of e-procurement in Ghana. International Journal of Procurement Management, 12(1), pp.1-14.

Walker, H. and Brammer, S., 2012. The relationship between sustainable procurement and e-procurement in the public sector. International Journal of Production Economics, 140(1), pp.256-268.

Weerasinghe, G., KanaheraArachchi, B., Jayaweera, M., Aryaratne, I., Samarasinghe, U. and Karunaratna, N., 2022. Effectiveness of implementing E-government procurement in Sri Lanka. In International conference on industrial engineering and operations management.

Weerasinghe, W.D., KanaheraArachchi, B.J., Jayaweera, L.P.M.I., Aryaratne, I.A., Samarasinghe, U. and Karunarathna, W.A.S.N., 2023. Critical Success Factors in the Implementation of Electronic Government Procurement in Sri Lanka. U. and Karunarathna, WASN, Critical Success Factors in the Implementation of Electronic Government Procurement in Sri Lanka (May 20, 2023).

Yin, R.K., 2009. Case study research: Design and methods (Vol. 5). sage.

NAVIGATING SUSTAINABLY: THE ECONOMIC RESILIENCE THROUGH CONTEMPORARY LOGISTICS MANAGEMENT

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"A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people." - Franklin D. Roosevelt

The Current Economic Crisis in Sri Lanka and Its Impact On Defence Spending And Logistics

Sri Lanka is currently navigating through a profound economic crisis, characterized by a severe foreign exchange shortage, high external debt, inflationary pressures and significant fiscal deficits. This economic turmoil has led to widespread shortages of essential goods, including fuel and medicine, and has sparked social unrest. The crisis has been exacerbated by the global economic slowdown, the impacts of the COVID-19 pandemic and rising energy prices (International Monetary Fund, 2023).

The defence sector, a critical component of the nation's sovereignty and security, has not been immune to these economic challenges. Defence spending and logistics operations, crucial for the maintenance of national security and the effective functioning of the military, including the Sri Lanka Navy (SLN), are facing unprecedented pressure. According to the Perera, M., & Silva, K, (2023), the economic constraints have necessitated a reevaluation of priorities, with an imperative need to optimize resource allocation without compromising operational readiness and effectiveness.

In this context, the impact on defence logistics is multifaceted. There's a heightened need for the SLN to pursue cost-efficiency in its operations, particularly in areas of purchasing, maintenance and operational expenditures. The scarcity of foreign currency complicates the procurement of imported equipment and supplies, which are vital for the navy's operational capabilities. Additionally, the budgetary constraints demand innovative approaches to sustain logistics operations, necessitating a shift towards more sustainable and economically viable practices (Ministry of Defence, Sri Lanka, 2023).

This situation presents both challenges and opportunities for the SLN to reorient its logistics and Supply Chain Management towards more sustainable and resilience-building practices. By adopting contemporary logistics management strategies, the Navy can not only navigate through the current economic difficulties but also set a precedent

for efficient and sustainable operations in the long term (Fernando, A., & Rajapakse, R, 2023).

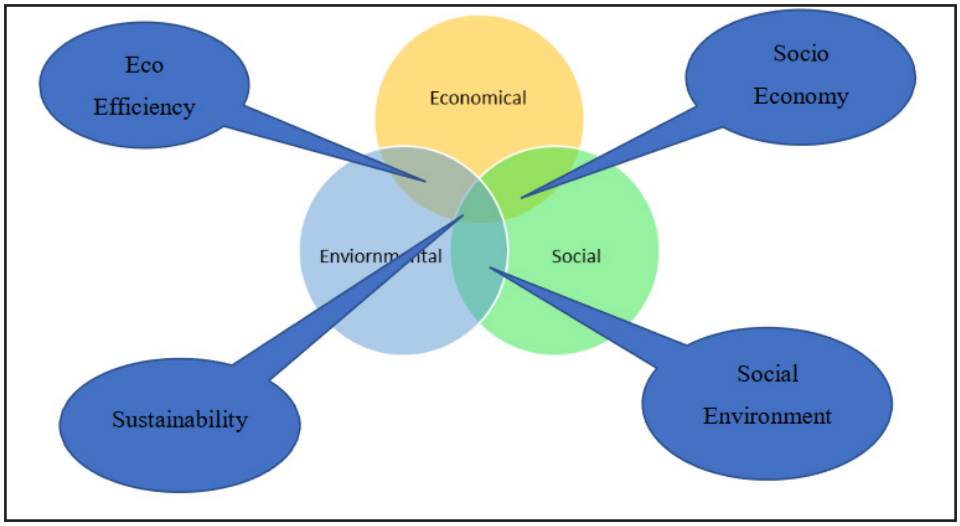
Background

The SLN, like many military organizations worldwide, has traditionally relied on a Logistics and Supply Chain Management system that prioritizes reliability, speed and operational readiness over cost-efficiency and environmental sustainability (Gunasekara, V., & Jayawardena, L, 2023). This system is designed to ensure that naval forces remain prepared and capable of performing their duties under any circumstances. It encompasses a wide range of activities, from procurement and inventory management to maintenance and distribution of resources across naval bases and fleet operations. Similarly, [Kumara, P., & De Silva, S. (2023)] highlighted that the primary focus has always been on meeting immediate operational requirements, often with less consideration for long-term sustainability and cost-effectiveness.

However, the economic crisis that Sri Lanka is currently facing has put unprecedented pressure on the SLN's traditional logistics practices. The crisis has led to significant budget cuts, forcing the Navy to operate within tighter financial constraints while still maintaining high standards of operational readiness. Additionally, the SLN is facing increased operational demands, further stretching its limited resources. In this context, the need for cost-efficiency has become more critical than ever. The challenge lies in reducing expenses without compromising the effectiveness and readiness of naval operations. This situation has necessitated a strategic reevaluation of logistics and supply chain management practices within the Navy (Sri Lanka Navy, 2023).

Sustainability is everything that human need directly or indirectly for the survival and their wellbeing with the natural environment. Sustainability is balance between human and nature under which conditions of existing social, economic, environmental and other requirements of present and future generations. It is nothing but the protecting of natural resources and environment for future generations sustainability for long run. Simply, actions taking to make some product today and how that process will affect in the future.

Further, sustainability is Triple Bottom Line theory (Dyllick, T. and Hockerts, K, 2002). Bottom line theory is unit to measure the success. Example of bottom line theory is to check that how much economic growth your company makes, also known as Single Bottom Line theory. Those company who consider the social aspect as well that is known as Double Bottom Line theory. Also, those company who consider the environmental as well that is known as Trible Bottom Line theory. If those company who consider the requirement of future generations in to the Bottom Line theory that is known as Quadra Bottom Line theory (Slaper T.F. and Hall, T.J., 2011).



The concept of sustainability in logistics emerges as a strategic response to these challenges. Sustainable logistics management involves the integration of environmental and social considerations into logistics and supply chain practices. It aims to minimize the ecological footprint of logistics activities while ensuring economic efficiency and social responsibility. For the SLN, adopting sustainable logistics practices represents an opportunity to address the current economic constraints without compromising its operational capabilities. It involves rethinking procurement strategies, investing in energy-efficient technologies, optimizing resource use, and reducing waste.

Sustainability in logistics is not just about environmental conservation; it's also about enhancing the economic resilience of the SLN through more efficient use of resources and cost savings. By adopting sustainable logistics practices, the SLN can reduce its operational costs, mitigate the impact of budget cuts, and contribute to a more sustainable and resilient national defence posture. This approach aligns with global trends in military logistics, where forces worldwide are increasingly recognizing the importance of sustainability as a means to achieve both operational excellence and long-term economic viability.

In this backdrop, the transition towards sustainable logistics and supply chain management emerges as an essential strategy for the SLN. It represents a shift from traditional practices towards more resilient, adaptable, and cost-effective logistics operations, ensuring that the Navy can continue to fulfill its vital role in national defense and security in an economically constrained environment.

The SLN, amidst an ongoing economic crisis, is at a crucial juncture where the management of its logistics and supply chain operations is imperative for maintaining operational readiness and economic resilience. The principles of sustainable logistics management are pivotal in navigating these challenging times, focusing on efficiency,

cost-effectiveness, and minimal waste. This essay delves into the pillars of sustainable logistics within the SLN, namely Purchasing and Procurement, Expenditure Management, Efficient Bill Payments and Financial Transactions, and Fund Allocation for Training, which collectively underpin the Navy's efforts to achieve operational excellence and financial prudence.

Purchasing and Procurement

Purchasing and procurement stand as critical components of the SLN's sustainable logistics framework. In the face of an economic downturn, the Navy has adopted strategic sourcing principles to ensure that procurement decisions are made with a focus on total life-cycle cost analysis (Carter, P.L. and Ellram, L.M., 2021), rather than just the initial purchase price. This involves selecting suppliers based on their ability to provide long-term value, reliability, and support for the Navy's sustainability objectives. By implementing competitive bidding processes, negotiating contracts that allow for flexibility and risk-sharing, and prioritizing local suppliers to reduce carbon footprints and support the local economy, the Navy ensures that its purchasing practices contribute to a more sustainable and resilient supply chain (Brammer, S. and Walker, H., 2022).

Expenditure Management

Effective expenditure management is another cornerstone of sustainable logistics. The SLN has instituted rigorous budgeting and financial oversight mechanisms to monitor and control spending closely. This includes the adoption of zero-based budgeting (Pyhrr, S.A., 2024), where every expense must be justified for each new period, promoting a culture of cost awareness and accountability. The Navy also leverages technology to improve financial transparency and efficiency, employing digital platforms for real-time monitoring of expenditures against budgets, identifying areas for cost savings, and ensuring that resources are allocated towards critical operational needs (Davies, R.J. and Bower, J.L., 2023).

Efficient Bill Payments and Financial Transactions

Efficient management of bill payments and financial transactions is crucial for maintaining the financial health and operational readiness of the Navy. Delays in payments can strain relationships with suppliers, leading to disruptions in the supply chain and potential operational setbacks (Carter, M.J. and Jennings, P.R., 2023). To combat this, the SLN has streamlined its payment processes, adopting electronic payment systems that reduce processing times, minimize errors, and improve cash flow management. These systems also allow for better tracking and auditing of transactions, ensuring transparency and accountability in financial dealings.

Fund Allocation for Training

Investing in training is essential for building a resilient and capable naval force. However, in times of economic constraints, balancing the need for comprehensive training with budget limitations becomes a challenge. The SLN addresses this by prioritizing fund allocation for essential training programs that enhance operational capabilities and readiness. This includes adopting blended learning approaches, combining traditional classroom instruction with online and virtual training methods, which can reduce costs while still delivering high-quality training (Thomson, A. R., & Jackson, L. M., 2023). Additionally, the Navy explores partnerships with other military institutions and allies for joint training initiatives, sharing resources, and knowledge to mutual benefit (Patel, S. K., & Mehra, V., 2022).

Not only above, the case studies and examples within the SLN and other navies worldwide showcase the tangible benefits of implementing sustainable logistics practices. These examples highlight how sustainable approaches can lead to cost savings, improved operational efficiency, and reduced environmental impact.

Case Study 1: Sri Lanka Navy's Green Procurement Initiative

In recent years, the SLN has embarked on a Green Procurement Initiative aimed at reducing the environmental footprint of its procurement activities while promoting sustainable practices. As part of this initiative, the Navy has prioritized sourcing products and services from eco- friendly suppliers and adopting environmentally friendly materials and equipment.

Outcomes:

Cost Savings: By prioritizing energy-efficient equipment and materials with longer lifespans, the Navy has achieved significant cost savings in maintenance and replacement expenditures.

Improved Operational Efficiency: Eco-friendly materials and equipment often have superior performance characteristics, leading to enhanced operational efficiency and effectiveness.

Reduced Environmental Impact: The adoption of green procurement practices has resulted in a measurable reduction in the Navy's carbon footprint and environmental impact, contributing to broader sustainability goals.

Case Study 2: United States Navy's Energy Conservation Program

The United States Navy has implemented an Energy Conservation Program aimed at reducing energy consumption and promoting energy efficiency across its fleet and shore installations. This program includes initiatives such as the use of alternative fuels, energy-efficient technologies, and operational practices that minimize fuel consumption.

Outcomes:

Cost Savings: The Energy Conservation Program has resulted in significant cost savings for the United States Navy, with reductions in fuel expenditures and maintenance costs.

Improved Operational Efficiency: By optimizing energy use and reducing reliance on fossil fuels, the Navy has improved the operational range and endurance of its vessels, enhancing overall mission capability.

Environmental Benefits: The program has led to a substantial reduction in greenhouse gas emissions and other pollutants, contributing to environmental stewardship and sustainability efforts.

Case Study 3: Royal Australian Navy's Waste Reduction Program

The Royal Australian Navy has implemented a Waste Reduction Program aimed at minimizing waste generation and promoting recycling and reuse practices across its operations. This program includes initiatives such as waste audits, recycling programs, and the adoption of sustainable packaging materials.

Outcomes:

Cost Savings: The Waste Reduction Program has resulted in cost savings for the Royal Australian Navy through reduced waste disposal fees and the monetization of recyclable materials.

Improved Operational Efficiency: By minimizing waste generation and promoting recycling, the Navy has streamlined its logistics operations and reduced the logistical burden associated with waste management.

Environmental Benefits: The program has led to a significant reduction in the Navy's waste footprint, contributing to environmental sustainability and conservation efforts. Above case studies and examples illustrate the tangible benefits of implementing sustainable logistics practices within naval operations.

Importance of Sustainable Logistics Management for Military Operations

Sustainable logistics management in the military context refers to the strategic planning and execution of logistics and supply chain activities with a focus on optimizing resources, minimizing environmental impact, and ensuring long-term operational efficiency and effectiveness. This concept extends beyond the traditional goal of logistics, which is to ensure the right items are at the right place, at the right time, and in the right condition. It incorporates principles of sustainability, emphasizing the need to balance economic, environmental, and social objectives.

Economic Efficiency

Economic constraints highlight the critical importance of cost-efficiency in military logistics. Sustainable logistics management helps in identifying and implementing cost-saving measures without compromising the quality or readiness of military operations. It involves strategic sourcing, inventory optimization, and investment in durable and multifunctional equipment, thereby ensuring that scarce resources are utilized effectively.

Resource Optimization

In times of limited resources, optimizing the use of available assets becomes paramount. Sustainable logistics management focuses on the efficient use of resources, reducing waste through better planning, maintenance, and the re-use of materials. This approach supports the military in maintaining operational capabilities even when resources are constrained.

Environmental Responsibility

Military operations have a significant environmental footprint, including fuel consumption, emissions, and waste production. Sustainable logistics practices, such as the use of alternative fuels, energy-efficient technologies, and waste reduction measures, can mitigate these impacts. This not only contributes to global environmental goals but also aligns with a growing need for the military to operate in an environmentally responsible manner.

Enhancing Operational Resilience

Sustainable logistics management enhances the resilience of military operations by ensuring that logistics systems are flexible and adaptable to changing conditions. This is particularly important in times of economic crisis, where supply chains may be disrupted, and traditional logistics routes may become untenable. A focus on sustainability can lead to more resilient and diversified supply chains, capable of maintaining operations under varied circumstances.

Social and Ethical Considerations

Incorporating social and ethical considerations into logistics management, such as fair labor practices and community engagement, can improve the military's standing both domestically and internationally. Sustainable logistics practices that consider the well-being of personnel and the communities in which operations occur contribute to a positive image and foster good relations, which are invaluable, especially in operations abroad.

Therefore, sustainable logistics management is crucial for military operations, especially under economic constraints. It offers a pathway to maintain operational readiness and effectiveness while ensuring economic efficiency, environmental responsibility, and social ethics. For the SLN, amidst the current economic crisis, adopting sustainable logistics practices is not just a strategic advantage but a necessity to navigate through challenging times and prepare for a sustainable future.

Training

E-Learning and Simulation-Based Training

Adopting e-learning platforms and simulation-based training can significantly reduce training costs while minimizing environmental impact. These technologies reduce the need for physical resources, travel, and accommodation, leading to lower expenditures and a smaller carbon footprint. Virtual simulations can provide realistic training scenarios for naval operations, maintenance, and combat tactics without the actual costs and logistical challenges associated with traditional training exercises.

Cross-Functional Skill Development

Promoting cross-functional skill development among personnel can enhance the flexibility and adaptability of the workforce. By training naval personnel in multiple disciplines, the Navy can optimize manpower and reduce the need for specialized training sessions, thereby saving on training costs and resources.

Purchasing

Strategic Sourcing and Procurement

Implementing strategic sourcing can help the Navy in identifying and procuring goods and services at the best possible prices. By adopting a centralized procurement system, the Navy can leverage its purchasing power, negotiate better terms with suppliers, and reduce costs. Furthermore, prioritizing suppliers that adhere to sustainable practices can minimize environmental impact and promote social responsibility.

Adopting Green Procurement Policies

Green procurement policies focus on purchasing products and services that have a lesser or reduced effect on human health and the environment compared to competing products. This includes opting for energy-efficient equipment, biodegradable materials, and reducing the reliance on single-use items. Such policies not only contribute to sustainability goals but can also lead to long-term cost savings through reduced energy consumption and waste management costs.

Expenditures

Energy Efficiency and Renewable Energy

Investing in energy-efficient technologies and renewable energy sources for naval bases and ships can significantly reduce energy costs. Solar panels, wind energy systems, and energy- efficient appliances can decrease reliance on fossil fuels, leading to substantial savings in operational costs over time.

Waste Reduction and Recycling

Implementing waste reduction strategies and recycling programs can minimize operational waste and associated disposal costs. By reducing, reusing, and recycling materials, the Navy can lower its expenditures on raw materials and waste management services.

Bill Payments

Electronic Payment Systems

Transitioning to electronic payment systems can streamline bill payments, reduce processing times, and cut down on administrative costs. Digital transactions are not only cost-efficient but also provide better tracking and management of financial flows, enhancing transparency and accountability.

Dynamic Budgeting and Financial Management

Adopting dynamic budgeting and financial management practices can help the Navy more effectively allocate resources based on priority and need. This involves regular review and adjustment of budgets based on operational demands and economic conditions, ensuring that funds are utilized efficiently and effectively.

By adopting contemporary sustainable logistics practices, the SLN can enhance its economic resilience, reduce its environmental footprint, and maintain high standards of

operational readiness even in the face of economic challenges.Implementing sustainable logistics practices in the SLN presents several challenges that must be addressed to ensure successful adoption and integration into operational procedures. These challenges include resistance to change, budget constraints, and the need for training.

Challenges

Resistance to Change

Resistance to change from traditional practices can hinder the adoption of sustainable logistics initiatives. Stakeholders may be reluctant to deviate from established procedures or may lack awareness of the benefits of sustainability.

Budget Constraints

Limited financial resources pose a significant challenge to implementing sustainable logistics practices. Budget constraints may restrict investments in sustainable technologies and infrastructure, making it difficult to initiate and sustain sustainability initiatives.

Need for Training

Personnel may require training to understand the principles of sustainable logistics and how to implement them effectively. Lack of training can lead to inefficiencies and resistance to new practices.
Solutions

Stakeholder Engagement

Engaging stakeholders, including naval personnel, leadership, suppliers, and other relevant parties, is crucial for overcoming resistance to change. By involving stakeholders in the decision-making process and communicating the benefits of sustainable logistics, buy-in and support for initiatives can be fostered.

Phased Implementation Plans

Implementing sustainable logistics practices in phases allows for gradual adaptation and minimizes disruptions to operations. By breaking down initiatives into manageable steps, the Navy can address challenges incrementally and build momentum for sustainable change.

Investment in Technology

Investing in technology, such as energy-efficient equipment, digital systems for tracking and monitoring, and renewable energy sources, can help overcome budget constraints and improve operational efficiency. Technology investments may initially require upfront costs but can yield long-term savings and environmental benefits.

Personnel Training

Providing comprehensive training programs on sustainable logistics principles and practices is essential for ensuring successful implementation. Training should be tailored to different levels of personnel and cover topics such as waste reduction, energy conservation, and green procurement. Investing in personnel training demonstrates the Navy's commitment to sustainability and empowers employees to contribute to ongoing initiatives.

Collaboration and Partnerships

Collaborating with external organizations, government agencies, and industry partners can provide valuable resources and expertise to support sustainable logistics efforts. Partnerships can facilitate knowledge sharing, access to funding opportunities, and joint initiatives to address common challenges.

Addressing the challenges of implementing sustainable logistics in the SLN requires a multifaceted approach that encompasses stakeholder engagement, phased implementation, investment in technology and training, and collaboration with external partners. By overcoming these challenges, the Navy can enhance its operational efficiency, reduce environmental impact, and build resilience in the face of economic constraints.

Conclusion

In conclusion, sustainable logistics management stands as a cornerstone for the SLN's economic resilience amidst the current economic crisis. Throughout this essay, it was able to explored the pillars of sustainable logistics, including purchasing and procurement, expenditure management, efficient bill payments and financial transactions, and fund allocation for training, showcasing how these practices contribute to operational excellence and financial prudence.

By strategically adopting sustainable logistics practices, the SLN can navigate economic challenges while ensuring operational readiness and effectiveness. From prioritizing green procurement initiatives to streamlining expenditure management and embracing digital payment systems, sustainable logistics not only drive cost savings but

also enhance operational efficiency and reduce environmental impact.

The critical role of sustainable logistics management in building economic resilience for the SLN cannot be overstated. By optimizing resource allocation, minimizing waste, and promoting transparency and accountability in financial transactions, the Navy can weather the storm of economic uncertainty and emerge stronger and more resilient.

Further, it is imperative for the SLN to maintain an ongoing commitment to sustainability practices, innovation, and strategic planning. By continually refining and adapting its logistics operations to changing economic conditions and emerging challenges, the Navy can effectively navigate the economic crisis and position itself for long-term success.

REFERENCES

International Monetary Fund. (2023). Sri Lanka: Economic Outlook. [Report].

Perera, M., & Silva, K. (2023). An Analysis of the Economic Crisis in Sri Lanka: Causes and Solutions. Journal of South Asian Economic Studies, 5(1), 45-60.

Ministry of Defence, Sri Lanka. (2023). Annual Report 2023: Impact of Economic Constraints on Defence Operations. [Government Document].

Fernando, A., & Rajapakse, R. (2023). Optimizing Defence Expenditures in Times of Economic Crisis: A Case Study of Sri Lanka. Defence Studies Journal, 17(2), 234-250.

Gunasekara, V., & Jayawardena, L. (2023). Innovative Logistics Strategies in the Sri Lanka Navy: Adapting to Economic Challenges. International Journal of Naval Warfare Studies, 12(3), 112-128.

Kumara, P., & De Silva, S. (2023). Building Resilience and Sustainability in Military Operations: Lessons from the Sri Lanka Navy. Journal of Sustainable Defence Management, 4(1), 75-89.

Sri Lanka Navy. (2023). Logistics and Supply Chain Management Strategy 2023-2028. [Military Strategy Document].

Slaper, T.F. and Hall, T.J. (2011). The Triple Bottom Line: What Is It and How Does It Work? Indiana Business Review, 86(1), pp.4-8.

Carter, P.L. and Ellram, L.M. (2021). Strategic sourcing in the public sector: A framework for defense procurement. Journal of Public Procurement, 21(1), pp. 12-31.

Brammer, S. and Walker, H. (2022). Sustainable procurement in the public sector: An international comparative study. International Journal of Operations & Production Management, 42(4), pp. 457-480.

Pyhrr, S.A. (2024). Zero-based budgeting in the defense sector: A pathway to financial efficiency. Journal of Defense Finance and Management, 11(2), pp. 45-62.

Davies, R.J. and Bower, J.L. (2023). Implementing rigorous financial oversight in public sector organizations. Public Administration Review, 83(1), pp. 100-115.

Carter, M.J. and Jennings, P.R. (2023). The impact of electronic payment systems on supply chain efficiency: A study in defense logistics. International Journal of Logistics Management, 34(3), pp. 775-794.

Thomson, A. R., & Jackson, L. M. (2023). Blended Learning in Military Education: Enhancing Operational Readiness in Economically Constrained Environments. Journal of Defense Education, 45(2), pp. 234-250.

Patel, S. K., & Mehra, V. (2022). Strategic Alliances in Military Training: A Pathway to Interoperability and Cost-Efficiency. International Review of Armed Forces Education, 17(1), pp. 89-107.

CONCEPTUALIZING THE SCM 4.0 FOR MANAGING SUPPLY CHAIN IN FOOD MANUFACTURING INDUSTRY: A SYSTEMATIC REVIEW

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Abstract

Supply Chain Management 4.0 (SCM 4.0) manages the network of the manufacturing industry through the establishment of a sustainable supply chain. Their functionality is spread throughout the world at this juncture, creating a volatile environment in this sector. Therefore, managers and policymakers need attention to adapt to this technological revaluation and gain a better understanding. This study mainly focuses on identifying the major technologies of SCM 4.0, their contribution, and the challenges of adaptation by developing a conceptual model for the food manufacturing industry. Due to a lack of studies about this phenomenon, literature from 2015–2023 was used, which was published in the Emerald Insight academic database and followed the Systematic Literature Review (SLR). It found emerging technologies of SCM 4.0 that are used in the manufacturing sector and their major contribution to the performance of the entire supply chain. Studies show that cloud computing, the Internet of Things, and big data analytics are the most commonly used technologies presently. Therefore, supply chain performance is mainly based on the capability of a data-driven supply network. While organizations are margining the supply chain, they are facing major difficulties in adapting these technologies: scarcity of infrastructure, lack of support from top management, unavailability of better policies, and inadequate human resource development. Finally, concluding these findings, this study develops the conceptual model with the contribution of past research in view of the development of the supply chain in the food manufacturing industry.

Key words: *Industry 4.0, Supply Chain Management 4.0, supply chain performance, manufacturing industry, challenges*

1. Introduction

The manufacturing industry has been largely affected by digitalization with the success of industrial revaluations. As a result of the manufacturing and service industries, there have been changes in the productivity of companies (Paksoy, et al., 2021). Approximately ten years ago, these changes were identified as digitalized autonomous factories, data-driven smart technologies, and integrated supply chains, which are called Industry 4.0 (I 4.0) or the 4th Industrial Revaluation. Therefore, industrial 4.0 has become a game changer in the manufacturing sector. Importantly, it has

converted supply chain management into an essential part of the production engineering process (Khan, et al., 2022) and added new dimensions to logistics and supply chain management (Özdağoğlu & Bahar, 2022). Meanwhile, this is also referred to as Supply Chain 4.0, which is reorganizing the supply chain: planning, distributions, procurement, warehousing, and reverse logistics using emerging technologies of Industry 4.0 (WTO, 2019). In fact, Logistics 4.0 utilizes this for the automation of material flow (Dallasega, et al., 2022).

Currently, in developed countries, emerging technologies have been used for the frontier of SCM in organizations (WTO, 2019) by introducing the latest technologies such as cloud computing, the internet of things, cyber security, big data analysis, augmented reality, additive manufacturing, artificial intelligence, robotics, etc. (Paksoy , et al., 2021). This vibrant technology helps to become an essential function of an organization creating balance performance of the environment and economic (Umar, et al., 2020), due to converting from liner model to more integrated model to flow the information from supplier to consumer in multiple directions (WTO, 2019), leveraging organization capabilities through the improvement of connectivity and transparency of material flow (Dallasega, et al., 2022), achieving sustainable development through digital collaboration between customers and suppliers in the network (Bag, et al., 2018), and leading to supply chain resilience (Nakandala, et al., 2023) which support for humanity and to collaborate between sustainable performance of the supply chain and cross over the countries (Acioli et al., 2021), make vertical and horizontal integration in the supply chain and ensure technological and information integration (Frederico, et al., 2021), improve efficiency, responsiveness, quality management, customer-oriented and sustainable performance (Chauhan & Singh, 2020), enhance competitive advantages on the basis of cost, differentiation, and focalization (Benitez, et al., 2022), and ensure the supply chain performance (SCP) (Erboz, et al., 2022).

However, as the premier international organization for trading and business, UNCTAD has highlighted the gap in the adaptation of new technology and innovation. As per the UNCTAD's technology and innovation report 2023, the adaptation of new technology has increased the rank of the countries that have addressed the new technologies and innovations for trading. Among the 166 economies in the world, the USA, Sweden, and Singapore earned the highest rank in 2022. However, Sri Lanka was placed 89th, indicating the minimum usage of new technological applications and innovations for trade and business.

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Table 1: Frontier Technologies Readiness Index - 2022

Country	Total Score	Rank
USA	1	1
Sweden	0.99	2
Singapore	0.96	3
China, Hong Kong	0.91	9
Malaysia	0.76	31
China	0.74	35
UAE	0.74	37
India	0.66	46
Vietnam	0.58	62
Sri Lanka	0.45	89

Source: Technology and Innovation Report 2023 (UNCTAD)

Food manufacturing is very important because it ensures global sustainability and food security. Most of the research and studies have concerned the importance, impact, and challenges of this industry. Meanwhile, considering the existing research about Supply Chain Management 4.0 (SCM 4.0)'s technologies, their importance and challenges have not been addressed with sufficient studies in the food manufacturing sector. Therefore, this study focuses on identifying the technologies of SCM 4.0, their importance, and adaptation challenges on a single platform through the development of a conceptual model. In fact, Table 1.1 shows the lack of adaptation to new technologies and innovation in the countries. As a result, this study focuses on the most pressing issues concerning technological adaptation. According to that study, address the following research questions:

RQ1: What are the major technologies and their importance of SCM 4.0 to manage the supply chain in food manufacturing sector?
RQ2: What are the challenges of adaptation of SCM 4.0 to manage the supply chain in food manufacturing sector?

To address these problems, the author has organized the article into five sections. After identifying the study background, problem, and objective under the introduction section, the researcher has described the systematic approach in view of addressing the research questions and objectives, which are clearly described in the methodology

section of the article. Thirdly, the results, findings, and analysis comprehensively present the insight of the findings using literature. After the discussion section, a conceptual model is introduced with the emerging technologies, their importance, and the challenges of adapting to managing the supply chain in the food manufacturing sector. Finally, the researcher concludes the article, addressing the research questions, future research directions, and limitations of the study.

2. Methodology

Mainly, researcher use the Systematic Literature Review (SLR) approach for the purpose of making the conceptualization model of SCM 4.0 in order to manage the supply chain in the food manufacturing sector. This technique consists of five steps, as per Denyer and Tranfield (2009):

1. Formulation of the research question
2. Identification of studies
3. Selection and evaluation of studies
4. Analysis and synthesis
5. Presentation of results and discussion

The initial step is the identification of research questions, which can be identified and determined in the introduction section of the study. The second stage is critical due to the identification of the relevant studies to answer the research questions. This study is carried out for articles published between 2015 and 2024 using the Emerald Insight data base, which is widely used for social sciences research, especially in the management-related field.

Table 2: Search Syntax

Data Collection source	Composition (Syntax) of the search
Search was performed on 07th March 2024 using the Emerald Insight, (www.emerald.com)	(content-type:article) AND (abstract:”Industry 4.0” OR (abstract:”SCM 4.0”) OR (abstract:”Logistics 4.0) AND (abstract:”Supply chain management”) AND (abstract:”Importance”) OR (abstract:”Significant”) AND (abstract:”Food manufacturing”) AND (abstract:”Challenges”) OR (abstract:”Barriers”)

Source: Developed by author

As the third step, after the searching of papers based on the abstract, key words, and title, the author found 677 articles on the database, which were found through search syntax (Table 2). After screening the purpose, findings, conclusion, and abstract of

the 677 identified journal articles, 85 articles were identified. Accordingly, 85 articles were selected that met the following exclusion criteria: papers relevant to this research. Therefore, 85 articles were critically examined, considering the abstract, objectives, and conclusion to drive and identify the relationship between SCM 4.0 and supply chain management in the manufacturing industry. Finally, 51 articles were identified as the most relevant to the research problem, topic, and objectives (Figure 1).

Under the analysis and synthesis stage, the author identifies the major technologies and their importance to drive the supply chain in the manufacturing sector. And also, challenges and barriers to the adaptation of SCM 4.0 to manage the supply chain are identified. Both aspects have been identified, and the various aspects serve as the foundation for the study's conclusion. As the final step, the results or findings are discussed by introducing the developed conceptual model to the identified literature.

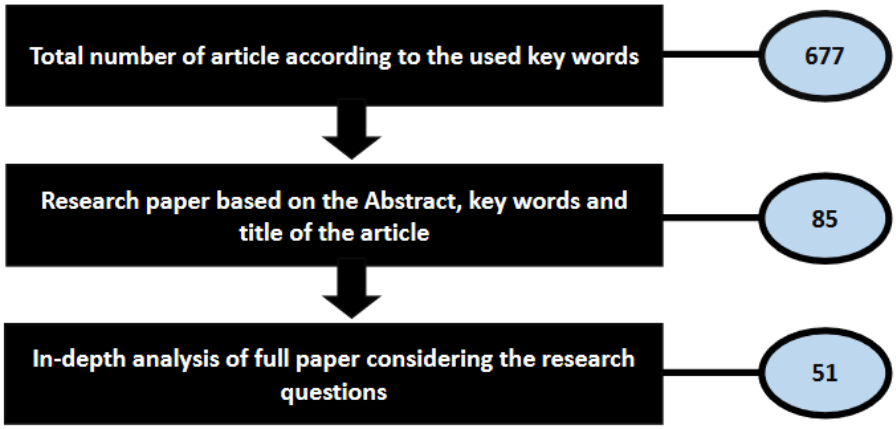

Figure 1: Article selection and screening
Source: Developed by author

3. Results

The results of 51 selected papers support identifying the current technologies of SCM 4.0, its importance (RQ.1), and the major challenges (RQ 2). Accordingly, studies were identified under three main categories to develop the conceptual model.

3.1 Technologies of SCM 4.0

In this section, the author identified the major technologies used in SCM 4.0 for managing the supply chain in the manufacturing sector. Commonly, Table 3 and Figure 2 show the thirteen technologies mentioned in the articles.

Table 3: Technologies of SCM 4.0

Technology	Articles
Cloud Computing (CC)	Ghadge, et al., (2020), Erboz, et al., (2022), Yuan, et al., (2022), Santacruz, et al., (2022), Tripathi & Gupta, (2020), Ardito, et al., (2019), Raji, et al., (2021), Queiroz, et al., (2021), Sundarakani, et al., (2019)
Internet of Things (IoT)	Erboz, et al., (2022), Tiwari, (2020), Dallasega, et al., (2022), Ali & Aboelmaged, (2021), Haddud & Bienhaus, (2018), Yuan, et al., (2022), Strange & Zucchella, (2017), Tripathi & Gupta, (2020), Sharma, et al., (2020), Raji, et al., (2021), Ghadge, et al., (2020), Queiroz, et al.,(2021), Jerome, et al., (2022)
Artificial Intelligence (AI)	Haddud & Bienhaus, (2018), Yuan, et al., (2022), Tripathi & Gupta, (2020), Queiroz, et al., (2021), Jerome, et al., (2022)
Big Data Analytics (BDA)	Ghadge, et al., (2020), Erboz, et al., (2022, (Haddud & Bienhaus, (2018), Yuan, et al., (2022), Strange & Zucchella, (2017), Tripathi & Gupta, (2020), Ardito, et al., (2019), Raji, et al., (2021), Queiroz, et al., (2021), Jerome, et al., (2022)
Radio Frequency Identification (RFID)	Ghadge, et al., (2020), Dallasega, et al., (2022), Phan & Ali, (2021), Sarkar, et al., (2022), Santacruz, et al., (2022), Queiroz, et al., (2021)
Cyber security	Erboz, et al., (2022), Queiroz, et al., (2021)
Machine Learning (ML)	Sundarakani, et al., (2019)
Block chain (BC)	Ali & Aboelmaged, (2021) 21, Mubarik , et al., (2021)43, Tripathi & Gupta, (2020), Queiroz, et al., (2021)
Virtual Reality (VR), Augmented Reality (AR)	Yuan, et al., (2022), Santacruz, et al., (2022), Queiroz, et al., (2021), Jerome, et al., (2022)
Autonomous guided Vehicle (AGV)	Santacruz, et al., (2022), Queiroz, et al., (2021)
Additive Manufacturing (AM)	Bag, et al., (2018), Strange & Zucchella, (2017)
Robotics	Strange & Zucchella, (2017)

Source: Developed by author

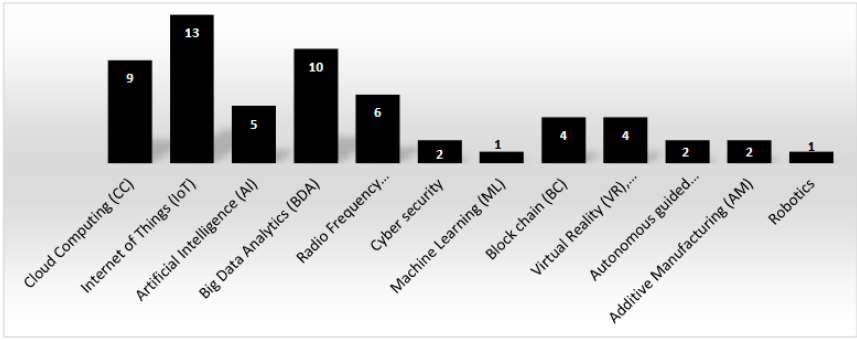

Figure 2: No. of articles mentioned Technologies of SCM 4.0
Source: Developed by author

According to this identification, CC, IoT, AI, BDA, RFID, and BC are frequently mentioned in the same articles. IoT and Big Data Analysis are the mostly mentioned technologies in 13 and 10 of the articles.

3.2 Contribution of Technologies in SCM 4.0

According to the research question, the author is required to identify the role and contribution of technology in managing the functions of the supply chain in the manufacturing sector. Therefore, Table 4 indicates the major contribution of these technologies to managing the supply chain by past scholars.

Table 4: Contribution of Technologies in SCM 4.0

Technology	Role /Contribution to manufacturing
Cloud Computing (CC)	Storing row data as structured information and providing input for data analysis and customer profiling (Ghadge, et al., 2020), Store and exchange data through the channel (Erboz, et al., 2022; Queiroz, et al., 2021; Ardito, et al., 2019), Providing infrastructure for other technologies (Yuan, et al., 2022), help to warehousing management (Santacruz, et al., 2022), identify the relationships, patterns, and correlations of the data (Tripathi & Gupta, 2020), making interoperability and remote access to data or information (Ardito, et al., 2019), coordinating and integrating activities (Raji et al., 2021), and efficient and cost-cutting operations (Queiroz, et al., 2021).
	Integration of logistics functions (Tiwari, 2020), product tracing throughout the chain (Dallasega, et al., 2022), Monitor temperature and humidity (Ali & Aboelmaged, 2021), warehouse management (Phan & Ali, 2021), Daily activities of business and administration, decision-making processes, and maintaining relationships with the buyer and

Internet of Things (IoT)	supplier (Haddud & Bienhaus, 2018), Linking activities of SCM (Yuan, et al., 2022; Queiroz, et al., 2021; Raji, et al., 2021), creation, capturing, processing, and transferring data (Strange & Zucchella, 2017; Tripathi & Gupta, 2020; Jerome, et al., 2022), Communication data and information through multiple sources across the partners of the global supply chain (Sharma, et al., 2020), Processing and sharing of information across SCM and marketing functions (Ardito, et al., 2019), Lean and agile practices of inventory management (Raji, et al., 2021), collecting raw data of inbound and outbound logistics throughout the supply chain interacting with products and customers (Ghadge, et al., 2020; Erboz, et al., 2022), integrating the data (Jerome, et al., 2022), and helping to demand planning for raw materials and production planning (Jerome, et al., 2022).
Artificial Intelligence (AI)	Daily activities of business and administration, decision making processes, and maintaining relationships with the buyer and supplier (Haddud & Bienhaus, 2018; Queiroz, et al., 2021), Relevant activities in manufacturing (Yuan, et al., 2022), Identify the relationships, patterns, and correlations (Tripathi & Gupta, 2020), analyze complex situations and large-scale data, provide support to make decisions, reduce errors, and reduce the cost of operations and training (Jerome, et al., 2022).
Big Data Analytics (BDA)	Providing customer profiling (Ardito, et al., 2019; Ghadge, et al., 2020; Erboz, et al., 2022) and analysis, generate knowledge (Ghadge, et al., 2020; Erboz, et al., 2022), Daily activities of business and administration, decision making processes, and maintaining relationships with the buyer and supplier (Haddud & Bienhaus, 2018; Raji, et al., 2021), Linking activities of SCM (Yuan, et al., 2022), Data storage and use for business decisions (Strange & Zucchella, 2017), Identify the relationships, patterns, and correlations (Tripathi & Gupta, 2020), support strategic decision-making integrating SCM and marketing (Ardito, et al., 2019), collect and analyze data in a short time and transfer it through the network in real-time (Queiroz, et al., 2021; Jerome, et al., 2022).
Radio Frequency Identification (RFID)	Inventory management (Ghadge, et al., 2020), product tracing throughout the chain (Dallasega, et al., 2022), warehouse management (Sarkar, et al., 2022; Santacruz, et al., 2022), port logistics activities (Sarkar & Kar, 2023), picking activity in the warehouse (Queiroz, et al., 2021).
Cyber security	Information protection (Erboz, et al., 2022) is a mandatory requirement to store and transfer data securely in the supply network (Queiroz, et al., 2021)
Machine Learning (ML)	Integration of logistics functions (Tiwari, 2020).
Additive Manufacturing (AM)	Autonomous manufacturing includes ordering and assessing manufacturability (Bag, et al., 2018).

Block chain (BC)	Monitor temperature and humidity (Ali & Aboelmaged, 2021), green procurement, design, manufacturing, and distribution (Mubarik , et al., 2021), procurement activities including ordering, selection, etc. (Tripathi & Gupta, 2020), making smart contracts, and creating a more responsive, agile, and economical supply network (Queiroz, et al., 2021).
Virtual Reality (VR), Augmented Reality (AR)	Relevant activities in manufacturing (Yuan, et al., 2022), warehousing management (Santacruz, et al., 2022). Stimulates the operation of warehouses and provides interaction in real time throughout the network (Queiroz, et al., 2021). Perfectly real-time information can be visualized during procurement activities such as meetings, bidding, negotiation, and making contract agreements through interaction (Jerome, et al., 2022).
Autonomous guided Vehicle (AGV)	Warehousing Management (Santacruz, et al., 2022), internal transport arrangement (Queiroz, et al., 2021).
Additive Manufacturing (AM)	Autonomous manufacturing includes ordering, assessing manufacturability (Bag, et al., 2018), and integrating the machines for all the activities (Strange & Zucchella, 2017)
Robotics	Activities related to manufacturing (Strange & Zucchella, 2017).

Source: Developed by author

3.3 Challenges to Adapt for SCM 4.0

` Challenges for adoption of the application of SCM 4.0 can be conceptualized as follows according the relevant articles.

a. Lack of infrastructure facilities

As a barrier to implementing SCM 4.0, insufficient and lack of infrastructure facilities are considerable challenges to implementing the technologies (Agarwel, et al., 2022; Chauhan & Singh, 2020; Khin & Kee, 2022; Sarkar, et al., 2022; Frederico, et al., 2021). It increases with the unavailability of the right capacities which leads to the abandonment of support (Haddud & Bienhaus, 2018). Meanwhile, authors mention this matter from different perspectives: lack of digital infrastructure facilities, networks, fiber connectivity, limits to accessing high-quality data (Ghadge, et al., 2020), outdated infrastructure facilities (Santacruz, et al., 2022), no provision of promising quantities and standards of physical infrastructure facilities, (Tripathi & Gupta, 2020). Jerome, et al., (2022) have mentioned that information communication technology and systems have become major barriers to implementing technologies

in procurement related innovations. And also, a lack of warehouse facilities (Queiroz, et al., 2021) and handling capacity in the port (Sarkar, et al., 2022) becomes a threat to the high quantity handling of cargo in port logistics.

b. Insufficient research and development

The limitations of innovation capabilities make it difficult to spread the adaptation of Logistics 4.0 (Tripathi & Gupta, 2020). In addition to that development and application of practices, product research and product development have become challenges in the organization (Claudia Lizette Garay-Rondero, et al., 2020), and the specially operation environment of port logistics has been changing with innovative international logistics (Sarkar, et al., 2022). However, this innovation comes through R&D and limits the applications of port logistics such as terminal operation, clearance, inbound and outbound transportation, warehouse handling, loading and unloading, etc. (Sarkar, et al., 2022).

c. Maintaining lack of inter department and organization coordination

Coordination among the actors in the supply chain ensures the smooth functioning of the supply chain (Agarwel, et al., 2022), inversely, lack of coordination and collaboration creates problems of data security and, as a result, legal issues (Ghadge, et al., 2020); especially, lack of coordination among the inter organizations (Frederico, et al., 2021), ineffective communication between departments (Jerome, et al., 2022), and lack of integration with suppliers and customers (Queiroz, et al., 2021) have been making threats to the adopting technology.

d. Inadequate human resource development

Capabilities for the implantation of the I4.0 such as human resource development and organizational skills (Frederico, et al., 2021), and policies related to workers are essential to implementing the innovative technology (Queiroz, et al., 2021). HR and organizational skills (Agarwel, et al., 2022), the major challenge is absorbing the right people to implement Industry 4.o, in addition to the absence of knowledge, lack of skill development and training of the operators (Chauhan & Singh, 2020; Jerome, et al., 2022), and traditional attitude of the operators. (Khin & Kee, 2022), skill and competency development (Tripathi & Gupta, 2020; Chauhan & Singh, 2020), mainly its impact on delaying the digital transformation (Weerabahu, et al., 2022).

e. Lack of Top management support

Support from top management (Agarwel, et al., 2022; Ghadge, et al., 2020), and leadership (Frederico, 2021), strategic vision directly and indirectly impacts the implementation of I4.0 (Ghadge, et al., 2020). One of the major reasons for that uncertainty is the return on investment on the new technologies (Jerome, et al., 2022). Without their contribution, it is difficult to map the technology enhancement in the operation of international logistics (Sarkar, et al., 2022).

f. Deficiency of the required polies and strategies

The policy of the organization can influence the adaptation of emerging technologies, and a lack of policies leads toward minimizing research and development (Ghadge et al., 2020). Further policies related to skill and competency development (Romanello & Veglio, 2022), information and communication technology (Queiroz, et al., 2021), training, procedures, processes, and instructions (Dallasega, et al., 2022) impact adaptation negatively. Meanwhile, staff training, procedures, processes, instructions, and policies will facilitate and guide effective collaboration among the actors in the supply chain. And also, this can be developed through the building of the analytics and technological capacity of workers (Dallasega, et al., 2022).

In addition, organizations don't define new roles, responsibilities, and tasks considering the emerging technologies for the employees in their organizational structure (Haddud & Bienhaus, 2018). Such as the unavailability of standardization of the implementation (Santacruz, et al., 2022), indicated a lack of government support despite the unavailability of strong policies. Further, the slow performance of digital awareness, regulations, procedures, digital infrastructure, and cyber security has a slow performance compared with the international context, and poor improvement over the year and policy implications. (Tripathi & Gupta, 2020) harm to the adaptation of technology. Therefore, strategies for new manufacturing in smart factories (Claudia Lizette Garay-Rondero, et al., 2020), and the strategic vision (Agarwel, et al., 2022) of the organization create a feasible environment for the digital environment (Sarkar, et al., 2022).

g. Insufficient awareness

Awareness among the parties (Agarwel, et al., 2022), understanding

are very important, which relate to the requirements, benefits, and capabilities of the implementation (Jerome, et al., 2022). Further, they don't have an idea about the investment and required capital (Jerome, et al., 2022). Therefore, marketing becomes a challenge to implement I4.0. (Claudia Lizette Garay-Rondero, et al., 2020). Meanwhile, it is a challenge to identify the actual return on investment due to the changing modern environment. As a result, it is difficult to identify the actual economic benefits and gains of the implementations (Weerabahu, et al., 2022).

h. Inertia of the organization and workers

Due to consideration of the economic benefits of I4.0 and the unavailability of digital culture, it is difficult to implement I4.0 (Ghadge, et al., 2020). Some organizations do not accept advanced technology for their administration and operations (Santacruz, et al., 2022), which is one of the major reasons for the inertia of the organization and its workers towards the adoption of technology (Queiroz, et al., 2021). Further suppliers are not willing to implement new technologies, and they don't have the capacity capacities with other stakeholders (Jerome, et al., 2022) and to comply with cultural changes (Jerome, et al., 2022; Agarwel, et al., 2022).

i. Financial constraint

Financial resources are vibrant in an organization that is smoothly running with new technology. Without this capability, organizations cannot successfully navigate the digital transformation (Ghadge, et al., 2020).Because it is a heavy investment (Santacruz, et al., 2022; Chauhan & Singh, 2020) due to the unavailability of funding, financial matters (Khin & Kee, 2022) adaptation became more limited (Haddud & Bienhaus, 2018; Weerabahu, et al., 2022).

j. Privacy and security threats

Vulnerable threats and risks can be identified as cyber security threats to the digital transformation (Santacruz, et al., 2022). There are privacy issues and cybersecurity issues. (Frederico, 2021; Chauhan & Singh, 2020; Jerome, et al., 2022). Specially data is flow to inside and outside therefore it has threats of hacking, confidentiality, reliability and data protection issues comes with this. These data security issues and complex legal issues also impact the underutilization of the I4 (Weerabahu, et al., 2022).

4. Discussion

The literature on SCM 4.0 can be identified from the previous article, but it has little attention to this. As a result, many authors attempt to add knowledge about these concepts. In this study, the major aim was to make a conceptual model considering the technologies of SCM 4.0 in view of food manufacturing supply chain, their importance, and the challenges of adaptation. According to the findings, researchers could identify the relationships between these concepts and supply chain performance (Figure 3). According to literature, this relationship has been highlighted on various occasions.

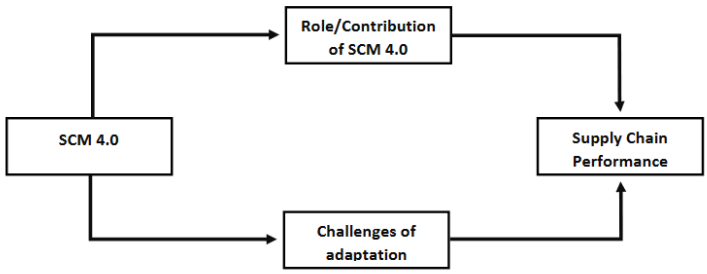

Figure 3: Conceptual model of SCM 4.0 in food manufacturing industry
Source: Developed by the author

This paper inculcates a compressive analysis of the latest technological expansions, their significance, and the challenges for adaptation in supply chain management in the manufacturing sector (Figure 4). SCM 4.0 provides a revaluation of the management of the supply chain. In a volatile, uncertain, complex, and ambiguous environment, I4.0 makes the business adaptation process easier (Dallasega, et al., 2022). I4.0 helps to maintain transparency, communicate effectively, and foster collaboration, flexibility, responsiveness, and accuracy throughout the entire supply chain (Claudia Lizette Garay-Rondero, et al., 2020; Agarwel, et al., 2022). Umar, et al., (2022) have pointed out that the decision-making process is improved by the management of real-time information related to products and production. I4.0. Gives productivity, efficiency, flexibility, cost savings, and opportunity for competitiveness (Khin & Kee, 2022). SC 4.0 facilitates collaboration, coordination, and integration in the lean SC and ensures competitive advantage effectively (Bravo, et al., 2023). In port logistics, I4.0-enabled technologies can ensure the transfer of real-time data, transparency in tracking cargo movement and transactions, traffic and gate management, and paperless administration (Sarkar & Kar, 2023).

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SCM 4.0	Role/Contribution of SCM 4.0	Challenges of adaptation
• Cloud Computing (CC) • Internet of Things (IoT) • Artificial Intelligence (AI) • Big Data Analytics (BDA) • Radio Frequency Identification (RFID) • Cyber security • Machine Learning (ML) • Additive Manufacturing (AM) • Block chain (BC) • Virtual Reality (VR), Augmented Reality (AR) • Autonomous Guided Vehicle (AGV) • Additive Manufacturing (AM)	• Data storage and sharing in real time, converting to structured information • Identify the pattern and correlations of the data • Enhancing connectivity • Providing remote access to data • Integrating functions of SCM • Analyzing complex situation and large scale data • Providing customer profiling and analysis, generate knowledge • Support for strategic decision integrating SCM and marketing • Warehouse management • Tracking and tracing facility • Ensuring security of the data and information • Autonomous manufacturing • Managing procurement activities • making smart contracts and creating a more responsive, agile and economical supply network	• Lack of infrastructure facilities • Insufficient research and development • Maintaining insufficient inter department and organization coordination • Inadequate human resource development • Lack of Top management support • Deficiency of the required polies and strategies • Insufficient awareness • Inertia of the organization and workers • Financial constraint • privacy and security threats

Figure 4: Conceptually identifying of main technologies of SCM 4.0, their importance and challenges for adaptation
Source: Developed by the author

Further, Sarkar & Kar, (2023) have mentioned the positive impact of technology on the economy, environment, organization, human resources, and strategically. It covers increasing production and environmental sustainability. And also improve the operation capabilities, effective communication through the chain, and problem solving in the organization. And also increased supervision, knowledge sharing, digital traceability, strategic capability, planning, and forecasting (Romanello & Veglio, 2022). Especially, it helps to enhance sustainability performance in the manufacturing operation through improving cleaner production, procurement process optimization, reducing logistics and production costs, improving collaboration, and effectively monitoring and developing training (Umar et al., 2022). This ensures the efficient use of resources, mitigates the

environmental impact, and manages the reverse flow of materials and resources. And making a bridge between environmental performance and the sustainability of the supply chain operation (Stocco & Cezarino, 2022). Especially, it helps to enhance sustainability performance in the manufacturing operation through improving cleaner production, procurement process optimization, reducing logistics and production costs, improving collaboration, and effectively monitoring and developing training (Umar, et al., 2022).

Ghadge, et al.,(2020) have highlighted that the main challenges were identified as strategic, legal, ethical, technological, and organizational challenges. The strategic dimension is important due to the policy of the organization, which can influence the adaptation of emerging technologies. Also, a lack of policies leads toward minimizing research and development, consider the economic benefit of I4.0 and the unavailability of digital culture, which make the implementation of I4.0 difficult. When considering legal and ethical issues, a lack of coordination and collaboration creates problems of data security and, as a result, legal issues. Also, a lack of digital infrastructure facilities limits access to high-quality data. In organizational terms, support from top management and strategic vision directly and indirectly impact the implementation of the 14. Also, financial constraints are another matter.

Most of the authors clearly identified these barriers as IT infrastructure, HR and organizational skills, coordination among the actors in the supply chain, higher management support, awareness among the parties, strategic vision, and compliance requirements (Agarwel, et al., 2022) . (Bag, et al., (2018) have mentioned that some dark sides are faced by the I4.0 which are affected by both customers and suppliers in the network. Such as workers, job losses, decreasing morale of the employees, lack of knowledge among the suppliers about industry 4.0, lack of fund allocation to develop the technology, unavailability of professional and competent suppliers in the sector, and projects, and lack of involvement in security and privacy standardization. These issues impact creating an uncertain and risky environment when adopting I4.0 during the pre- and post-adaptation period.

Further, it is important for the government to contribute to the development of technology in the manufacturing sector. Tripathi & Gupta, (2020) have indicated a lack of government support due to the unavailability of strong policies, standards, and enough infrastructure, which should be in line with I4.0. Further slow performance of digital awareness, regulations, procedures, digital infrastructure, and cyber security has slow performance compared with the international context and observed poor improvement over the year and policy implications. Further, there is no provision of a promising quantity of physical infrastructure facilities, innovation capabilities, and skill and competency development.

6. Conclusion

The paper conclusion is based on the result of the elaborated journal article using a systematic literature review, and it can be concluded incorporating the conceptual model:

> **RQ1:** what are the major technologies and their importance of SCM 4.0 to manage the supply chain in manufacturing sector?

Research findings indicate the emerging technologies of SCM 4.0 are used for managing supply chains in the food manufacturing sector. These technologies play an important and vibrant role according to the functionality and objectives of the chain actors. Cloud computing: identifying relationships, patterns, and correlations (Tripathi & Gupta, 2020); organizing, sharing, interoperability, and remote access to data or information (Ardito, et al., 2019), coordinating and integrating activities. The Internet of Things (IoT) helps with the creation, capture, processing, and transfer of data (Strange & Zucchella, 2017; Tripathi & Gupta, 2020), communication of data and information through multiple sources across the partners of the global supply chain (Sharma, et al., 2020), and processing and sharing of information across SCM and marketing functions.

Artificial intelligence (AI) makes the daily activities of business and administration, decision-making processes, and maintaining relationships with customers and suppliers possible. Big Data Analytics (BDA) creates customer profiling (Ardito, et al., 2019; Ghadge, et al., 2020; Erboz, et al., 2022) and analysis, generating knowledge (Ghadge, et al., 2020; Erboz, et al., 2022), daily activities of business and administration, decision-making processes, and maintaining relationships with the customer and supplier. Radio Frequency Identification (RFID) helps with product tracking throughout the chain (Dallasega, et al., 2022), warehouse management (Santacruz, et al., 2022; Santacruz, et al., 2022), and port logistics activities (Sarkar & Kar, 2023). Block chain (BC) monitoring of temperature and humidity (Frederico, 2021), green procurement, design, manufacturing, and distribution (Mubarik , et al., 2021), procurement activities including ordering, selection, etc.

> **RQ2:** what are the challenges of adaptation of SCM 4.0 to manage the supply chain in manufacturing sector?

Through the literature review, the author could identify the challenges when adapting the new technology for SC management in the food manufacturing sector. The author has identified 10 major challenges when adapting SCM 4.0: 1. Lack of infrastructure facilities 2. insufficient research and development; 3. maintaining insufficient inter-departmental and organization coordination; 4. inadequate human resource development; 5. lack of top management support; 6. deficiency of the required policies and strategies; 7. insufficient awareness; 8. inertia of the organization and workers; 9. financial constraints; and 10. privacy and security threats.

Therefore, managers and policymakers need to be concerned and analyse these challenges in depth for the successful implementation of SCM 4.0. The new implications of the organization should identify the priority that is initially required for that. Finally, this research helps the theorist identify and develop the theories relevant to SCM 4.0 that have been insufficiently concerned by the researcher. In fact, the inputs of the model vary according to the organization's capacities and country. Therefore, future researchers can be concerned about this different identification when doing future research.

REFERENCES

Acioli, C., Scavarda, A. & Reis, A., 2021. Applying Industry 4.0 technologies in the COVID–19 sustainable chains. International Journal of Productivity and Performance Management, 70(5), pp. 988-1016.

Agarwal, S., Tyagi, M. & Garg, R. K., 2022. Framework development and evaluation of Industry 4.0 technological aspects towards improving the circular economy-based supply chain. Industrial Robot: the international journal of robotics research and application, 49(3), pp. 555-581.

Ali, I. & Aboelmaged, M. G. S., 2021. Implementation of supply chain 4.0 in the food and beverage industry: perceived drivers and barriers. International Journal of Productivity and Performance Management.

Ardito, L., Petruzzelli, A. M., Panniello, U. & Garavelli, A. C., 2019. Towards Industry 4.0 :Mapping digital technologies for supply chain management-marketing integration. Business Process Management Journal, 25(2), pp. 323-346.

Bag, S., Telukdarie, A., Pretorius, J. & Gupta, S., 2018. Industry 4.0 and supply chain sustainability: framework and future research directions. Benchmarking: An International Journal.

Belhadi, A., Kamble, S., Gunasekaran, A. & Mani, V., 2022. Analyzing the mediating role of organizational ambidexterity and digital business transformation on industry 4.0 capabilities and sustainable supply chain performance. Supply Chain Management: An International Journal, 27(6), p. 696–711.

Benitez, G. B., Ferreira-Lima, M., Ayala, N. F. & Frank, A. . G., 2022. Industry 4.0 technology provision: the moderating role of supply chain partners to support technology providers. Supply Chain Management: An International Journal, 27(1), p. 89–112.

Bravo, M. I. R., Maqueira-Marin, J. M. & Moyano-Fuentes, 2023. Supply chain 4.0 ambidexterity and lean supply chain management: interrelationships and effect on the

focal firm's operational performance. Supply Chain Management: An International Journal, 28(7), p. 112–128.

Chaopaisarn, P., 2021. The impact of applying knowledge in the technological pillars of Industry 4.0 on supply chain performance. Kybernetes.

Chauhan, C. & Singh, A., 2020. A review of Industry 4.0 in supply chain management studies. Journal of Manufacturing Technology Management, 31(5), pp. 863-886.

Claudia Lizette Garay-Rondero, C. L. et al., 2020. Digital supply chain model in Industry 4.0. Journal of Manufacturing Technology Management, 31(5), pp. 887-933.

Colin, M., Galindo, R. & Hernández, O., 2015. Information and Communication Technology as a Key Strategy for Efficient Supply Chain Management in Manufacturing SMEs. Procedia Computer Science, p. 833 – 842.

Dallasega, P., Woschank, M., Sarkis, J. & Tippayawong, K. Y., 2022. Logistics 4.0 measurement model: empirical validation based on an international survey. Industrial Management & Data Systems, 122(5), pp. 1381-1409.

Erboz, G., Y. & Szegedi, Z., 2022. The partial mediating role of supply chain integration between Industry 4.0 and supply chain performance. Suuply Chain Management: An Interntional Journal, pp. 538-559.

Falks, M. S., 2018. Supply Chain Management Strategies in the Manufacturing Industry, s.l.: Walden University.

Frederico, G. F., 2021. Towards a Supply Chain 4.0 on the post-COVID-19 pandemic: a conceptual and strategic discussion for more resilient supply chains. Rajagiri Management Journal, 15(2), pp. 94-104.

Frederico, G. F., Garza-Reyes , J. A., Anosike, A. & Kumar, V., 2020. Supply Chain 4.0: Concepts, Maturity and Research Agenda. Supply chain Management. 25(2), pp. 262-282.

Frederico, G. F., Garza-Reyes , J. A., Kumar, A. & Kumar, V., 2021. Performance measurement for supply chains in the Industry 4.0 era: a balanced scorecard approach. International Journal of Productivity and Performance Management, 70(4), pp. 789-807.

Ghadge, A., Er Kara, M., Moradlou, H. & Goswami, M., 2020. The impact of Industry 4.0 implementation on supply chains. Journal of Manufacturing Technology Management.

Ghosh, D., Mehta, P. & Avittathur, B., 2021. Supply chain capabilities and competitiveness of high-tech manufacturing start-ups in India. Benchmarking: An International Journal, 28(5), pp. 1783-1808.

Haddud, A. & Bienhaus, F., 2018. Procurement 4.0: factors influencing the digitisation of procurement and supply chain. Business Process Management Journal, 24(4), pp. 965-984.

Jerome, J. J. J., Saxena, D., Sonwaney, V. & Foropon, C., 2022. Procurement 4.0 to the rescue: catalysing its adoption by modelling the challenges. Benchmarking: An International Journal, 29(1), pp. 217-254.

Khan, M., Schaefer, D. & Milisavljevic-Syed, J., 2022. Supply Chain Management 4.0: Looking Backward, Looking Forward. s.l., Elsevier B.V., pp. 9-14.

Khin, S. & Kee, D. M. H., 2022. Factors influencing Industry 4.0 adoption. Journal of Manufacturing Technology Management.

Mubarik , M., Rasi, R. Z. R. M., Mubarak, M. F. & Ashraf, R., 2021. Impact of Blockchain Technology on Green Supply Chain Practices: Evidence from Emerging Economy. n Management of Environmental Quality An International Journal.

Nakandala, D., Yang, R., Lau, H. & Weerabahu, S., 2023. Industry 4.0 technology capabilities, resilience and incremental innovation in Australian manufacturing firms: a serial mediation model. Supply Chain Management An International Journal, 28(4), pp. 760-772.

Özdağoğlu, A. & Bahar, . S., 2022. Logistics 4.0 and Smart Supply Chain Management. Industry 4.0 and Global Businesses, pp. 163-183.

Paksoy , T., Koçhan, Ç. & Ali, S. S., 2021. Logistics 4.0: Digital Transformation of Supply Chain Management. Boca Raton: Taylor & Francis Group .

Phan, M. H. & Ali, I., 2021. Industry 4.0 Technologies and Sustainable Warehousing: A Systematic Literature Review. Second Asia Pacific International Conference on Industrial Engineering and Operations Management , pp. 166-179.

Queiroz, M. M., Pereira, S. C. F., Telles, R. & Machado, M. C., 2021. Industry 4.0 and digital supply chain capabilities: A framework for understanding digitalisation challenges and opportunities. Benchmarking: An International Journal, 28(5), pp. 1761-1782.

Raji, I. O., Shevtshenko, E., Rossi, T. & Strozzi, F., 2021. Industry 4.0 technologies

as enablers of lean and agile supply chain strategies:an exploratory investigation. The International Journal of Logistics Management, 32(4), pp. 1150-1189.

Romanello, R. & Veglio, V., 2022. Industry 4.0 in food processing: drivers, challenges and outcomes. British Food Journal, 124(13), pp. 375-390.

Salam, M. A., 2019. Analyzing manufacturing strategies and Industry 4.0 supplier performance relationships from a resource-based perspective. Benchmarking: An International Journal.

Santacruz, R. F. B., Perotti, S., Bremer, P. & Beer, J. E., 2022. Logistics 4.0 in warehousing: a conceptual framework of influencing factors, benefits and barriers. The International Journal of Logistics Management, 33(5), pp. 193-220.

Sarkar, B. D. & Kar, A. K., 2023. Port logistic issues and challenges in the Industry 4.0 era for emerging economies: an India perspective. Benchmarking: An International Journal, Volume 30, pp. 50-74.

Sarkar, B. D., Shankar, R. & Kar, A. K., 2022. Severity analysis and risk profiling of port logistics barriers in the Industry 4.0 era. Benchmarking: An International Journal.

Sharma, J., Tyagi, M. & Bhardwaj, A., 2020. Parametric review of food supply chain performance implications under different aspects. Journal of Advances in Management Research, 17(3), pp. 421-453.

Stocco, L. C. & Cezarino, L. O., 2022. Wholesaler echelon and Industry 4.0 in circular supply chains – a systematic review. Moern Supply hain Researh an Appliations, 4(2), pp. 141-158.

Strange, R. & Zucchella, A., 2017. Industry 4.0, global value chains and international business. Multinational Business Review, 25(3).

Sundarakani, B., Kamran, R., Maheshwari, P. & Jain, V., 2019. Designing a Hybrid Cloud for a Supply Chain Network of Industry 4.0: A Theoretical Framework. Benchmarking An International Journal.

Tiwari, S., 2020. Supply chain integration and Industry 4.0: a systematic literature review. Benchmarking: An International Journal.

Tortorella, G., Fogliatto, F. S., Gao, S. & Chan, T.-K., 2022. Contributions of Industry 4.0 to supply chain resilience. The International Journal of Logistics Management, 33(2), pp. 547-566.

Tripathi, S. & Gupta, M., 2020. A framework for procurement process re-engineering in Industry 4.0. Business Process Management Journal.

Tripathi, S. & Gupta, M., 2021. Indian supply chain ecosystem readiness assessment for Industry 4.0. International Journal of Emerging Markets.

Umar, M. et al., 2022. The role of emerging technologies in implementing green practices to achieve sustainable operations. The TQM Journal, pp. 232-249.

Umar, M. et al., 2020. Industry 4.0 and green supply chain practices: an empirical study. International Journal of Productivity and Performance Management.

UNCTAD., 2023. Technology And Innovation Report 2023, New York: United Nations.
World Trade Organization, 2019. Global Value Chain Development Report : Technological innovation, supply chain trade, and workers in a globalized world, Washington: World Bank Publications.
Weerabahu, W. S. K., Samaranayake, P., Nakandala, D. & Hurriyet, H., 2022. Digital supply chain research trends: a systematic review and a maturity model for adoption. Benchmarking An International Journal.

Yuan, C. et al., 2022. Supply chain innovation announcements and shareholder value under industries 4.0 and 5.0: evidence from China. Industrial Management & Data Systems, 122(8), pp. 1909-1937.

THE EMBODIMENT OF SUSTAINABILITY PRACTICES IN THE LOGISTICS SECTOR TO ACHIEVE ECONOMIC RESILIENCE THROUGH THE CIRCULAR ECONOMY

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Abstract

Many countries adopt a sustainable development model to balance economic growth, environmental preservation, and social protection. Transitioning to a circular economy is a viable approach for developing sustainable logistics systems at present. However, assessing sustainable logistics practices in the circular economy environment is challenging due to the dynamic and complex nature of logistics systems. In this milieu, this study attempts to examine what are the sustainability practices used by the logistics sector and how these practices help to create economic value while balancing the social and environmental for the circular logistic sector. To accomplish the purpose of the study analytical review of the existing literature approach is used. As per the findings of the study sustainable logistics practices towards circular economy such as green purchasing, green transportation, environmental preservation practices, sustainable product and service practices, reconfiguration and social well-being ensure the economic performance of the organization while reducing the costs. Further, it will minimize the harmful social and environmental impact of the organization.

Keywords; *Sustainable development, Circular economy and Sustainable/green logistics*

1. Introduction

At present, rising concerns about environmental issues, rising sea levels, climate changes, food crises and social crisis have become global issues due to adverse human activities (Luu, Chromjakova, & Nguyen, 2023; Cheng et al., 2023; Kumar, 2015). Further, governing bodies unanimously recognized that 'sustainability' is the only possible solution to address the negative effects of human activity on the globe (Kumar, 2015; Madhuwanthi, 2020). As a consequence, the world of work must embark on the notion of sustainability in doing business (Kumar, 2015).

In this context, logistics operations in the supply chain have taken much attention (Kumar, 2015). Since this sector is fundamental to developing country especially, developing countries (Kumar, 2015). Further, this is the sector that can be seen with high industry competition as well as low-profit margins (Hausmana et al., 2021; Jayarathna et al., 2022). Moreover, in the literature, this sector has been labelled as causing extensive harm to the environment, resource depletion and social issues due to high energy

consumption (Zaman & Shamsuddin, 2017; Jayarathna et al., 2022; Afum et al., 2020; Jayarathna et al., 2021; Ritchie, 2020; United Nations, 2014; Kumar, 2015). Therefore, the embodiment of sustainability practices is vital to balance not only economic gain but also social and environmental pressure in the logistics sector (Afum et al., 2020; Halldorsson and Kovacs, 2010; Agyabeng-Mensah et al., 2020a, b, c, d and e). Thus, green logistics practices or sustainable logistics practices are one such key concern in the present context.

In the literature, both terms; green logistics and sustainable logistics are used interchangeably. Therefore, this study also uses these terms interchangeably. When it comes to green logistics it attempts to foster environmentally friendly practices by considering the environmental harm that the logistics system users do through their operations (Cheng et al., 2023). Further, at the end of sustainable development, green logistics or sustainable logistics can be defined as "producing and distributing goods in a sustainable way, taking account of environmental and social factors" (Kumar, 2015, p. 8). By considering the adverse social and environmental consequences created by the logistics system, and prevailing social pressure to go with sustainable practices, organizations have implemented the strategies and practices to claim sustainability (Jayarathna et al., 2021; Jayarathna et al., 2022).

Though most organizations attempt to incorporate sustainability through conventional practices, it is not enough in this present VUCA world (Genoveseet al., 2017; Jayarathna et al., 2022). Moreover, it is revealed that conventional organizational logistics practices cause greenhouse gases that cause more harm to the environment as well as ecological balance (Calzolarietal, 2022; European Commission, 2020; Jayarathna et al., 2022). Circular economy, therefore, has been identified as one of the possible solutions to address the issues, such as environmental pollution, resource depletion, social and other economic issues, etc., which create through logistics activities (Kumar et al., 2019: Lahane et al., 2020; Atasu et al., 2021; Jayarathna et al., 2022; Jayarathna et al., 2023, Gengetal.,2013; Ripanti & Tjahjono, 2019). Further, as the prime objective of most businesses is profit, to the accomplishment of economic well-being, the circular economy plays a vital role in sustainable logistics operations (Kumar, 2015; Jayarathna et al., 2022).

The circular economy is defined as "a global economic model to minimize waste and environmental pollution through the design of materials, products, and business systems" (Jayarathna et al., 2022, p.705). In this milieu, the circular economy has become one of the growing areas in the literature on sustainable development (Bocken &Short, 2016; Hofmann, 2019; Panwaretal, 2020; Rubel et, al., 2018, Jayarathna et al., 2023). However, the concept of circular economy has largely been explored from the manufacturing perspective, as manufacturing is the sector which can pave the eye on the environmental impact of the product during the entire product lifecycle (Ciliberto et al., 2021; Kumar et al., 2019; Negri et al., 2021; Jayarathna et al., 2022).

When it comes to service systems, there can be seen a gap in relation to the circular economy (Jayarathna et al., 2022). Embodiment the circular economy practices in the logistics sector helps to achieve economic resilience in a sustainable manner. Therefore, this paper aims to explore how the logistics sector incorporates sustainability practices to achieve economic resilience towards a circular economy. Though the existing literature focuses on green logistics practices and sustainability performance (Jayarathna et al., 2022), there is a need to explore sustainability practices in creating economic value while balancing both social and environmental value towards circular logistics systems. In this backdrop, this study addresses the research questions of (i) what are the sustainability practices used by the logistics sector and (ii) how these practices help to create economic value while balancing social and environment for circular logistic sector. Reviewing relevant contemporary literature is the method adopted in carrying out the analysis to address the aforementioned questions of the study.

Sustainable Logistics

The logistics sector extensively contributes to environmental degradation and resource depletion through greenhouse gas emission, energy consumption, waste processing etc… (Cheng et al., 2023; Mensah et al., 2020: Bozhanova et al., 2022; de Soza et al., 2022) in supply chain. As sustainability has become a growing concern in the present context, sustainability in the logistics sector also has become one such pressing issue in achieving a sustainable globe. Sustainable/green logistics can be defined as "supply chain management practices and strategies that reduce the ecological and energy footprints of the distribution of goods which focuses on material handling, waste management, packaging and transport" (Seroka-Stolka & Ociepa-Kubicka, 2019, p. 472). Simply, green logistics is producing and distributing goods by balancing economic, social and environmental impacts into consideration (Kumar, 2015; Sibihi & Eglese, 2009).

The literature largely addressed the importance of green logistics practices, green logistics and economic performance, benefits and barriers of implementing green logistics practices (Jayarathna et al., 2022; Jayarathna et al., 2021; Laari et al., 2018; Singh et al., 2021). Implementing green logistics practices is not only sufficient to gain substantial advantages in terms of economic, environmental and social performances in the present context (Van Buren et al., 2016). It is required to embody circular economy in logistics systems to accomplish the long-term real benefits from green logistics practices (Geng et al., 2012; Geng et al., 2013; Liu et al., 2018; Jayarathna et al., 2022).

Circular Economy

The prime objective of the circular economy is to achieve sustainable development by creating economic, social and environmental value not only for the present generation but also for the next generation (Kirchherr et al., 2017). Boulding

(1966) considers the earth as a closed system with a circular interaction between the economy and the environment.

> "A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), micro-level (eco-industrial parks) and macro level (city, region, nation and beyond), to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (Cheng et al., 2023, p.21).

The circular economy is, therefore, an alternative economic model which focuses on limiting resource consumption through reduction, reuse, recycling, remanufacturing and redesigning (Jayarathna et al., 2022). Further, this nonlinear model not only limits resource consumption but also greenhouse gas emissions and waste consumption while increasing the economic value (Geng et al., 2016). Moreover, it creates space for more innovation by eliminating waste and creating business opportunities by boosting the organization's capacity (Bocken & Short, 2016). This makes the opportunity for employees to work attractive and healthy working place (Van Buren et al., 2016).

Sustainable Practices for the Circular Logistics Sector

Organizations utilize a variety of sustainable methods to align the triple bottom line with the circular economy. One such practice is green purchasing, it makes the prerequisites of environmental considerations before purchasing goods such as ISO 14000, purchase goods which can be recycled, reused, and repaired and ensure suppliers are in line with fair and ethical sourcing practices when purchasing the products from suppliers (Zhu et al., 2007; Jayarathna et al., 2023). As transportation is one of the major activities in the logistics system which causes harm to the environment, organizations pay attention to green transportation to minimize this harm. Green transportation refers to the utilization of renewable energy rather than natural resources (Jayarathna et al., 2023). Transport certification, freight model shift, multi-model transport for delivering the product, improving energy efficiency (Jayarathna et al., 2023; Blauwens et al., 2006; Shakya & Shrestha, 2011; Piecyk et al., 2015; Atz, 2019) are some of the practices that could be carried out under the green transportation.

Further, organizations use environmental preservation practices such as the use of hybrid trucks, multimodal transport, efficient fuel usage, transporting at night, route optimization, optimum utilization of vehicle capacity, reducing truck-run empty, use of electrical vehicles, transition to cleaner energy (Jayarathna et al., 2022). Sustainable product and service practices are also one of the prominent methods to go with a circular logistics system. Here organizations focus on reducing the harmful environmental impact

through redesigning products or processes (Jayarathna et al., 2022). Organizations practice this through reducing waste and optimum usage of the resource, recycling, reusing, green packaging, green purchasing, proper waste management systems and upcycling the plastics.

Reconfiguration; by implementing automation of the process, green warehousing, environmental policy and certifications organizations adopt sustainable practices. Social well-being practices are other such practices that can be used to create a sustainable logistics system for an organization. Ensuring employee safety, employee security and welfare, employee rewards, employee grievances management system, gender equality, fair labour, code of ethics, social equality, human rights, corporate social responsibility, local community, and providing employment opportunities (Jayarathna et al., 2022) are the ways to achieve social well-being in the logistics system.

Achieving Economic Growth through Sustainable Practices

The aforementioned sustainable logistics practices have a direct relationship not only with economic performance but also with balancing the other two dimensions; social and environmental. As an example, green purchasing addresses the contemporary social trend of a sustainable globe. And, when a company purchases products in line with that sustainability principle then, stakeholders' perspective towards organizations becomes positive. For example, when customers of the organizations are looking towards sustainable products then, such practice helps to enhance the revenue of an organization. Moreover, reducing energy usage will result in major cost savings to the organization (Jayarathna et al., 2022: Jayarathna et al., 2023: Kumar; 2015; Bozhanova et al., 2022).

Further, implementing such practices would be able to gain favourable recognition to the organizations. Thus, it helps to long-term survival of an organization. The important thing is, that these practices could gain competitive advantages to the organizations though the initial cost is high to implement those. Not only economic benefits but also other social and environmental benefits can be achieved for the organizations. For example, through these sustainable logistics practices, organizations can ensure community well-being, enhance the quality of life, enhance diversity; give equal opportunities despite of gender, and create new employee opportunities organizations help to reduce unemployment and poverty in society (Jayarathna et al., 2022: Jayarathna et al., 2023: Bozhanova et al., 2022; Kumar; 2015).

Further, such practices would be able to have a positive impact on the organization. Such as minimising greenhouse gas emissions, enhancing the life of natural resources, optimum utilization of natural resources, and reducing air pollution and environmental pollution (Jayarathna et al., 2022: Jayarathna et al., 2023: Kumar; 2015; Bozhanova et al., 2022). Followings economic, social and environmental benefits would be able to achieved through these sustainable logistics practices.

Table 1: Benefits of Green Logistics Practices

Economic	Social	Environment
Cost savings	Creation of new employment opportunities	Reduce the greenhouse gas emission
Increase market size, sales and profitability	Enhance the quality of life	Optimum utilization of the natural resource
Enhance customer satisfaction	Reducing the health issues of the employees	Access to clean water and clean energy
Enhance the relationship with customers	Raising the population's awareness	Reduce the air pollution
Enhance the productivity of an organization	Improving social value through ensuring social equality, human rights etc.	Reduce the environmental waste
Improve the financial performance	Enhance the social capital	
Reduce risk	Minimizing the poverty	
Due to the waste reduction mechanism, saving the cost		

Source: The author developed

Conclusion

Recent supply chain studies emphasize the importance of sustainable practices in achieving Sustainable Development Goals. Educating organizations about green logistics and circular economy is crucial in today's world. The increasing amount of waste is becoming a major concern worldwide. Though implementing the circular economy is a tough task in a logistics system, it is vital to accomplish a sustainable globe. Therefore, this study examined how sustainable logistics practices towards a circular economy ensure the economic resilience of the logistics sector. The findings indicate that sustainable logistics practices towards circular economy ensure the economic performance of an organization while balancing the social and environmental dimensions. Further, value creation in a circular economy encompasses activities relating to products, processes, services, resources, energy efficiency, and waste management that benefit the economy, environment, and society. Logistics firms create these values through transportation, warehouse management, and other services.

REFERENCES

Agyabeng-Mensah, Y., Afum, E., Acquah, I.S.K., Dacosta, E., Baah, C. and Ahenkorah, E. (2020). The role of green logistics management practices, supply chain traceability and logistics ecocentricity in sustainability performance. The International Journal of Logistics Management, 32(2), pp.538–566. doi:https://doi.org/10.1108/ijlm-05-2020-0187.

Atasu, A., Dumas, C., & Van Wassenhove, L. N. (2021). The circular busi ness models. Harvard Business Review. https://hbr.org/2021/07/the circular-business-model

Atz, F. (2019). Logistics management practices in road freight transport companies. International Journal of Entrepreneurship & Small Business, 23(3), 1–16.

Blauwens, G., Vandaele, N., Van de Voorde, E., Vernimmen, B., & Witlox, F. (2006). Toward a modal shift in freight transport? A business logistics analysis of some policy measures. Transport Reviews, 26(2), 239–251. https://doi.org/10.1080/01441647.2010.537101

Bocken, N. M. P., & Short, S. W. (2016). Towards a sufficiency-driven busi ness model: Experiences and opportunities. Environmental Innovation and Societal Transitions, 18, 41–61. https://doi.org/10.1016/j.eist. 2015.07.010

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. Journal of Industrial and Production Engineering, 33(5), 308–320. https://doi.org/10.1080/21681015.2016.1172124

Boulding, K. E. (1966). The economics of the coming spaceship earth. Resources for the Future/Johns Hopkins University Press.

Bozhanova, V., Korenyuk, P., Lozovskyi, O., Belous-Sergeeva, S., Bielienkova, O. and Koval, V. (2022). Green Enterprise Logistics Management System in Circular Economy. International Journal of Mathematical, Engineering and Management Sciences, 7(3), pp.350–363. doi:https://doi.org/10.33889/ijmems.2022.7.3.024

Calzolari, T., Genovese, A., & Brint, A. (2022). Circular economy indicators for supply chains: A systematic literature review. Environmental and Sustainability Indicators, 13, 100160. https://doi.org/10.1016/j.indic. 2021.100160

Cheng, Y., Masukujjaman, M., Sobhani, F.A., Hamayun, M. and Alam, S.S. (2023). Green Logistics, Green Human Capital, and Circular Economy: The Mediating Role of Sustainable Production. Sustainability, 15(2), p.1045. doi:https://doi.org/10.3390/su15021045.

Ciliberto, C., Szopik-Depczynska, K., Tarczynska-Łuniewska, M., Ruggieri, A., & Ioppolo, G. (2021). Enabling the circular economy tran sition: A sustainable lean manufacturing recipe for industry 4.0. Busi ness Strategy and the Environment, 2801(7), 3255–3272. https://doi. org/10.1002/bse.2801

De Souza, E. D., Kerber, J. C., Bouzon, M., & Rodriguez, C. M. T. (2022). Performance evaluation of green logistics: Paving the way towards cir cular economy. Cleaner Logistics and Supply Chain, 3, 100019. https:// doi.org/10.1016/j.clscn.2021.100019

European Commission, (2020) Retrieved May 24, 2022, from https://ec. europa.eu/ environment/biodiversity/business/news-and-events/ news/news-130_en.htm

Geng, Y., Fu, J., Sarkis, J., & Xue, B. (2012). Towards a national circular economy indicator system in China: An evaluation and critical analysis. Journal of Cleaner Production, 23, 216–224. https://doi.org/10.1016/j. jclepro.2011.07.005

Geng, Y., Sarkis, J., & Ulgiati, S. (2016). Sustainability, well-being, and the circular economy in China and worldwide. Science, 6278,73–76.

Geng, Y., Sarkis, J., Ulgiati, S., & Zhang, P. (2013). Measuring China's circu lar economy. Science, 339(6127), 1527–1527.

Genovese, A., Acquaye, A. A., Figueroa, A., & Koh, S. C. L. (2017). Sustain able supply chain management and the transition toward a circular economy: Evidence and some applications. Omega, 66, 344–357. https://doi.org/10.1016/j.omega.2015.05.015

Halldorsson, A. and Kovacs, G. (2010), "The sustainable agenda and energy efficiency", International Journal of Physical Distribution and Logistics Management.

Hausmana, L., Mittal, A., & Rome, G. (2021). Lessons from growth out performers in logistics. Retrieved April 04, 2022 from https://www. mckinsey.com/business-functions/ strategy-and-corporate-finance/ our-insights/lessons-from-growth-outperformers-in-logistics

Hofmann, F. (2019). Circular business models: Business approach as driver or obstructer of sustainability transitions? Journal of Cleaner Produc tion, 224, 361–374. https://doi. org/10.1016/j.jclepro.2019.03.115

Jayarathna, C. P., Agdas, D., Dawes, L., & Miska, M. (2021). Exploring sector-specific sustainability indicators: A content analysis of sustain ability reports in the logistics sector. European Business Review, 34(3), 321–343. https://doi.org/10.1108/EBR-02-2021-0047

Jayarathna, C.P., Agdas, D. and Dawes, L. (2022). Exploring sustainable logistics practices toward a circular economy: A value creation perspective. Business Strategy and the Environment, 32(1), pp.704–720. doi:https://doi.org/10.1002/bse.3170.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Industrial and Systems Engineering, 17(2), 186–201. https://doi.org/10. 1504/IJISE.2014.061993

Kumar, A. (2015). Green Logistics for sustainable development: an analytical review. IOSRD International Journal of Business, 1(1), pp.7–13.

Kumar, V., Sezersan, I., Arturo, G.-R. J., Gonzalez Ernesto, D. R., & Anwer, A.-S. M. (2019). Circular economy in the manufacturing sector: Benefits, opportunities and barriers. Management Decision, 57(4), 1067–1086. https://doi.org/10.1108/MD-09-2018-1070

Kumar, V., Sezersan, I., Arturo, G.-R. J., Gonzalez Ernesto, D. R., & Anwer, A.-S. M. (2019). Circular economy in the manufacturing sector: Benefits, opportunities and barriers. Management Decision, 57(4), 1067–1086. https://doi.org/10.1108/MD-09-2018-1070

Laari, S., Töyli, J., & Ojala, L. (2018). The effect of a competitive strategy and green supply chain management on the financial and environ mental performance of logistics service providers. Business Strategy and the Environment, 27(7), 872–883. https://doi.org/10.1002/bse. 2038

Lahane, S., Kant, R., & Shankar, R. (2020). Circular supply chain manage ment: A state-of-art review and future opportunities. Journal of Cleaner Production, 258, 120859. https://doi.org/10.1016/j.jclepro.2020. 120859

Liu, J., Feng, Y., Zhu, Q., & Sarkis, J. (2018). Green supply chain manage ment and the circular economy. International Journal of Physical Distri bution and Logistics Management, 48, 794–817. https://doi.org/10. 1108/IJPDLM-01-2017-0049/full/html

Luu, T. V., Chromjakova, F., & Nguyen, H. (2023). A model of industry4.0 and a circular economy for green logistics and a sustainable supply chain, Business Strategy Development, 897-920. DOI:10.1002/bsd2.286

Negri, M., Neri, A., Cagno, E., & Monfardini, G. (2021). Circular economy performance measurement in manufacturing firms: A systematic litera ture review with insights for small and medium enterprises and new adopters. Sustainability, 13(16), 9049. https://doi.org/10.3390/ su13169049

Panwar, R., Niesten, E., et al. (2020). Advancing circular economy. Business Strategy and the Environment, 29(6), 2890–2892. https://doi.org/10. 1002/bse.2602

Piecyk, M., Browne, M., Whiteing, A., & McKinnon, A. (2015). Green logis tics: Improving the environmental sustainability of logistics (Vol. 45) (pp. 459–485). Kogan Page Publishers. https://doi.org/10.1108/ IJPDLM-08-2013-0228

Ripanti, E. F., & Tjahjono, B. (2019). Unveiling the potentials of circular economy values in logistics and supply chain management. The International Journal of Logistics Management, 30(3), 723–742. https://doi. org/10.1108/ijlm-04-2018-0109

Ritchie, H. (2020). Cars, planes, trains: Where do CO2 emissions from transport come from?. Our World in Data. Accessed 04 April, 2022. https://ourworldindata.org/co2-emissions-from-transport

Rubel, H., Schmidt, M., Meyer Zum Felde, A., Mendiluce, M., Brown, A., Edgerton, B., Tylor, J., (2018). The new big circle: Achieving growth and business model innovation through circular economy implementation. The Boston Consulting Group. Available: http://docs. http://wbcsd.org/ 2018/01/The_new_big_circle.pdf (Accessed 31 August 2022).

Sbihi, A. & Eglese, R.W. (2009). Combinatorial optimization and Green Logistics. Annals of Operations Research, 175(1), 159 175.

Seroka-Stolka, O., & Ociepa-Kubicka, A. (2019). Green logistics and circu lar economy. Transportation Research Procedia, 39, 471–479. https:// doi.org/10.1016/j. trpro.2019.06.049

Shakya, S. R., & Shrestha, R. M. (2011). Transport sector electrification in a hydropower resource rich developing country: Energy security, envi ronmental and climate change co-benefits. Energy for Sustainable Development, 15(2), 147–159. https://doi.org/10.1016/j. esd.2011. 04.003

Singh, R. K., Kumar Mangla, S., Bhatia, M. S., & Luthra, S. (2021). Integra tion of green and lean practices for sustainable business management. Business Strategy and the Environment, 31, 353–370. https://doi.org/ 10.1002/bse.2897

Van Buren, N., Demmers, M., Van der Heijden, R., & Witlox, F. (2016). Towards a circular economy: The role of Dutch logistics industries and JAYARATHNA ET AL. governments. Sustainability: Science Practice and Policy, 8(7), 647. https://doi. org/10.3390/su8070647

Zaman, K., & Shamsuddin, S. (2017). Green logistics and national scale eco nomic indicators: Evidence from a panel of selected European coun tries. Journal of Cleaner Prod

Zhu, Q., Sarkis, J., & Lai, K.-H. (2007). Green supply chain management: pressures, practices and performance within the Chinese automobile industry. Journal of Cleaner Production, 15(11), 1041–1052. https:// doi.org/10.1016/j.jclepro.2006.05.021

NAVIGATING THROUGH COLLABORATIVE LOGISTICS: FOSTERING THE PRIVATE-PUBLIC PARTNERSHIP TOWARDS THE ECONOMIC RESILIENCE OF SRI LANKA

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Abstract

This study explores the significance of fostering Private Public Partnerships (PPPs) towards Economic Resilience in Sri Lanka through Collaborative Logistics. Economic resilience is a crucial aspect of a nation's ability to stand, deliver, and sustain the economy aftershocks that occur due to uncertainties such as geopolitical issues, terrorism, climate change, natural disasters, etc. In a dynamic global landscape, Sri Lanka as a third-world developing country has to find suitable mechanisms to secure the resilience of the economy. Therefore, the researcher studies fostering Private Public Partnerships through Collaborative Logistics as a mechanism for said fact. Accordingly, the researcher conducted the study as a desk review research by exploring the existing knowledge. For that purpose, the researcher reviewed sixty-five (65) sources including research articles/papers/textbooks & other sources, and twenty-six (26) sources examined systematically. Consequently, the researcher formulated four (4) research questions and reviewed the literature through three segments namely Economic Resilience, Private Public Partnerships, and Collaborative Logistics. Through that exploration, the researcher builds the conceptual framework as the originality of the study and it shows the interrelationship among the Economic Resilience, Private Public Partnerships, and Collaborative Logistics. Moreover, the conceptual framework acts as a basement for future research in view of testing the proposed conceptual framework with pragmatic evidence.

Keywords - *Economic Resilience, Private Public Partnerships (PPPs), Collaborative Logistics.*

1. Introduction

The contemporary world rotates with dynamic issues and challenges including man-made and natural disasters such as geopolitical uncertainties & conflicts, global terrorism, trade wars, economic fluctuations, and natural disasters, for instance recently globally affected issues like the Covid Pandemic, geo-political conflicts (such as Russian-Ukraine War, Gaza Conflict). The consequences of said challenges can be affected by any macro-environmental factors such as Economic, Political, Technological, Social, Cultural, Environmental, etc. Moreover, the dynamic issues/challenges drive and motivate the countries to find strategies to look after their populations by protecting them

from negative consequences and taking them into a better future within the context of globalization and interconnectedness. In other words, it can be identified as 'Resilience'. As per the Oxford online dictionary, resilience means 'the capacity to withstand or to recover quickly from difficulties; toughness'. Accordingly, economic resilience can be identified as the capacity of an economy to withstand, recover from, and adapt to adverse events while maintaining its essential structure and function. Moreover, it encompasses the crucial framework for understanding and enhancing a nation's ability to navigate turbulent times (Jayasinghe, et al., 2022).

Sri Lanka is a third-world developing country that still stands at a crossroads of economic development and resilience building. Even though the International Monetary Fund (IMF) praised the economic reforms recently (Deshapriya, 2024), Sri Lanka was rated as a bankrupt country in the year 2022 due to the economic downturns. Apart from that country suffered from public unrest/struggles, the COVID-19 pandemic, Easter Sunday attacks, and natural disasters as well. Therefore, Sri Lanka has to identify and re-strategize the ways and means of reinforcing the resilience of the economy.

In that case, private-public partnerships (PPPs) can be identified as an effective mechanism for economic resilience. As an island nation that navigating with the complexities of contemporary global dynamics and logistical challenges, it is significant to recognize the relationship between efficient logistics systems and economic prosperity. Therefore, this research explores the imperative of collaborative logistics practices within the framework of PPPs in the Sri Lanka context where leveraging the strengths of both private and public sectors can significantly boost the country's resilience to economic shocks and disruptions.

This study focuses on a comprehensive exploration of the role and potential of PPPs in advancing Sri Lanka's economic resilience through collaborative logistics practices. Moreover, the study examines answering the following research questions (RQ) to provide insights for interested parties.

RQ 1: What is economic resilience and what are the main components?
RQ 2: What is the role and potential of PPPs?
RQ 3: How can collaborative logistics contribute to enhancing economic resilience?
RQ 4: What is the interrelationship among economic resilience, PPPs, and collaborative logistics?

Methodology

The researcher employed the desk review method to review and international reports, published research papers, web articles, handbooks, case studies &, etc.) as the sources being the existing knowledge base which allows for a comprehensive analysis

and a nuanced understanding of the research questions.

This analysis contains three segments. The first segment focuses analyze the literature systematically and further synthesize the secondary data (such as national/ on exploring the meaning and the components/parameters of economic resilience. The second segment emphasizes on exploring the role potential and the present context of PPPs. The third segment focuses on exploring the potential contribution of the collaborative logistics for the aforesaid two segments. Based on the literature, the researcher focuses on identifying the most relevant aspects and relationships to build up the conceptual framework for the study.

A. Segment I

1. Economic Resilience

The term 'resilience' derives from the Latin word 'resilire' (leap back) and most scholars define 'resilience' as the ability to recover quickly from the effect of an adverse incident (Briguglio, 2006). The concept of economic resilience has gathered more attention in recent years, especially due to the uncertainties and persistent shocks happening in the global context.

According to Briguglio (2006), economic resilience refers to the ability to recover from, or adjust to, the negative impacts of external economic shocks. Moreover, Briguglio (2006) suggests three (3) senses relating to economic resilience. Those are as follows;

i. Ability of an economy to recover quickly. This is associated with the flexibility of an economy, enabling it to bounce back after being adversely affected by a shock. This ability will be severely limited if, for example, there is a chronic tendency for large fiscal deficits or high rates of unemployment.

ii. Ability to withstand shocks. This suggests that the adverse effect of a shock can be absorbed or neutered so that the end effect is zero or negligible. This type of resilience occurs when the economy has in place mechanisms to react endogenously to negative shocks to reduce their effects, which we can refer to as 'shock-absorption'.

iii. Ability of an economy to avoid shocks. This type of resilience is considered to be inherent and can be considered the obverse of economic vulnerability.

2. Components of economic resilience

Briguglio (2006) identifies four (4) variables as components that help to measure economic resilience which are highly influenced by economic policy and which can serve an economy to build its economic resilience to meet the consequences of adverse shocks. Those are;

i. Macroeconomic stability. Macroeconomic stability relates to the interaction between an economy's aggregate demand and aggregate supply. It includes the internal balance actors such as fiscal position, employment rate, inflation, etc., and the external balance actors such as international current account position or the level of external debt.

ii. Microeconomic market efficiency. The science of economics views markets, and their efficient operation through the price mechanism, as the best way to allocate resources in the economy. Economic Freedom of the World Index Gwartney & Lawson (2005) state five major areas, namely size of government, legal structure and security over property rights, access to sound money, freedom to trade internationally, and regulation of credit, labor, and business to measure the Microeconomic market efficiency component.

iii. Good governance. This is essential for an economic system to be resilient which assists in absorbing adverse shocks to result in economic and social chaos and unrest. Gwartney & Lawson (2005) state that judicial independence reflects the indicators namely the impartiality of courts, the protection of intellectual property rights, military interference in the rule of law, the political system, and the integrity of the legal system.

iv. Social development. This is another essential component that indicates the extent to which social relations in a society are properly developed, enabling an effective functioning of the economic apparatus without the hindrance of civil unrest. As per the UNDP (2004), Education and Health are the main sectors that can be utilized to measure the social development component.

3. Economic resilience of Sri Lankan context – major sectors

Jayasinghe, et al., (2022) identify four (4) key economic sectors that cover the different parts of the Sri Lankan Economy and the need to formulate ways to develop resilience against uncertainties and shocks. The respective sectors are;

i. Agriculture Sector
ii. Apparel Sector

iii. Tourism Sector
iv. Construction Sector

B. Segment II

1. Private Public Partnerships (PPPs)

PPPs can be identified as special forms of interaction between business and government in the economies which are deployed in many countries as a tool for creating new infrastructure facilities and providing services for the organization of public works (Hoeppner & Gerstlberger, 2003).

In other terms, PPP is an institutional and organizational alliance of state power and private business with the aim of implementing socially significant projects in a wide range of areas from the development of strategic sectors of the economy to the provision of public services throughout the country or individual territories (Osborne, 2000).

2. The role and potential

According to the Asian Development Bank (2008), PPPs recognize that the public and the private sectors each have certain advantages, relative to the other, in performing specific tasks. The government's contribution to a PPP may take the form of capital for investment (available through tax revenue), a transfer of assets, or other commitments or in-kind contributions that support the partnership.

The government also facilitates social responsibility, environmental awareness, local knowledge, and the ability to mobilize political support. The private sector's role is to make use of its expertise in commerce, management, operations, and innovation to run the business efficiently. The private partner may also contribute investment capital depending on the form of the contract.

The Finance Commission of Sri Lanka (2017) indicates four (4) approaches to PPPs namely management contracts, provision of infrastructure facilities through small-scale private suppliers, user fee PPP, and PPP based on readymade service.

3. PPPs of Sri Lankan Context

The Finance Commission of Sri Lanka (2017) states that Sri Lanka has no longer a history of PPPs. However, the Mid Term Development Policy Framework (2011-2016) emphasized the PPP as a successful alternative funding method and adopted for the uplifting of infrastructure gained considerable progress in the PPP approach. For example, the construction of brake water of the Colombo Port City project, the second coal power plant project, Trincomalee, and further expected areas such as transport,

aviation, dairy farming, tourism, and drinking water supply.

Contradictionarily, the United States Agency for International Development (2017) states that Sri Lanka has a significant history of introducing PPPs in its infrastructure development. Sri Lanka entered seventy-three (73) PPP projects with a total investment of over $6 billion between 1990 and 2014. Nevertheless said projects were restricted to three (03) sectors, namely electricity, telecommunications, and ports. However, the United States Agency for International Development (2017) states that Sri Lanka has to facilitate the legal, regulatory, and institutional framework by defining the benefits, risks, and responsibilities to develop and execute the PPP projects and building up confidence in private sector investors.

C. Segment III

1. Logistics and components

According to Szymonik (2012), the word logistics has probably a Greek origin derived from the words such as logos - 'counting' or 'reason', logistike - 'the art of calculation', logismos - 'calculation', 'calculus', 'reflection'. Further, the scope and the definitions have evolved over the decades. Yildiz (2023) defines logistics as Planning, implementing, and controlling the effective flow of goods, services, and related information from the point of origin to the point of consumption to satisfy customer needs. So, this definition can be identified as a general explanation when concerning the literature available. Logistics is also defined as an integral functional field under supply chain management (Larson & Halldorsson, 2004).

Moreover, the main components of logistics are inventory management, transportation, warehousing, customer service, and information technology, will be covered in this section (Yildiz, 2023).

2. Collaborative Logistics

Audy, et al., (2010) state that collaborations take place when two or more entities form a coalition and exchange or share resources including information, to make decisions or realize activities that will make advantages that could not be achieved individually. Further, the collaborations are deeply studied in the different business contexts (Chen, 2003) (Bagchi & Larsen, 2005) (Van der Vaart & Van Donk, 2008). Therefore, the effectiveness of logistics operations can be gained through the creation of collaboration among public and private sectors (Audy, et al., 2010).

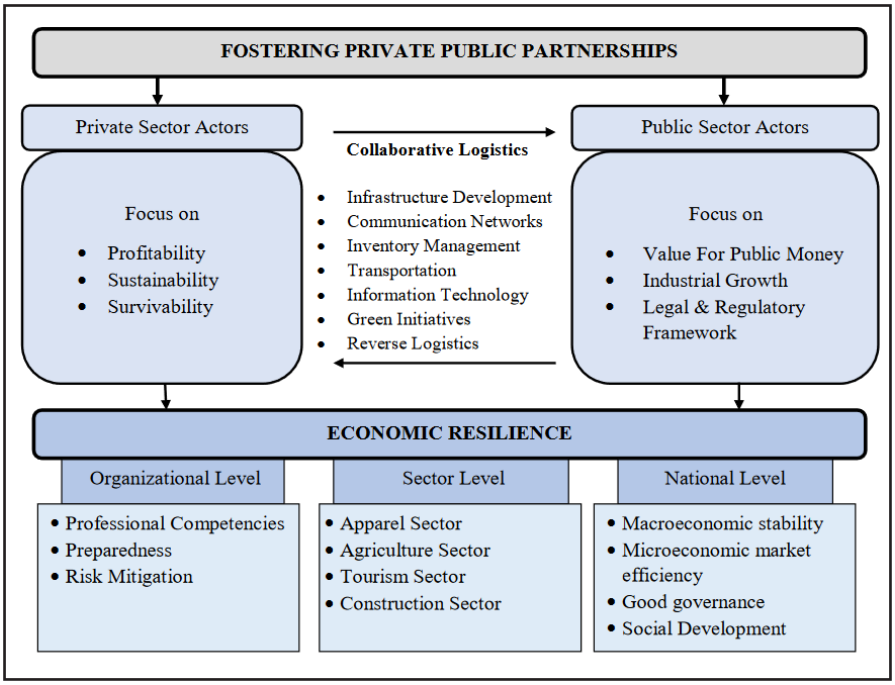
3. Conceptual Framework of the Study

After reviewing the existing knowledge and the literature considered, many authors/ scholars have emphasized the following;

i. Significance of enhancing economic resilience due to dynamic uncertainties.
ii. The impact of Private Public Partnerships as a development tool.
ii. The contribution of collaborative logistics.

Accordingly, the researcher constructs the basic conceptual framework of the study by identifying the relationship among major aspects, as indicated in Figure 1.

Figure 1: The Conceptual Framework of the Study



Source: Author's Illustration based on Literature

3. Discussion and Implications

The researcher expected to answer the four research questions. For that objective, the researcher identified what is economic resilience and its components that support to measure (RQ 1). Then, the researcher derived the role, necessity, and potential of PPPs (RQ 2). Consequently, the significance and components of collaborations in logistics have been identified (RQ 3). Based on the literature reviewed, the researcher formulated and built up the conceptual framework of the study to identify the relationship among economic resilience, PPPs, and collaborative logistics (RQ 4).

Most of scholars and institutions identified the PPPs as an effective mechanism for establishing Win-Win situations and initiating collaboration among the key actors of the economic system namely, the private sector and the state (Kazbekova & Kyzylorda,

2019). Osei-Kyei & Chan (2015) also assisted said facts and believed that the kind of mechanisms between the state and business is much more helpful.

According to prevailing literature, most scholars identified two major aspects given fostering the PPPs. Firstly, a clear policy, legal, and institutional framework should be established at the strategic level (Fernando, 2019). Secondly, it is required to select the best potential methods/models for formulating PPPs.

The formation of the correct model should be based on well-defined theoretical and methodological basis that focuses on the effective deployment of the country's competitive potential (Zakharina, et al., 2020). Further, World Bank (2020) identifies six (6) models based on management and lease contracts, namely;

i. "Rehabilitate - operate - transfer" (ROT)
ii. "Build - rehabilitate - operate - transfer" (BROT)
iii. "Rehabilitate - lease or rental - transfer" (RLT)
iv. "Build - lease - transfer" (BLT)
v. "Build - operate - transfer" (BOT)
vi "Build - own - operate" (BOO)

Table 1 shows how the United Kingdom, France, and Germany execute the application of public-private partnership models in the implementation of innovation and infrastructure development projects as benchmarked applications (Zakharina, et al., 2020).

Table 1: Benchmarked application of effective models of public-private partnership

Country	Working models of public-private partnership in a proper country (according to the World Bank classification)	Importance in the implementation of public policies
United Kingdom	1. Concession agreements; 2. Management contracts; 3. Greenfield projects.	Can be implemented in different spheres: transport, health, education, housing and municipal services, waste management, defense, information technology and residential construction in order to ensure the strategic goals of social and economic development of the national economy.
Germany	1. Concession agreements; 2. Leasing; 3. Management contracts; 4. DBFM agreements (design, build, finance, maintain) and BOT (build, operate, transfer).	Can be implemented in different spheres: transport, utilities, energy, health and education in order to ensure sustainable development of the transport system, improve the quality of housing services and create an effective system of medical services
France	1. Concession agreements; 2. Management contracts; 3. Greenfield projects.	Can be implemented in different spheres: transport, health, education, housing, waste management and residential construction in order to create conditions for the powerful development of construction process and improve the mechanism of functioning of public utilities. An important area of work in the context of public policy is the creation of an extensive system of parking zones.

Source: European PPP Expertise Center (2020)

Eventually, existing knowledge emphasized the significance of engaging with the main contributing economic sectors (such as apparel, tourism, agriculture, and construction in the Sri Lankan context) to execute PPPs to enhance the economic resilience of the country. Governments also have to facilitate the key functional areas (such as infrastructure development, communication networks, inventory management, transportation, information technology, green initiatives, and reverse logistics of logistics) for collaboration to build up the collaborative nodes among suppliers, manufacturers, retailers, and logistics service providers, etc. Moreover, scholars have identified the key challenges (Verdonck, 2017) (Diehlmann, et al., 2021) and issues in executing the effective PPPs (Fernando, 2019).

4. Conclusion

During the study, the researcher discussed the critical role of fostering Private Public Partnerships towards building Economic Resilience in Sri Lanka. Based on a systematic literature review, the study highlighted the potential collaboration in logistics between the private and public sectors to drive toward a Win-Win situation and economic resilience. As a developing third-world country and due to unfavorable economic conditions of the country, Sri Lankan state policymakers can utilize the PPPs as an effective mechanism for the development of the key economic sectors which are major contributors to Gross Domestic Production (GDP) by facilitating key logistics functions such as infrastructure, warehousing, transportation, communication networks, etc. Consequently, the private sector can work on promoting potential socio-economic benefits such as job creation, technology transfer, and enhanced competitiveness on a global scale.

In the present global landscape, many more uncertainties and shocks are occurring in a dynamic manner such as geopolitical conflicts, climate change, terrorism, natural disasters pandemics, etc. Therefore, the study highlights the necessity of a proactive approach to enhancing collaboration in logistics to maintain the aggregate production of the country by avoiding barriers, and disruptions and overcoming the challenges and issues collectively towards the resilience of the economy.

Based on the above considerations, future researchers can pay attention to exploring innovative models and strategies for facilitating collaboration in logistics, as same assessing the long-term returns of PPPs on the economic resilience of Sri Lanka. Ultimately, this study generates valuable insights and recommendations for policymakers, industry stakeholders, and researchers exerting to explore the landscape of collaborative logistics and motivate positive change toward the resilience of Sri Lanka.

5. Recommendations

The researcher suggests following as the recommendations for fostering PPPs toward economic resilience.

i. Formulate a master plan and strategy to develop PPPs and integrate them into national policy/logistics frameworks by establishing a national-level committee including representatives from private and public sectors.

ii. Establish a strong regulatory, institutional, and administrative framework for PPPs which could not be changed due to government changes.

iii. Buildup and suitable PPP models for key economic sectors of Sri Lanka based on the benchmarked practices of respective countries by integrating collaborative logistics. The following example shows an existing scenario in the Agriculture Sector.

Example: Agriculture Sector – Supply Chain of Vegetables

The country facing a huge issue of fluctuating the prices of vegetables regularly due to various reasons like weather conditions, transportation disruptions, rise in fuel prices, and so on. So, that creates economic vulnerabilities and negative effects on the public. In that case, solutions could be found through effective PPPs.

Presently, Vegetables are distributed for wholesale and retail sale through the economic centers established especially at Dambulla, Colombo, Walisara, Nuwaraeliya, Ratmalana, etc. These centers receive the stocks every day and create huge waste due to proper transportation methods and not selling all the stocks. Also, if there is weather changes occur continually for reasonable periods, the prices may increase. As an example, recently the prices of Carrots have gone up unexpectedly.

In this case, the government can provide opportunities for the private sector to establish proper warehouses beside economic centers by having modern warehousing methods and techniques. Then, those warehouses can store the vegetables for a reasonable period, the price may not fluctuate due to the aforementioned reasons. To initiate the investment of the private sector, the government can provide suitable lands, infrastructure facilities, legal support, etc. This process can be facilitated through a model approach and both the state and private sectors will drive collectively and collaboratively toward resilience.

iv. Decentralization of the processes of partnership between the government and the private sector, which is caused by different economic and social efficiency of projects at the national and local levels.

v. Establish fast-track implementation and controlling mechanisms by introducing effective standards in PPPs and the logistics sector.

REFERENCES

Asian Development Bank, 2008. Public-Private Partnership Handbook. s.l.:Asian Development Bank.

Asian Development Bank, 2016. Preparing a Public–Private Partnership Law Philippines, s.l.: Asian Development Bank.

Audy, J. F., Lehoux, N. & D'Amours, S., 2010. A Framework for an Efficient Implementation of Logistics Collaborations. CIRRELT.

Bagchi, P. K. & Larsen, S. T., 2005. Supply chain integration: A European Survey. International Journal of Logistics Managment, pp. 275-294.

Briguglio, L., 2006. Conceptualizing and measuring economic resilience. Research Gate. Chen, F., 2003. Information Sharing and Supply Chain Cordination. In: Handbooks in operations research and management science. Amesterdam: Elsevier.

Deshapriya, S., 2024. IMF praises Sri Lanka's Economic Reforms. Sunday Observer, 24 03, p. 9.

Diehlmann, F., Luttenberg, M. & Verdonck, L., 2021. Private Public Collaborations in emergency logistics: A Framework based on Logistical and game theoretical concepts. Elsevier.

European PPP Expertise Center, 2020. Public-private partnerships financed by the European Investment Bank. [Online] Available at: https://www.eib.org/attachments/epec/epec_ppp_financed_by_eib_1990_2019_en.pdf.
[Accessed 28 3 2024].

Fernando, P. G., 2019. Regulating Public Private Partnership in Sri Lanka: The Public Sector Perspective, s.l.: s.n.

Finance Commission of Sri Lanka, 2017. Private Partnership Approach: Theory and Practice. [Online] Available at: http: // fincom .gov.lk/ public-private -partnership

-approach -theory- and -practice /?lang =si
[Accessed 25 03 2024].

Gwartney, J. & Lawson, R., 2005. Economic Freedom of the World, s.l.: Fraser Institute.
Hoeppner, R. R. & Gerstlberger, W., 2003. Public private partnership: A guide for public administration and entrepreneurs. s.l.:s.n.

Jayasinghe, N., Fernando, S. & Haigh, R., 2022. Economic resilience in an era of 'systemic risk': Insights from four key. Elsevier.

Kazbekova, L. & Kyzylorda, K. A., 2019. Types, forms and models of Public Private Partnerships and their application in the Kazakhstani Practice. Academy of Strategic Management Journal, 18(6).

Larson, P. D. & Halldorsson, A., 2004. Logistics Versus Supply Chain Management: An International Survey. International Journal of Logistics: Research and Applications, 7(1).

Osborne, S., 2000. Public-private partnerships: Theory and practice in international perspective. s.l.:Routledge.

Osei-Kyei, R. & Chan, A. P., 2015. Review of studies on the critical success factors for Public-Private Partnership. International Journal of Project Management.

Szymonik, A., 2012. Logistics and Supply Chain Management. s.l.:ResearchGate.
UNDP, 2004. Cultural Liberty in Today's Diverse World, Geneva: UNDP.

United States Agency for International Development, 2017. Report on Sri Lanka's current PPP Environment and Recommendations for Future Strategy, s.l.: USAID.

Van der Vaart, T. & Van Donk, D. P., 2008. A critical review of survey based research in supply chain integration. International Journal of Production Economics, pp. 42-55.

Verdonck, I., 2017. Collobarative Logistics from perspective of freight transport companies, Diepenbeek, Belgium: s.n.

World Bank, 2020. Private Participation in Infrastructure Database. [Online] Available at: https: //ppi. worldbank. org/en/ppidata [Accessed 25 03 2024].

Yildiz, T., 2023. Logistics and Supply Chain Management: Fundamentals and Strategies. s.l.:ResearchGate.

Zakharina, O. V., Volodymyr, V. & Kovalenko, N. V., 2020. Effective Public-Private Partnership Models and their Application. International Journal of Economics and Business Administration, Volume VIII, pp. 239-247.

ANALYSING THE ROLE OF PUBLIC-PRIVATE PARTNERSHIPS IN FOSTERING SUSTAINABLE LOGISTICS PRACTICES FOR ECONOMIC RESILIENCE IN SRI LANKA

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Abstract

This study explores the role that Public-Private Partnerships (PPPs) play in advancing environmentally friendly logistics methods as a means of bolstering Sri Lanka's economy. Through an examination of cooperative initiatives between public and private sectors, this research study was conducted as desk research by scrutinizing existing knowledge to clarify the ways in which PPPs support the implementation of sustainable logistics management practices. This article offers insights into how PPPs can successfully navigate the difficulties of modern logistics management to achieve economic resilience and environmental sustainability in the Sri Lankan context through a thorough analysis of case studies and policy frameworks unique to Sri Lanka.

In order to assess the role of PPPs in promoting sustainable logistics development, the study synthesizes data from case studies, policy analysis, and stakeholder perspectives. It also tackles important research concerns about the socio-economic, environmental, and governance processes of PPPs. Recommendations are made for improving cooperation and policy support for sustainable development in Sri Lanka, as well as the implications of PPPs in sustainable logistics for environmental sustainability and economic resilience. With an emphasis on the Sri Lankan context, further potential study paths and possibilities for further investigation are indicated. The article's goals are to add to the body of knowledge in the field, influence policy choices, and assist interested parties in creating a logistics ecosystem in Sri Lanka that is more resilient and sustainable.

Keywords: *Sustainable Logistics, Public-Private Partnership, Economic Resilience, Collaborative Governance*

1. Introduction

Sri Lanka's strategic location in the Indian Ocean is pivotal for global trade. Efficient logistics are essential for economic growth, but sustainability is crucial for long-term resilience against environmental challenges and global disruptions.

Logistical sustainability approaches, according to Jayathilake and Nallathiga (2020), include tactics to reduce environmental effects, maximize resource use, and

improve supply chain effectiveness. Since there are few resources of natural origin and serious threats from environmental deterioration in Sri Lanka, it is critical to implement sustainable logistics management techniques.

Sustainable logistics management in Sri Lanka involves optimizing transportation routes, implementing green technologies, and adopting circular economy principles to enhance environmental sustainability, operational efficiency, and cost-effectiveness (World Bank, 2020). These practices offer socio-economic benefits by reducing dependency on fossil fuels, minimizing pollution, and preserving natural ecosystems, thereby enhancing the country's resilience to external shocks and attracting foreign investment and trade.

Particularly in developing countries like Sri Lanka, sustainable logistics has been a vital factor in promoting economic resilience in recent times. The role of public-private partnerships (PPPs) in promoting sustainable logistics practices has grown in importance amid issues like resource shortages and environmental deterioration. The significance of investigating PPPs' role in promoting sustainable logistics practices to strengthen Sri Lanka's economic.

A. Public-Private Partnerships (PPPs)

Public-Private Partnerships (PPPs) facilitate collaboration between government entities and private stakeholders to tackle socio-economic and environmental challenges (Samaranayake & Hirakawa, 2019). In Sri Lanka, they play a key role in driving sustainable development, particularly in logistics management, crucial for trade and economic growth (Ministry of Finance, Sri Lanka, 2020). PPPs enhance economic resilience by leveraging resources and expertise from both sectors.

B. Thesis Statement

This study aims to explore how Public-Private Partnerships (PPPs) promote sustainable logistics practices for economic resilience in Sri Lanka. By analyzing collaborative efforts between government and private sectors, it seeks to understand how PPPs facilitate the adoption of sustainable logistics strategies and enhance the country's economic resilience and seeks to address the following research questions.

RQ1. How have public-private partnerships evolved in Sri Lanka's logistics sector over time?
RQ2. What are the key components of collaborative governance in sustainable logistics development in Sri Lanka?
RQ3. What is the impact of public-private partnerships on the adoption of sustainable logistics practices in Sri Lanka?

RQ4. How do public-private partnerships contribute to economic resilience in Sri Lanka's logistics sector?

2. Literature Review

A. Stage 1: Historical Context of Public-Private Partnerships in Sri Lanka's Logistics Development

With the advent of liberalization and privatization policies in Sri Lanka in the late 1970s and early 1980s, Public-Private Partnerships (PPPs) in the logistics sector evolved (Jayasuriya & Wegiriya, 2017). These attracted private investment and expertise intending to modernize infrastructure, particularly logistics. This shift away from state-led strategies brought in a cooperative model that included both industries (Rathnayake, 2019).

B. Stage 2: Theoretical Framework: Collaborative Governance and Its Application to Sustainable Logistics in Sri Lanka

A theoretical framework for comprehending the dynamics of collaborations between the public and commercial sectors in the development of sustainable logistics is provided by collaborative governance. To accomplish common objectives in logistical sustainability, collaborative governance in Sri Lanka entails the coordination and collaboration of several stakeholders, including communities, businesses, government agencies, and civil society groups (Fernando & Jayakody, 2018).

3. Research Methodology

A. Research approach: case study analysis and policy review, focusing on Sri Lankan context

Using a mixed-method approach, this study examines how public-private partnerships (PPPs) affect sustainable logistics strategies for Sri Lanka's economic resilience through case study analysis and policy evaluation. Case studies provide an in-depth understanding of particular PPP projects, while policy reviews look at laws and policies about PPPs and sustainable logistics in Sri Lanka.

B.Selection criteria for case studies and policy documents relevant to the Sri Lankan context

Relevance to the study aims and the Sri Lankan context will be given priority in the selection criteria for case studies and policy papers. Case studies will be in line with PPP activities related to trade facilitation, environmentally sustainable logistics, and infrastructure development. PPPs, sustainable logistics, and economic resilience in Sri

Lanka will also be the subjects of policy papers, which will include national development plans, transportation policies, environmental laws, and PPP frameworks.

C. Data collection methods: Qualitative analysis of case studies and policy documents specific to the Sri Lankan context

The primary method of gathering data for this study will be the qualitative examination of policy papers and case studies that are particular to Sri Lanka. To discover important themes about PPPs and sustainable logistics, case studies will be analyzed using qualitative research techniques including content analysis and thematic coding. Comparably, policy papers will be subjected to qualitative analysis to comprehend the legislative and policy frameworks that control PPPs and environmentally friendly transportation in Sri Lanka. In order to conceptualize the current study, researcher reviewed 40 recently published and mostly cited research papers at publications and indexes such as 'Emerald', 'Research Gate', 'Google scholar', 'Academia' and 'Web of science' and systematically scrutinized 20 most relevant studies for the current study A thorough organization and analysis of pertinent data from government papers, scholarly journals, and industry reports will be conducted to determine the contribution of PPPs to sustainable logistics for Sri Lanka's economic resilience.

This study's approach guarantees a thorough analysis of PPP programs and legislative frameworks pertinent to Sri Lanka's sustainable logistics development, offering insightful information on the workings of public-private partnerships and their effects on the country's ability to withstand economic downturns.

4. Case Studies

A. Public-Private Partnership in Sustainable Logistics: Sri Lankan Perspective

Public-private partnerships, or PPPs, are essential to the advancement of sustainable logistics techniques in Sri Lanka since they promote both environmental sustainability and economic resilience. In addition to giving an overview of successful PPPs in Sri Lanka's logistics sector and analyzing the factors that support and obstruct effective PPPs in promoting economic resilience through sustainable logistics, this section expounds on the significance of collaboration between the public and private sectors in the country's sustainable logistics development.

1. Importance of collaboration between public and private sectors in Sri Lanka's sustainable logistics development: For several reasons, public-private sector cooperation is essential to Sri Lanka's sustainable logistics growth. First off, the government might not have the means, know-how, or effectiveness to handle the many issues facing the logistics industry, including building

infrastructure, embracing new technologies, and adhering to regulations (Jayasuriya & Wegiriya, 2017). The government may improve the efficacy and efficiency of logistics operations by collaborating with private companies and making use of their resources and experience.

PPPs in Sri Lanka improve sustainable logistics management by fostering innovation, information exchange, and technology transfer between the public and private sectors (Ministry of Finance, Sri Lanka, 2020). Working together ensures congruence with sectoral demands and societal objectives by fostering openness, accountability, and stakeholder involvement.

2. Overview of successful PPPs in Sri Lanka's logistics sector: PPPs that have been successful in Sri Lanka's logistics industry, such as the Colombo Port Expansion Project, have improved sustainability and development. The project, which increased the Port of Colombo's capacity, efficiency, and competitiveness, was led by the Sri Lanka Ports Authority (SLPA) and private terminal operators (Jayasuriya & Wegiriya, 2017).

The Southern Highway Project, which includes working with private contractors and the government to build and run a toll-based highway connecting Colombo with the southern area of Sri Lanka, is another example of a successful Public-Private Partnerships (PPP) (World Bank, 2019). As a result of this project, travel times and traffic on the current road networks have decreased and goods and passenger transit has become safer and faster.

3. Analysis of the drivers and barriers to effective PPPs in fostering economic resilience through sustainable logistics in Sri Lanka: Effective Public-Private Partnerships (PPPs) in Sri Lanka's sustainable logistics sector are made possible by factors including favorable government policies, well-defined project objectives, sufficient funding, and robust institutional frameworks. These PPPs boost the country's economic resilience and competitiveness (Ratnayake, 2019).

Political unpredictability, legal ambiguity, bureaucratic red tape, and a lack of transparency are obstacles to successful PPPs in Sri Lanka's sustainable logistics industry (Samaranayake & Hirakawa, 2019). Successful implementation is further hampered by issues including insufficient risk-sharing mechanisms and competing stakeholder interests (World Bank, 2017). To address these and enable successful PPPs for economic resilience through sustainable logistics in Sri Lanka, changes to governance, improvements to regulations, and strengthened institutional capacities are needed to promote transparency, accountability, and stakeholder involvement.

A. Case Study 1: PPPs for Infrastructure Development and Modernization of Logistics Systems in Sri Lanka

The Colombo Port's efficiency and capacity were intended to be increased by the Colombo International Container Terminal (CICT) project, a successful PPP between China Merchants Port Holdings Company Limited (CMPort) and the Sri Lanka Ports Authority (SLPA). By using a build-operate-transfer (BOT) strategy, CMPort made investments in the development and management of additional container terminals, resulting in notable advancements in infrastructure. Modern terminals, outfitted with cutting-edge handling machinery, established the Colombo Port as a premier transshipment center, drawing in more cargo and enhancing Sri Lanka's competitiveness in marine commerce (Jayasuriya & Wegiriya, 2017).

B. Case Study 2: Collaborative Initiatives for Promoting Green Logistics and Environmental Sustainability in Sri Lanka

Under the direction of the Ministry of Environment, Sri Lanka's Green Freight Initiative (GFI) sought to improve environmental sustainability in freight transportation by fostering cooperation between public and commercial partners (Ministry of Environment, Sri Lanka, 2019). Cleaner cars were introduced, transportation routes were optimized, and initiatives to develop driving skills for sustainable driving were put into action. Additionally, the effort encouraged public and commercial organizations to adopt green procurement practices and build green logistical hubs.

In addition to providing real environmental advantages including lower carbon emissions and air pollution, the GFI has also helped logistics companies save money and operate more efficiently with gasoline. In addition, the program has helped players in the logistics industry develop a culture of environmental responsibility and increased knowledge, which has helped Sri Lanka achieve its larger sustainability objectives (Ministry of Environment, Sri Lanka, 2019).

C. Case Study 3: Cross-Sector Partnerships for Innovation and Technology Adoption in Logistics Specific to Sri Lanka

The "Logitech" program is a notable example of cross-sector cooperation for innovation and technology adoption in logistics that is unique to Sri Lanka. The goal of this cooperative endeavor was to use digital technologies to improve the efficiency, transparency, and competitiveness of Sri Lanka's logistics industry. It was headed by the Ministry of Industry and Commerce and involved technology companies and logistics service providers.

Several cutting-edge solutions were put into practice under the Logitech initiative, such as the creation of digital platforms for tracking and booking freight, the deployment

of Internet of Things (IoT) devices for real-time cargo movement monitoring, and the adoption of blockchain technology for transparent and safe supply chain management. These technology advancements have improved the visibility and traceability of goods, lowered paperwork, and expedited logistical processes—all of which have increased corporate productivity and decreased costs.

By partnering with the public and commercial sectors, the Logitech program in Sri Lanka has fostered innovation and collaboration within the logistics sector. The project seeks to promote Sri Lanka as a regional center and boost the nation's competitiveness in the global logistics industry by embracing digital transformation and technical improvements. Sri Lanka's Ministry of Industry and Commerce, 2020).

A. Policy Analysis: Sri Lankan Context

1. Policies and Regulatory Frameworks in Sri Lanka Encouraging PPPs for Sustainable Logistics Development: Public-private partnerships (PPPs) are being used by Sri Lanka to foster sustainable logistics development via the implementation of regulatory frameworks and policies. Under the direction of the Ministry of Ports and Shipping, the National Logistics Policy seeks to improve industry sustainability and efficiency by fostering cooperation between the public and private sectors (Ministry of Ports and Shipping, Sri Lanka, 2018). The legal foundation for PPPs in port development is provided by the Sri Lanka Ports Authority Act, which makes it possible for the private sector to participate in initiatives like the Colombo Port Expansion (Jayasuriya & Wegiriya, 2017). Green logistics projects are further encouraged by incentives including tax rebates and subsidies (Ministry of Environment, Sri Lanka, 2019).

2. Assessment of Policy Effectiveness in Promoting Public-Private Collaboration and Economic Resilience in Sri Lanka : In Sri Lanka, obstacles still exist in the way of encouraging public-private cooperation and economic resilience, even in the face of legislative frameworks and policy measures. PPP implementation is hampered by political unpredictability, legal ambiguity, and bureaucratic red tape, which causes delays and cost overruns (Ratnayake, 2019). PPP success is hampered by a lack of coordination between public and private entities, leading to problems including insufficient risk-sharing mechanisms and competing agendas (Samaranayake & Hirakawa, 2019).

3. Policy Recommendations for Enhancing PPPs and Fostering Sustainable Logistics Practices in Sri Lanka: To enhance PPPs and sustainable logistics in Sri Lanka, policy recommendations include streamlining regulatory processes to reduce bureaucratic hurdles and establishing a dedicated PPP unit for oversight (World Bank, 2017).

The second thing that has to be done is work on improving capacity-building programs and stakeholder engagement to improve public-private sector cooperation.

This might entail creating forums or platforms with several stakeholders to facilitate discussion, information sharing, and cooperative problem-solving on sustainable logistics-related challenges (United Nations, 2019).

Sri Lanka should make investments in infrastructure, technology, and the development of human capacity to promote sustainable logistics. It should also provide incentives, technical support, and training programs (Ministry of Finance, Sri Lanka, 2020). These steps can promote environmental sustainability, economic resilience, and public-private cooperation.

5. Discussion

The synthesis of findings from case studies and policy analysis underscores the pivotal role of public-private partnerships (PPPs) in advancing sustainable logistics practices in Sri Lanka. Case studies like the Colombo International Container Terminal (CICT) project and the Green Freight Initiative (GFI) exemplify how PPPs contribute to infrastructure development and environmental sustainability (Jayasuriya & Wegiriya, 2017; Ministry of Environment, Sri Lanka, 2019). However, policy analysis reveals challenges such as bureaucratic hurdles and legal uncertainties that hinder effective PPP implementation (Ratnayake, 2019). Despite these challenges, PPPs have the potential to drive economic resilience and environmental sustainability by leveraging the strengths of both sectors.

PPPs hold significant implications for Sri Lanka's economic resilience and environmental sustainability. They foster collaboration, modernize infrastructure, and drive innovation, enhancing the nation's competitiveness and attracting investments (World Bank, 2017). Sustainable logistics practices promoted through PPPs also align with Sri Lanka's sustainability goals, contributing to emissions reduction and resource conservation (Ministry of Environment, Sri Lanka, 2019).

Stakeholders in Sri Lanka encounter opportunities and challenges in leveraging collaborative governance for sustainable development. While PPPs offer access to financing and technology transfer, institutional fragmentation and limited coordination hinder effective collaboration (Samaranayake & Hirakawa, 2019). Overcoming these challenges requires strengthening institutional capacities and fostering a conducive environment for partnership-building (Fernando & Jayakody, 2018).

6. Conclusion & Recommendations

The conclusion underscores the critical role of Public-Private Partnerships (PPPs) in driving sustainable logistics practices and economic resilience in Sri Lanka. Through collaborative efforts, PPPs have facilitated the development of modern infrastructure, efficient logistics systems, and innovative solutions for environmental

sustainability. Notable case studies like the Colombo International Container Terminal (CICT) project and the Green Freight Initiative (GFI) demonstrate the effectiveness of PPPs in infrastructure development and environmental sustainability, respectively (Jayasuriya & Wegiriya, 2017; Ministry of Environment, Sri Lanka, 2019). However, challenges such as bureaucratic hurdles and legal uncertainties hinder effective PPP implementation, suggesting the need for streamlined regulatory processes and enhanced coordination between stakeholders (Ratnayake, 2019).

Moving forward, stakeholders in Sri Lanka must prioritize collaboration and policy support for sustainable development. This entails fostering greater coordination and communication between the public and private sectors, enhancing stakeholder engagement, and strengthening institutional capacities for PPP implementation. Policymakers must enact supportive regulations and incentives to encourage investment in sustainable logistics initiatives and create an enabling environment for innovation and technology adoption (World Bank, 2017). By leveraging the collaborative power of PPPs, stakeholders can address the challenges of contemporary logistics management and propel Sri Lanka towards a more resilient and sustainable future.

To further advance research in this area, several recommendations can be considered. Long-term impact assessments of PPP projects are essential to understand their economic, social, and environmental implications over time. Stakeholder perspectives on PPPs should be explored to identify motivations, challenges, and strategies for enhancing collaboration. Comparative analyses with international cases can provide valuable insights into effective PPP models and practices for sustainable logistics development. Additionally, research should explore innovative financing mechanisms, technological innovations, capacity-building initiatives, and policy evaluation and reform to support sustainable logistics practices in Sri Lanka (Ministry of Finance, Sri Lanka, 2020).

Furthermore, community engagement and social impact assessments are crucial to ensure that sustainable logistics projects benefit local communities and respect their needs and aspirations. Climate resilience and adaptation strategies should also be integrated into logistics planning to mitigate the impacts of climate change on logistics operations. Lastly, policy implementation and monitoring mechanisms must be strengthened to enhance accountability and governance in sustainable logistics governance (Ministry of Ports and Shipping, Sri Lanka, 2018).

By addressing these research recommendations, scholars and practitioners can contribute to advancing knowledge, informing policy decisions, and driving positive change toward sustainable and resilient logistics development in Sri Lanka. Overall, the conclusion emphasizes the transformative potential of PPPs in fostering sustainable logistics practices and economic resilience, paving the way for a more sustainable future for Sri Lanka.

REFERENCES

Eisenhardt, K. M., 1989. Building theories from case study research.. Academy of Management Review, pp. 14(4), 532-550.

Fernando, M., & Jayakody, J. , 2018. Collaborative governance: A conceptual framework for sustainable development in Sri Lanka.. South Asian Journal of Social Studies and Economics, pp. 1(2), 1-14.

Jayasuriya, R., & Wegiriya, P., 2017. Public-private partnerships (PPP) in port development in Sri Lanka. Engineering, Technology & Applied Science Research,, pp. 7(2), 1607-1612.

Jayathilake, D. R., & Nallathiga, R. , 2020. Sustainable Logistics and Supply Chain Management in Sri Lanka. International Journal of Scientific and Research Publications, Volume 10(10),, pp. 394-398.

Jayathilake, J. M., & Nallathiga, R. , 2020. Sustainable logistics practices: A review of the literature and implications for developing countries. Sustainability. pp. 12(8), 3146.

Ministry of Environment, Sri Lanka, 2019. National policy on solid waste management, s.l.: Ministry of Environment, Sri Lanka.

Ministry of Environment, Sri Lanka, 2019. National policy on solid waste management., s.l.: Ministry of Environment, Sri Lanka.

Ministry of Finance, Sri Lanka. , 2020. Public-Private Partnerships in Sri Lanka: Strategic Framework and Action Plan. , s.l.: Government of Sri Lanka.

Ministry of Finance, Sri Lanka, 2020. Annual Report 2019, s.l.: Ministry of Finance, Sri Lanka.

Ministry of Industry and Commerce, Sri Lanka, 2020. Annual Report 2019, s.l.: Ministry of Industry and Commerce, Sri Lanka.

Ministry of Ports and Shipping, Sri Lanka, 2018. National Logistics Policy, s.l.: Ministry of Ports and Shipping, Sri Lanka.

Ratnayake, R., 2019. An overview of public-private partnerships (PPP) in Sri Lanka: Progress,challenges, and prospects.. International Journal of Management, Economics and Social Sciences, pp. 8(1), 41-54.

Samaranayake, P., & Hirakawa, H. , 2019. Public-private partnerships for infrastructure development: Lessons from international experiences for Sri Lanka.. Journal of Urban and Regional Planning, Volume 23(2), pp. 81-96.

United Nations, 2019. Public-private partnerships for sustainable development: A toolkit, s.l.: United Nations.

World Bank., 2020. Sri Lanka: Logistics performance and trade facilitation assessment., s.l.: World Bank Group.

World Bank, 2017. Public-private partnerships reference guide version 2.0., s.l.: World Bank Group.

World Bank, 2019. Sri Lanka - Southern Road Connectivity Project: environmental assessment (Vol. 2)., s.l.: World Bank Group.

World Bank, 2020. Sri Lanka: Building Sri Lanka's Logistics Infrastructure, s.l.: World Bank Group.

World Economic Forum, 2021. The future of the last-mile ecosystem. , s.l.: World Economic Forum.

Yin, R. K, 2014. Case study research:. Design and methods. Sage publications.

TRANSFORMATIVE LOGISTICS FOR SRI LANKA'S ECONOMIC RESILIENCE

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Abstract

In this research, I delve into the pivotal role played by transformative logistics in strengthening Sri Lanka's economic resilience amid the dynamic global landscape. By delving into the conceptual framework, implications, and transformative potential intrinsic to logistics practices, this research sheds light on strategies aimed at fortifying economic resilience. Key focal points include innovation, efficiency, and sustainability within the sphere of supply chain management, offering insights into the intricate relationship between transformative logistics and Sri Lanka's economic progress. Leveraging insights gleaned from existing literature, this investigation highlights the importance of enhancing logistics infrastructure, fostering industry-driven innovation, and fostering collaborative resilience-building initiatives. Ultimately, this study emphasizes the transformative power of logistics in bolstering Sri Lanka's economic resilience and fostering sustainable growth in the face of evolving challenges.
Keywords: *Transformative logistics, economic resilience, Sri Lanka, supply chain management, innovation, efficiency, sustainability, logistics infrastructure, industry innovation, collaborative resilience-building*

1. Introduction

Sri Lanka, with its strategic positioning as a pearl in the Indian Ocean, stands as a testament to the intersection of history, culture, and commerce. Its geographical location has historically rendered it a vital hub for maritime trade, facilitating exchanges between the East and West through its bustling ports and well-established trade routes. Yet, despite its inherent potential, Sri Lanka's economic landscape is a canvas painted with a diverse array of challenges and opportunities, beckoning for strategic interventions to navigate its course towards resilience and prosperity.

Central to the quest for economic resilience in Sri Lanka is the pivotal role played by its logistics sector. Logistics, acting as the intricate web of transportation, warehousing, and distribution networks, serves as the lifeblood of global commerce, enabling the seamless movement of goods and services across borders. In the Sri Lankan context, a robust logistics infrastructure is not merely a facilitator of economic growth but also a shield against the uncertainties prevailing in the global arena.

At the core of Sri Lanka's pursuit of economic resilience lies the paradigm of transformative logistics. Going beyond conventional supply chain management, transformative logistics embodies the principles of innovation, efficiency, and sustainability. It encompasses a holistic approach to optimizing logistics operations, leveraging cutting-edge technologies, fostering strategic collaborations, and crafting forward-looking policies to propel economic development and fortify resilience.

In this light, the significance of transformative logistics for Sri Lanka's economic resilience cannot be overstated. By harnessing the potential of transformative logistics, Sri Lanka stands poised to carve out new avenues towards prosperity, bolster its trade competitiveness, and forge an economy that stands resilient in the face of the ever-evolving global landscape. In this research endeavor, we embark on a journey to delve into the intricacies of transformative logistics for Sri Lanka's economic resilience. Through a meticulous examination of Sri Lanka's economic terrain, the critical role played by logistics in fostering resilience, and the transformative potential of innovative logistics practices, our aim is to offer valuable insights into the pivotal role of transformative logistics in shaping the trajectory of Sri Lanka's economic future.

2. Literature Review

The burgeoning interest in transformative logistics, characterized by its emphasis on innovation, efficiency, and sustainability within supply chain management, reflects a global pursuit to fortify economic resilience amidst a dynamic and evolving landscape. In Sri Lanka, a nation distinguished by its strategic geographical position and burgeoning economy, the imperative role of transformative logistics in bolstering economic resilience stands as a cornerstone of national development. This literature review endeavors to delve into existing research and scholarship pertinent to transformative logistics, with a particular focus on its implications for Sri Lanka's economic resilience.

A. Transformative Logistics: Conceptual Framework and Key Principles

Scholarly discourse on transformative logistics offers valuable insights into its conceptual underpinnings and fundamental principles. According to Christopher et al. (2016), transformative logistics heralds a paradigmatic shift in supply chain management, underscored by the integration of innovative technologies, process optimization, and a steadfast commitment to sustainability. At its core, the conceptual framework of transformative logistics is anchored in principles such as innovation, efficiency, and sustainability, deemed essential for fostering economic growth and resilience (Fernie & Sparks, 2014).

Innovation emerges as a linchpin of transformative logistics, with researchers advocating for the adoption of cutting-edge technologies such as artificial intelligence, blockchain, and automation to augment supply chain efficiency and efficacy (Mangan

et al., 2016). Efficiency, another cardinal principle, accentuates the imperative to streamline processes, curtail costs, and maximize resource utilization across the supply chain continuum (Grant et al., 2018). Moreover, sustainability assumes a pivotal role in transformative logistics discourse, with scholars championing eco-friendly practices, green supply chain management, and judicious resource stewardship to mitigate environmental impact (Seuring & Müller, 2008).

B. Transformative Logistics and Economic Development in Sri Lanka

Numerous studies have delved into the pivotal role of transformative logistics in propelling economic development in Sri Lanka. Jayamaha et al. (2020) underscore the paramount importance of logistics infrastructure development, encompassing ports, transportation networks, and digital connectivity, in bolstering Sri Lanka's trade competitiveness and economic resilience. The authors advocate for strategic investments in logistics infrastructure to underpin export-oriented growth and entice foreign investment.

Furthermore, industry innovation emerges as a catalyst for economic advancement within Sri Lanka's logistics sector. According to Gunawardana et al. (2019), the embracement of emerging technologies and best practices such as digitalization, automation, and data analytics holds the key to enhancing competitiveness and productivity within Sri Lanka's logistics domain. The authors emphasize the imperative of nurturing a culture of innovation and collaboration among stakeholders to galvanize industry innovation and spur economic growth.

C. Transformative Logistics and Resilience Building

The literature on transformative logistics underscores its pivotal role in fortifying resilience within supply chains and fostering economic resilience in Sri Lanka. Flexible and adaptable supply chains, facilitated by transformative logistics practices, exhibit the capacity to swiftly respond to disruptions and mitigate their adverse impacts on economic activities (Ponomarov & Holcomb, 2009). Furthermore, the diversification and redundancy within supply chain networks, catalyzed by transformative logistics, serve to mitigate risks associated with single points of failure and fortify resilience against external shocks (Sheffi, 2015). Additionally, collaborative endeavors and synergistic coordination among stakeholders within the logistics ecosystem, underpinned by transformative logistics principles, stand poised to bolster resilience by fostering information exchange, resource pooling, and collective problem-solving (Lavastre et al., 2012)

3. Methodology

A. Research problem

The research endeavors to delve into the intricate challenges and latent opportunities encountered by Sri Lanka's logistics sector as it endeavors to adopt transformative logistics paradigms, aimed at fortifying the nation's economic resilience. This investigation is primed to scrutinize the intricate interplay of factors involved in the assimilation of innovative technologies, optimization of operational efficiencies, and implementation of sustainable logistics methodologies within the Sri Lankan logistics landscape. Through this inquiry, the study aims to elucidate the pivotal role played by these transformative logistics practices in ameliorating critical logistical bottlenecks. Furthermore, it seeks to discern the extent to which these strategic endeavors contribute to Sri Lanka's capacity to withstand the reverberations of external perturbations and adeptly navigate the ever-evolving dynamics of the global economic arena.

B. The conceptual framework

1. **Supply Chain Resilience Framework:** The Supply Chain Resilience Framework focuses on evaluating the robustness of supply chains in managing disruptions and uncertainties. It assesses the capability of supply chains to absorb shocks, rebound from disruptions, and adapt to evolving conditions. In the context of Sri Lanka's economic resilience, this framework offers a structured methodology for comprehending the vulnerabilities and strengths of the country's logistics networks, thereby enabling the identification of strategies to fortify their resilience.

2. **Component:** The Supply Chain Resilience Framework typically consists of several essential components:

   i. **Risk Identification:** This entails pinpointing potential threats and vulnerabilities that could impact supply chain operations, such as natural calamities, geopolitical instability, or market fluctuations.

   ii. **Risk Assessment:** Once risks are identified, they are evaluated in terms of their likelihood and potential impact on supply chain activities. This process aids in prioritizing risks and allocating resources more efficiently.

   iii. **Risk Mitigation:** Strategies and measures are formulated to alleviate identified risks and bolster the resilience of supply chains. This may involve diversifying suppliers, implementing

redundant systems, or investing in technology to enhance visibility and coordination.

3. Response and Recovery: In the event of a disruption, supply chain stakeholders enact response and recovery plans to mitigate the impact on operations and restore normalcy swiftly. This could entail alternative sourcing, emergency logistics arrangements, or collaborative endeavors with partners and stakeholders.

C. Application to the Research Topic

In the context of "Transformative Logistics for Sri Lanka's Economic Resilience," the Supply Chain Resilience Framework can be employed to evaluate the resilience of Sri Lanka's logistics networks and devise strategies to enhance their capacity to withstand external shocks and navigate dynamic economic environments. Researchers can leverage this framework to:

1. **Identify Vulnerabilities:** Analyze the weaknesses and vulnerabilities in Sri Lanka's logistics infrastructure, encompassing transportation networks, ports, and information systems, which may impede economic resilience.

2. **Assess Risks:** Evaluate the risks and threats confronting Sri Lanka's logistics sector, such as natural disasters, trade disruptions, or technological breakdowns, and gauge their potential impact on economic resilience.

3. **Develop Resilience Strategies:** Formulate strategies and interventions to mitigate identified risks and reinforce the resilience of Sri Lanka's logistics networks. This could entail investments in infrastructure, adoption of technology, regulatory reforms, or capacity-building initiatives.

4. **Monitor and Evaluate:** Continuously monitor the efficacy of resilience strategies and interventions, adjusting them as necessary based on evolving circumstances and emerging risks.

By applying the Supply Chain Resilience Framework, researchers can glean valuable insights into the dynamics of Sri Lanka's logistics sector and its contribution to economic resilience. This framework furnishes a systematic approach to identifying challenges, devising solutions, and enhancing capacity to navigate uncertainties and disruptions, thereby fostering sustainable economic growth and development.

4. Discussion

A. Impact of the utilization of the supply chain resilience framework within the realm of transformative logistics for Sri Lanka's economic resilience

The utilization of the Supply Chain Resilience Framework within the realm of "Transformative Logistics for Sri Lanka's Economic Resilience" holds considerable potential for various noteworthy outcomes:

1. Heightened Preparedness: Employing the framework empowers Sri Lanka's logistics sector to proactively pinpoint vulnerabilities and risks inherent within its supply chains. This heightened level of awareness enables stakeholders to craft comprehensive contingency plans and response strategies, thereby elevating the nation's readiness to effectively tackle potential disruptions.

2. Enhanced Risk Management: The framework facilitates a methodical evaluation of the risks and threats confronting Sri Lanka's logistics networks. This systematic assessment empowers stakeholders to prioritize risks based on their probability and potential impact. Such prioritization ensures the efficient allocation of resources toward mitigating the most significant risks, consequently diminishing the overall vulnerability of the logistics sector.

3. Reinforced Resilience: Implementing resilience strategies recommended by the framework, such as diversifying suppliers, establishing redundancy in systems, and investing in technology, can fortify Sri Lanka's logistics networks against external shocks and disruptions. This bolstered resilience enables the nation to rebound swiftly from disruptions, ensuring the seamless continuity of supply chain operations and minimizing the adverse impact on economic activities.

4. Augmented Competitiveness: A resilient logistics sector can enhance Sri Lanka's competitiveness on the global stage by guaranteeing dependable and efficient supply chain operations. Demonstrating the ability to withstand disruptions and maintain uninterrupted supply chain activities enables Sri Lanka to allure investments, forge robust trade partnerships, and capitalize on emerging market prospects, thereby propelling economic advancement and prosperity.

5. Promotion of Sustainable Development: The Supply Chain Resilience Framework underscores the significance of sustainability in supply chain management. By integrating sustainable practices into resilience strategies, such as green logistics initiatives and responsible resource management, Sri Lanka's logistics sector can contribute to the nation's enduring economic and

environmental sustainability objectives.

B. Challenges of utilization of the supply chain resilience framework within the realm of transformative logistics for Sri Lanka's economic resilience

Navigating the integration of the Supply Chain Resilience Framework within the context of "Transformative Logistics for Sri Lanka's Economic Resilience" presents several notable challenges:

1. Resource Constraints: Sri Lanka may encounter difficulties in mobilizing sufficient financial and human resources necessary for the effective implementation of the Supply Chain Resilience Framework. Limited budget allocations and a scarcity of skilled professionals in logistics management could impede the comprehensive adoption of resilience strategies.

2. Technological Readiness: The successful execution of the framework heavily relies on harnessing advanced technologies for risk assessment, real-time monitoring, and decision-making. However, Sri Lanka may face hindrances related to technological readiness, including restricted access to cutting-edge technologies, inadequate digital infrastructure, and low levels of digital literacy among logistics stakeholders.

3. Data Availability and Quality: The efficacy of the Supply Chain Resilience Framework is contingent upon the accessibility and reliability of data for risk identification, assessment, and mitigation. Sri Lanka may confront challenges in obtaining trustworthy and up-to-date data due to gaps in data collection systems, limited mechanisms for data sharing, and inconsistencies in data standards across various sectors.

4. Regulatory and Policy Barriers: The existing regulatory frameworks and policies in Sri Lanka may not fully align with the principles and requirements outlined in the Supply Chain Resilience Framework. Regulatory obstacles, bureaucratic procedures, and legal constraints could hinder the implementation of resilience strategies and impede collaboration among stakeholders.

5. Organizational Silos: Fragmentation and a lack of coordination among different stakeholders within Sri Lanka's logistics ecosystem present significant hurdles to establishing a cohesive resilience framework. Organizational silos, turf battles, and conflicting priorities among government agencies, private sector entities, and civil society organizations may obstruct collaboration and hinder essential information sharing for effective resilience-building efforts.

6. Capacity Building Needs: Strengthening the capacity of logistics professionals and stakeholders to comprehend, implement, and sustain resilience strategies is essential for the successful adoption of the Supply Chain Resilience Framework. Sri Lanka may face challenges in providing adequate training, education, and opportunities for skill development to cultivate the necessary expertise and capabilities.

Addressing these challenges will necessitate a coordinated, multi-dimensional approach involving government intervention, private sector engagement, academic collaboration, and international cooperation. By overcoming these obstacles, Sri Lanka can unlock the transformative potential of logistics, thereby enhancing economic resilience and fostering sustainable development.

5. Discussion

In my journey of exploration, I have delved into the intricate world of transformative logistics and its profound impact on Sri Lanka's economic resilience. Through our study of the conceptual framework, transformative potential and real-world applications of logistics practices, I've illuminated a pathway towards fortifying the nation's resilience amidst the ever-changing global landscape.

My in-depth analysis of existing literature has underscored the critical role of transformative logistics in shaping Sri Lanka's economic trajectory. By embracing innovation, efficiency, and sustainability in supply chain management, Sri Lanka can harness the transformative power of logistics to overcome challenges and pursue sustainable growth opportunities.

The adoption of the Supply Chain Resilience Framework provides a structured approach to evaluating and strengthening Sri Lanka's logistics networks. Through the identification of vulnerabilities, assessment of risks, and development of tailored resilience strategies, stakeholders can enhance the nation's ability to withstand disruptions and ensure smooth continuity in supply chain operations.

Nevertheless, our journey towards leveraging transformative logistics for Sri Lanka's economic resilience is not without obstacles. From limited resources to technological barriers and regulatory complexities, there are numerous challenges to overcome. Addressing these challenges will require collaborative efforts across sectors, driven by innovation, cooperation, and a shared commitment to building resilience.

As we navigate towards a more resilient future, it's crucial to recognize the transformative potential of logistics in shaping Sri Lanka's economic landscape. By overcoming challenges, seizing opportunities, and embracing a holistic approach to resilience-building, Sri Lanka can pave the way for sustainable economic growth and

prosperity. Through ongoing research, collaboration, and innovation, we can unlock the full potential of transformative logistics and steer towards a future of resilience and prosperity for Sri Lanka.

REFERENCES

Christopher, M., Men, C. & Khan, O., 2016. Approaches to resilience – A narrative review. International Journal of Production Research, 54(1), pp. 1-35.

Fernie, J. & Sparks, L., 2014. Logistics and retail management: Emerging issues and new challenges in the retail supply chain. s.l.:Kogan Page Publishers.

Grant, D. B., Wong, C. Y. & Trautrims, A., 2018. Sustainable logistics and supply chain management: Principles and practices for sustainable operations and management. s.l.:Kogan Page Publishers.

Gunawardana, K., Jayasinghe, S. & Rathnayaka, R. M., 2019. Drivers of innovation in Sri Lanka's logistics industry: A case of freight forwarding companies. Journal of International Business Research and Marketing, 4(1), pp. 1-11.
Impact of infrastructure development on economic (2020) Jayamaha, A., Perera, N., & Uddin, M..

Lavastre, O., Gunasekaran, A. & Spalanzani, A., 2012. Supply chain risk management in French companies. Decision support systems. pp. 828-838.

Mangan, J., Lalwani, C. & Butcher, T., 2016. Global logistics and supply chain management. s.l.:John Wiley & Sons.

Ponomarov, S. Y. & Holcomb, M. C., 2009. Understanding the concept of supply chain resilience.. The International Journal of Logistics Management, 20(1), pp. 124-143.

Seuring`, S. & Müller, M., 2008. From a literature review to a conceptual framework for sustainable supply chain management. Journal of Cleaner Production, 16(15), pp. 1699-1710.

TRANSFORMATIVE LOGISTICS FOR SRI LANKA'S ECONOMIC RENAISSANCE

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Abstract

ILogistics management is a component of the supply chain management process that is required to fulfill the customers' requirements by implementing the planning, acquisition, distribution, sustaining, and dispositioning With the usage of tools in effective and efficient movements and keep the data and information. The goods, and services from the origin point to the destination point. Logistics management is important to reduce expenditures, and wastage and to enhance the end users' services. The values given by the logistics supplies extend beyond the point of consumption. These services are sometimes referred to as reverse logistics such as recycling.

The term "transformative logistics" describes major adjustments or innovations in logistics procedures to attain increased effectiveness, efficiency, and overall performance. It describes the changing logistics techniques will improve the long-term results.

Modern technological developments, such as current communicative tools and types of equipment, digital aids, automotive machines, and new logistics parallel software can add more value for logistics improvements. The current situation is topped up by a lack of a cohesive and comprehensive policy strategy, paperwork, uncoordinated transport infrastructure development, and a lack of synergy between port and city growth. To solve issues caused by poor coordination and communication, a master plan and a national logistics committee must be developed. However, the growing use of information and communication technologies will help Sri Lanka achieve a long-term economic rebirth.

KEYWORDS: *Logistics Management, Transformative Logistics, Economic Renaissance, technological innovations, visibility*

1. Introduction

Sri Lanka's economic crisis came to the front three years ago with great difficulties in to lives people of the country. The government faced hardships and challenges to overcome the crucial situations due to various reasons such as poor management in all

economic aspects. Sri Lanka has defaulted the more than USD 51 billion in external debts. There were no funds for fuel, or medicines, and important surgeries were also canceled. The problem was the different failures of economic angles.

The objective of this paper is to find the loose points of poor management of the economy, how it affected to commencement of the economic crisis and how far it will help to provide transformative logistics support aspects, and what corrective actions are to be taken to convert normal conditions of the economy in a wide range of angle.

2. Literature Review

The history of logistics is a long story. Its origins can be traced to the Greek and Roman era battles when military personnel known as "Logistics" were in charge of providing and distributing essential supplies and services. Having them had a crucial part in how the battle turned out.

During World War 11, logistics systems saw significant development (1939–1945). Throughout the war, the armies of the United States and its allies outperformed Germany. Due to damage to German armament stocks, the USA army was able to provide its forces with the necessary supplies at the least expensive moment and place.

Sri Lanka has been a developing country since a long time ago and there was no proper plan to develop the country utilizing resources of the country and obtaining loans from foreign countries and local banks. Even though geographical advantages were maximized to the country there was no logistics infrastructural development point with the harbour to an important destination. Sri Lanka is located with most busiest sea line communication and by improving the facilities with the logistics hub concept. it can be developed like a Singapore logistics hub with expecting more income opportunities. Because Singapore is the first place in the Logistics Performance Index.

3. Methodology

The Research Problem

Sri Lanka has been a bankrupt country in the recent past due to the poor management of the country since the open economy implementation. The geographical location of the country will gain more advantages. The problem is to find the challenges faced by the country and how the country can develop transformative logistics with cutting-edge technological solutions.

The Research Objectives

a. To evaluate the extent to affect transformative logistics adaptation in economic development in Sri Lanka.

b. To examine the transformative logistics factors that will increase the efficiency and effectiveness of the development of the economy.

Hypotheses

The transformative logistics factors will increase the performance level of development of the economy of Sri Lanka.

Research Design

This part is used to describe the tools and methods used in this research. Since this research takes a qualitative trait, the researcher has to incorporate both primary and secondary data in this research. After carefully investigating the literature review completed based on books, journals, paper articles, the internet, and Portable Document Format (PDF), variables were identified to construct a conceptual framework in a slightly broader view to study for future researchers.

The conceptual framework

The researcher developed the framework based on the dependent variable which is the economic renaissance of Sri Lanka some factors were identified as independent variables in logistics aspects.

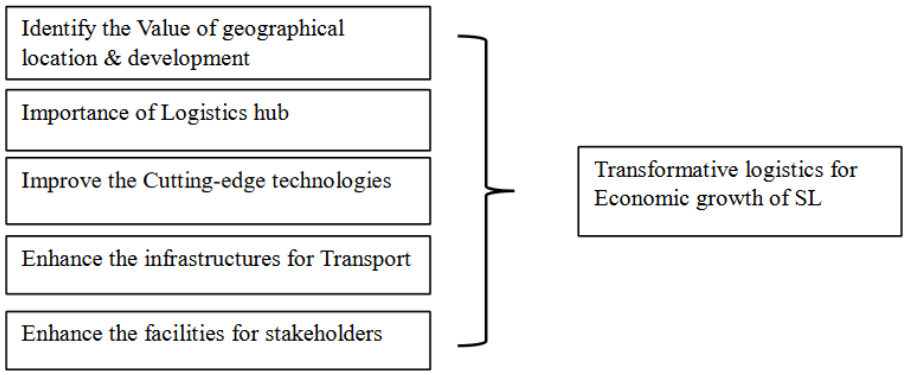

Figure 1 – Conceptual framework
Source: Developed by the Researcher

There were many reasons for the economic crisis including politically unbalanced decisions and maintaining the standards. Since the independence it carried out poor management of the political and officials in the departments, they may be directly responsible for the years of trade deficit. As well as higher imports rather than the exports so that may lead to double the debt. With a debt-to-GDP ratio of 113.8 % (Central Bank Report of Sri Lanka 2022)

Key Causes of the Sri Lanka Economic Crisis

a. TAX reduction and cash flow decrease During the year of 2019 presidential election campaign, the administration promised to lower taxes, which had a substantial impact on the functioning of the government. Government revenue and fiscal policies have deteriorated. This reduces taxpayers by 335% by lowering VAT to 8%, corporation tax from 28% to 24%, removing the PAYE tax, and establishing a 2% national building tax because of the significant losses in tax income. As a result, the country may soon run out of finances as investors evacuate Sri Lanka, making it harder for the country to access the world market.

b. The External debt of Sri Lanka From the years 2010 to 2020, the country's external debt increased up to double. In 2019, the foreign debt rate accounted for about 42% of its GDP. It has, however, increased up to 119% of GDP in 2021. Also, Sri Lanka aims to repay its debtors USD 4 billion by the end of 2022, with the government's reserves at USD 2.3 billion as of April 2022. The renowned Chinese debt is 10% as of April 2021. However, SL has indicated that it will not pay its USD 49.7 billion foreign debt in 2022.

c. Sri Lanka's agricultural crisis In April 2021, the government of Sri Lanka stated that SL will only allow organic agricultural farming, with all other agrochemical fertilizers banned. They hoped that this would benefit their health and alleviate various difficulties. However, many people realized that the health concerns were not the cause of the financial constraints. However, this impacted agricultural production. The decrease in tea production owing to the fertilizer ban alone resulted in millions of dollars in losses. Furthermore, the government was compelled to import rice due to a 20% decrease in rice production in the first six months alone.

d. Impact on the tourism sector The 2019 Easter bombing and the COVID-19 pandemic had a bad impact on it. In that event, borders were blocked, and tourists stopped arriving entirely. Sri Lanka's tourist industry facilitates 13% of the country's GDP. Tourists also generate foreign exchange. In 2020, Sri Lanka attracted only 173,000 tourists. The estimated number was 2.3 million. By 2021, Sri Lanka's tourism revenue has dropped to USD 2.8 billion, according to a World Bank analysis dated April 2021.

e. Tea exports were affected due to the Russian-Ukrainian war
Russia invaded Ukraine in 2022 and SL suffered hardships. Russia is the second largest market for Sri Lanka tea exports also the tourism industry heavily depends on both countries.

4. Discussion

Pulling the transformative Logistics advantages through geography

Transformative logistics seeks to address issues such as high logistics costs, inefficient processes, and environmental problems by finding innovation and best practices to build a more graceful, resilient, and sustainable logistics system.

The country has a significant geographical advantage due to its closeness to the primary East up-to-West maritime route that connects East Asia with Africa, Europe, and the East Coast of the United States. Colombo has been a prominent seaport in Asia since the 14th century, and it was historically frequented by merchants from what is now the People's Republic of China, India, Persia, and other countries. The Journal of Commerce classified Colombo as the world's 30th busiest port in 2014. India has been operating since 1990 as well and the advantage through the geographic may be increasing stronger.

Colombo is the region's main transshipment center for Indian subcontinent cargo, accounting for over 35% of total transshipment volume. The distance from Colombo to major regional ports is shorter than it is from other regional hub ports, as is the time and expense of transportation. Following are the special characteristics that obtain the logistics advantages.

a. Access to Transport Networks Developing the many number of transport modes such as highways, railways, and airports, can improve connection and flexibility in logistics operations. This can assist cut transportation costs, improve delivery times, and provide economic benefits.

b. Infrastructure Sufficient infrastructure, such as roads, ports, and warehouses, can boost logistics efficiency.

c. Market Access Expanding the market range may obtain more benefits to develop the customer base and increase sales. This can expand throughout the urban areas by selecting locations to make the economy grow.

Importance of Transformative logistics aspects

This explores how Sri Lankan logistics have evolved and performed, with a focus on the policy changes required to increase productivity. Logistics, a huge and diverse sector of the services industry, requires change if Sri Lanka is to accelerate its development and become more globally competitive.

Any country's logistics efficiency and effectiveness are one of the most important reasons compared with the competition of global competitors. With the normal barriers to trade, most countries may play an important role in price differences between local and foreign markets. Without focusing on the flexible reforms it may lead to the most

disappointing causes.

The significance of effective logistics services is valued by technological advancements in the global transportation and communication subsectors as well as in the global organization of production activities, encompassing both commodities and services.

Comparison of Logistics cost with regional logistics suppliers

The more proficient regional logistics providers are currently ahead of Sri Lanka. In contrast to the global standard of 10%, the 'Chartered Institute of Transport and Logistics' of Sri Lanka (CILT) reports that logistics costs may amount to 23% of GDP. The People's Republic of China (21%), Malaysia (13%), Singapore (8%), the Republic of Korea (16%), and Thailand (20%) are among the other regional economies with lower figures than Sri Lanka. (Indonesia Investments 2013; Arumugam 2012) As the productive textile and apparel industry in Sri Lanka often emphasizes, such high logistics costs undermine Sri Lanka's competitiveness in trade and production.

Impact on Logistics Performance Index

Trade logistics can improve their performance by using LPI as a benchmarking tool to discover performance concerns and opportunities. LPI makes it possible to compare the 139 nations. Sri Lanka is ranked 73rd out of them. These are the characteristics that influence LPI, and countries with a geographic advantage need to develop their LPI tools to maximize their advantages.

When considering the effectiveness of trade, it's important to assess the transportation infrastructure, easy of arranging competitively priced shipments, quality of logistics services, ability to track and trace shipments, and the consistency of shipments arriving at consignees within expected delivery times.

COUNTRY	POSITION
Sri Lanka	73
India	38
Singapore	01
Malaysia	28
Thailand	34

Figure 2: Global ranking of LPI in 2023
Source: https://www.lpi.worldbank.org/international/global

Integrating cutting-edge technology for logistics

These can bring numerous benefits, including improved efficiency and effectiveness, cost savings, and enhanced customer satisfaction. Some examples of cutting-edge technologies that can be integrated into logistics operations.

a. Warehousing and Inventory Management Tools Automation and Robotics technology can be utilized using automated guided vehicles (AGVs) and autonomous mobile robots (AMRs) for material movement within warehouses, while robotic arms are employed for tasks like picking, packing, and sorting goods. These technologies help reduce manual labor and minimize errors.

b. Blockchain This technology provides a safe, decentralized method of tracking products along the supply chain and recording transactions. It offers a visible and unchangeable ledger that is accessible to all authorized parties, guaranteeing openness and confidence. Blockchain technology can be applied to logistics to improve workflows in areas like tracking shipments, managing inventories, and authenticating products. In the end, it can assist save expenses by lowering fraud and mistakes.

c. Internet of Things (IoT) describes a network of linked devices that gather and share data. IoT devices like sensors, RFID tags, and GPS trackers can be used in logistics to track the whereabouts, state, and condition of commodities in real time. Using this real-time data, supply chain visibility can be increased overall, inventory control can be strengthened, and routes can be optimized.

d. Artificial Intelligence (AI): AI tools that can be used to analyze massive amounts of data and spot trends, patterns, and anomalies include machine learning and predictive analytics. AI may be used in logistics to automate decision-making processes, forecast demand, and optimize routes. Algorithms driven by AI, for instance, can assist in figuring out the best routes for delivery trucks, saving money on gasoline and expediting delivery times. AI can also be used to streamline warehouse tasks like order picking and inventory control, which can save costs and increase productivity.

e. Last-Mile Delivery Testing of delivery robots and ‘drones’ for last-mile delivery is underway to save delivery times and increase efficiency. Urban logistics and e-commerce stand to gain a great deal from these innovations.

f. 3D Printing Also known as additive manufacturing, 3D printing is a technology that creates three-dimensional objects by layering materials based on a digital model. In logistics, 3D printing can be used to create spare parts on demand, reducing inventory costs and lead times.

5. Recommendation

Design a master plan and national-level strategies with all key stakeholders

both private and public sectors has to maintain the comparative advantage of geographical advantages in maritime and logistics policies. Develop short-, medium--, and long-term policies to ensure the coordination of plans and strategies.

Ensure the objectives of city development are integrated into logistics development

Being the region's key logistics hub, Colombo City has not developed the required facilities. There should be harmony among the major cities and ports. There should be particular attention to the Colombo city.

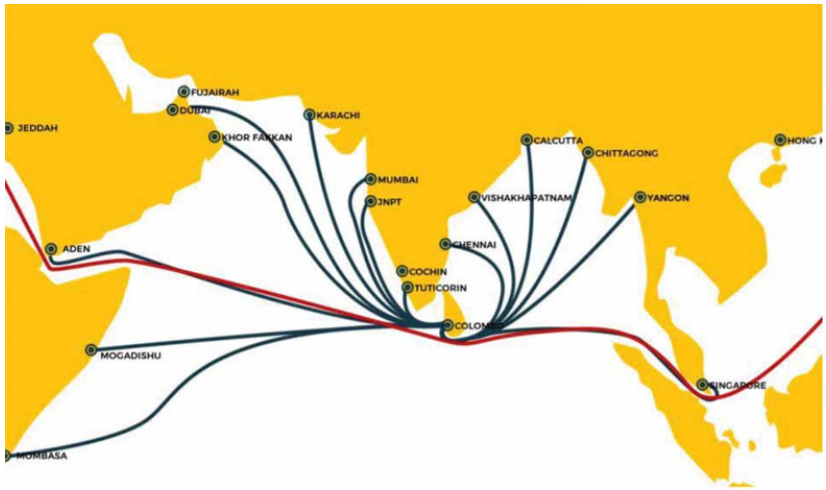

Figure 3: geographic location in SL
Source: https://www.google.com

Introduce a central trade information center

Establishing one window for trading parties may be more beneficial to stakeholders to obtain their smooth function. As examples Singapore trade net identified as a benchmark. It may provide services such as the following things

.

a. Quick guidance for new traders and registration services
b. Competent authorities are required to check and confirm the items
c. Trade price list and related charges
d. Activation of CUSTOM accounts as quickly as possible
e. Online application forms facilities
f. Manual applications form for trade services as conveniently

Provide facilities for leading global third-party logistics providers

The active participation of international third-party providers may contribute to boosting the economy at the harbour. Removing the foreign participants may not add value to 3PL. encouraging and providing facilities may be impressed.

Increase the focus on transport infrastructure facilities

Logistics have not received adequate attention in efforts to improve modes of transport infrastructure, particularly for air, road, and rail. Plans for the logistics subsector have mostly focused on seaport expansion. The failure to integrate cargo capacities into the proposed BIA facility expansion is a significant issue that must be addressed as a priority.

Fast-track implementation of logistics infrastructures

Sri Lanka has many places to build modern logistics spread parks, air or sea cargo villages, inland dry ports, and inland container depots that are well-connected to seaports and airports. It is critical to expedite the establishment of these logistical facilities. The world's greatest logistics hubs have succeeded because they have up-to-date infrastructure to enable value-added logistics services.

Proposed plan for development

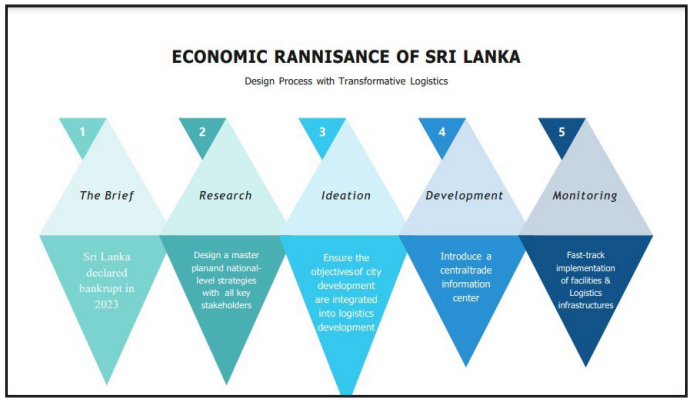

Figure 4: Proposed Plan
Source: Developed by the Researcher

6. Conclusion

Improving productivity in services and logistics can boost economic development and gradually improve distributional results. The country's unique location offers the potential to reestablish its standing as a regional and worldwide transportation and service hub.

All services including logistics require more infrastructures including funding,

Since the private sector is more qualified to run many logistics services and to relieve the government of its financial barriers, the major parts of this investment will need to come from the private sector, both domestic and foreign. The primary force behind this expansion, though, will have to be the government.

Investments in infrastructure projects, which typically have lengthy periods, require a clear, trustworthy, and transparent business environment before investors will feel safe allocating their capital. To guarantee that state-owned enterprises compete with the private sector fairly and to allow the private sector to enter any industry, regulatory reform is essential.

Reforming state-owned enterprises will boost productivity and lessen the financial burden they place on the public coffers. large infrastructure projects with inherent monopolistic features include ports, airports, large roadways, and telecommunications infrastructures. In these situations, the government's job is to set up independent regulatory organizations that safeguard the country's interests.

REFERENCES

Athukorala, P.-C., Ginting, E., Hill, H. and Kumar, U., n.d. The Sri Lankan Economy Charting a New Course.

Council of Logistics Management, United States. 1991. Cited in Encyclopedia Britannica. [Online] Available at: https://global.britannica.com/topic/Council-of-LogisticsManagement

Gajanayake, H., and M. Mudunkotuwa. 2015. A Study of Developing Colombo Port as a Major Multicountry Consolidation (MCC) Hub in South East Asia Region with the Help of Improving the Effectiveness of the MCC Activities. Proceedings of 8th International Research Conference, 27–28 August, Kotalawela Defense University. p 218.

Government of Sri Lanka (GSL). 2004. National Ports and Shipping Policy. Colombo: GSL.

Kotalwela, H. 2016. To Become Logistics Hub, SL Needs to Develop Human Capital: Maritime Professionals. Daily Mirror. 22 August.

Kumarage, A. 2004. Regulatory Impediments to Land Transport Sector in Sri Lanka, Workshop on Regulatory Impact Assessment. Sri Lanka Institute of Policy Studies. Colombo. 22–23 June.

World Economic Forum (WEF). 2016. Global Competitiveness Report 2016– 2017. Available at: https://www.weforum.org/reports/the-global-competitivenessreport-2016-2017-1

Yang, Xu. 2014. Status of Third Party Logistics, A Comprehensive Review. Journal of Logistics Management.

"Sri Lanka Forex Reserves Drop to US$1.9bn in March 2022." EconomyNext. Available at: https://economynext.com/sri-lanka-forexreserves-drop-to-us1-9bn-in-march-2022-92738/.

"Sri Lanka Reserves Drop to $1.93 Bn in March, $8.6 Bn Due in Payments This Year." Hindustan Times, 7 Apr. 2022. Available at: https://www.hindustantimes.com/worldnews/sri-lanka-news-sri-lanka-reserves-drop1-93-billion-in-march-101649331924641.html.

"Why Did Sri Lanka's Budget Deficit Increase in 2021?" Verité Research, 28 Oct. 2021. Available at: https://www.veriteresearch.org/2021/10/27/whydid-sri-lankas-budget-deficit-increase-in2021/.

Al Jazeera. "Sri Lanka to Suspend Foreign Debt Payments." Business and Economy News | Al Jazeera, 12 Apr. 2022. Available at: https://www.aljazeera.com/economy/2022/4/12/sri-lanka-to-suspend-foreign-debt-payments.

Department of Census and Statistics Ministry of Finance, Economic Stabilization and National Policies Central Bank of Sri Lanka: Annual Report 2022

LEVERAGING GREEN BONDS TO ADDRESS DEBT SUSTAINABILITY AND ECONOMIC RECOVERY IN SRI LANKA

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Abstract

Green Bonds have been a standout innovation in the field of sustainable finance over the past ten years. The fundamental financial tool for funding environmentally friendly initiatives is a Green bond. Sri Lanka, as a nation, has yet to fully embrace sustainability principles while other regional counterparts leverage the benefits of Green Bonds to gain competitive advantages in the global market. Similarly, there have only been few studies conducted in implementing of Green Bonds in Sri Lanka, even though it is a rapidly growing concept in the global market. Green bonds are becoming more and more popular as a financial instrument for addressing environmental issues and fostering economic expansion. Sri Lanka, like many other developing countries, has to address the need for sustainable growth as well as the problem of sustainable debt levels.

Keywords: *Green Bonds, Sustainable, Innovation*

1. Introduction

The concept of "green bonds" has garnered significant interest in this context as a possible remedy that purports to both fulfil financial and environmental concerns (Bhutta et al., 2022). Green bonds have become a viable means of raising money for green initiatives while simultaneously addressing issues with debt sustainability. Green bonds are designed to finance ecologically friendly projects. (Gilchrist, Yu and Zhong, 2021)

This study examines how green bonds used strategically to negotiate Sri Lanka's difficult intersection of debt sustainability and economic recovery. Further, this study will look at the real-world effects of green bond issuance in the Sri Lankan context in an effort to highlight the challenges and opportunities associated with using green financing to achieve sustainable development goals. In addition this study attempts to provide a comprehensive understanding of the role that green bonds can play in fostering both fiscal resilience and environmental stewardship in Sri Lanka's development trajectory through an interdisciplinary lens that integrates insights from economics, finance, and environmental studies

.

The Concept of Green Bond

The Climate Bonds Initiative, defines Green Bonds as fixed-income financial instruments issued by corporations, governments, municipalities, or financial institutions specifically to raise capital for environmental or climate-related projects or initiatives. The money raised through the issuance of green bonds will support sustainability-related projects like waste management, renewable energy, energy efficiency, clean transportation, sustainable agriculture, and climate adaptation. This is the primary distinction between these bonds and traditional bonds (Laskowska, 2018)

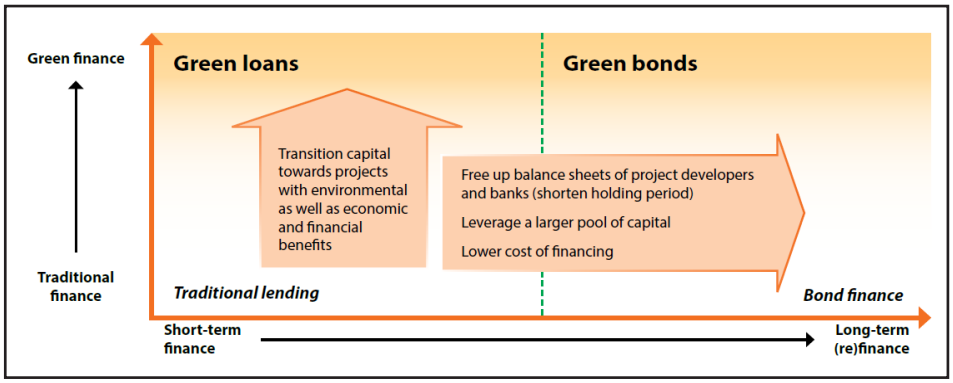

Figure 1. Ethics Review of Green Bonds
Source: https://sevenpillarsinstitute.org

Green Bond Principals

i. Environmental purpose – Specific use of proceed for environmental benefit projects
ii. Certification and verification – Obtaining certification and verifications from independent third parties.
iii. Reporting and Transparency – Issues are expected to provide regular reporting about environmental impact.
iv. Investor Demand – Environmental sustainability and positive impact on planet
v. Standardization and Guidelines - Developed standard guidelines for issuing and reporting on green bonds.
vi. Continuous Improvement - Exchanging best practices, tackling new problems, and encouraging creativity in green financing (Rao, 2021)

Literature Review

Green bonds are conceptualized as financial instruments that allocate funds to projects that positively affect the environment (Zhao et al., 2022). By allocating proceeds to environmentally friendly projects like energy efficiency, renewable energy,

sustainable transportation, and climate adaptation measures, green bonds give investors the chance to match their capital with climate and environmental goals (Zhao et al., 2022). Moreover, green bonds are perceived as a means of internalizing environmental externalities since they include environmental considerations into investment decisions and encourage the transition to a low-carbon economy (Flammer, 2021)

According to Tang and Zhang, 2018, green bonds have emerged as a potential instrument for addressing important development concerns in developing countries, including funding infrastructure, addressing environmental degradation, and bolstering climate resilience. Scholars have highlighted the potential of green bonds to support climate change resilience, ease knowledge transfer, and finance environmentally friendly infrastructure projects (Tang and Zhang, 2018). According to studies, it's critical to address institutional barriers, capacity constraints, and market shortages in order to fully realize the potential of green finance in underdeveloped countries (Maltais and Nykvist, 2020)

Research on the specific impacts of green bonds on Sri Lanka's debt sustainability and economic recovery is scarce. However, studies on sustainable finance, debt sustainability, and climate finance provide valuable context for understanding how green bonds work.

Need of the study

A financial instrument known as a "Green Bond" has arisen as a source of funding for environmental protection, pollution control, and the sustainability of the eco system, according to an analysis of the literature study as a nation grappling with issues of debt sustainability and economic recovery, Sri Lanka needs alternative financing solutions, including green bonds essentially to manage the debt issue and speedy financial recovery via ensuring environmental sustainability.

Objectives of the Study

Based on the literature review and need for the study, the following objectives are taken.

i. To assess the feasibility and potential impact of issuing green bonds as a mechanism for financing sustainable development projects in Sri Lanka.
ii. To study examine case studies and empirical data from other nations that have effectively benefited from green bonds.
iii. To derive strategies to Implement Green Bond initiatives with Respect to Sri Lanka

Methodology

The methodology used in this study involves utilization of secondary sources obtained from reputable journals, articles, and official websites. The secondary data collected from these sources based on researcher's analysis and findings. Through a comprehensive review of existing literature and pertinent information available in academic journals, articles, and official websites, researcher have integrated insights and perspectives relevant to research objectives. This approach ensures the credibility, depth, and breadth of the study.

Discussion and Implications

Recent shifts in the green bond market are suggestive of a dynamic environment marked by substantial growth and innovation. Based on information provided by the Climate Bonds Initiative, the amount of green bonds issued globally increased to $269.5 billion in 2021, indicating that green finance instruments are becoming more and more popular (Climate Bonds Initiative, 2022).

Additionally, the emergence of sustainability-linked bonds (SLBs), which align bond terms with issuers' ESG metrics, has given rise to a novel approach to rewarding sustainability performance (Climate Bonds Initiative, 2021). Initiatives like the Climate Bonds Standard and the EU Taxonomy for Sustainable activities, which offer guidelines and standards for identifying and evaluating the environmental impact of green bonds, have contributed to the growth of standardization and transparency (European Commission, 2021).

Success of Green Bond Market in European Countries

The growth of green bond market in Europe was previously the result of several legal frameworks and the increasing stance of investors towards environmentally conscious investments. Many countries, like Sweden, Germany, and France, have sold green bonds. France introduced a rule that makes sure sovereign green bond issuances should aim at achieving carbon neutrality programs (European Commission, 2021).

As other countries, Germany has filled its green bonds with funds used to develop alternatives to fossil fuel (e.g., renewables and energy-efficient projects), that have made the transition to a low-carbon economy in the country easier as well (Climate Bonds Initiative, 2021).

A binding legal framework has been created to regulate the issuance of sustainable financial products through the EU Taxonomy for Sustainable Activities and the adoption of the Green Bond Standard (European Commission, 2021). Europe still is a good example of how severe climate change can be prevented and what sustainable

development objectives can be achieved, demonstrated by its innovative activity on green bonds as a financial instrument for sustainable evolution.

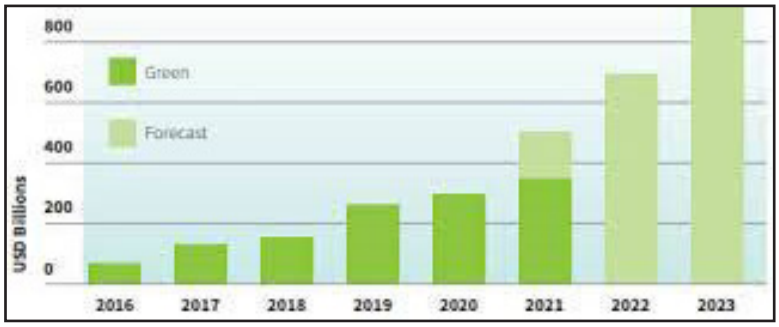

Figure 2. European Green Bonds
Source: https://www.europarl.europa.eu

Success of Green Bond Market in India

The current India ranks in the fifth in the list of countries with the largest economies. The Government of the country expects that the country will reach the third position among the strongest economies with GDP of $5 trillion in the next three years and GDP of $7 trillion in 2030. Indian economy is presently observing huge growth with it dyed by dimes such as population advantages, transport structure development, and technologic rise. (Nagpal, Aishwarya;Jain, Megha, 2023)

Green bonds are certainly one of the reasons the economy of India is expected to become one of the largest among the developed countries as these bonds provides fund for the projects of sustainable infrastructure which in turn contributes to the sustainable economic development. Initially, Yes Bank led the path through issuing India's first green corporate bond in 2015, which raised $160 million as a corrosion result. (Yes bank 2024) This path breaking initiative proved that, green bond could be successfully issued and introduced to the Indian capital markets, develop interest among investors and invoke wide spread green financing interest and activities.

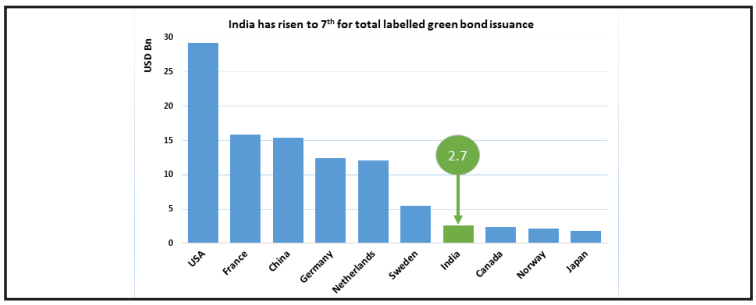

Figure 3. Indian Green Bonds (2023)
Source: https://www.climatebonds.net

Success of Green Bond Market in Bangladesh

The economy of Bangladesh started experiencing an unprecedented pace of growth in the recent decades, becoming one of the world's fastest growing economies. Bangladesh is deemed to be the fifth largest South Asian economy due to its massive people volume, which is at 160,000,000. However, this large country shares mutual interests and focuses on key sectors- textiles and garment, agriculture, manufacturing, and services. (Md. Bokhtiar Hasan et al., 2024)

Existence of green bonds are very crucial in the Bangladesh attempt to take its place among growing economies where environmentally sustainable development is the core. The government and the private sector have more and more preferred green bonds as a way of financing green projects thus being the response. (Md. Bokhtiar Hasan et al., 2024) Infrastructure Development Company Limited (IDCOL), a well-known name, in Bangladesh, has used more than one green bonds for the implementation of renewable energy undertakings. To cite on example IDCOL issued a green bond dedicated to finance solar home systems and the value of which was over $37 million in 2018. The government, public institutions, and private companies have also been issuing green bonds to finance the implementation of large-scale renewable energy projects. (Infrastructure Development Company Limited (IDCOL), 2024) For instance, in 2019, the government of Bangladesh raised an amount of revenues equal to $200 million, through issuing a green bond for the construction of a solar power plant of 200 MW.

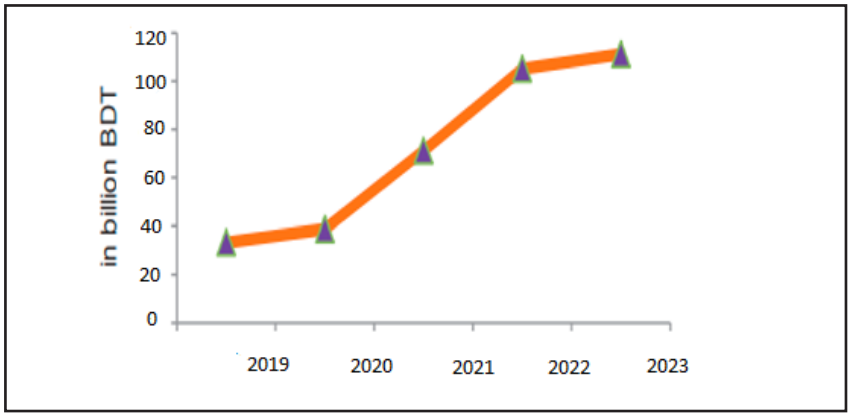

Figure 4. Bangladesh Green Bonds Investments Development (2019-2023)
Source: (IFC supports Bangladesh Bank to promote domestic green bond market, 2024)

Policies Used to Develop Green Bond Market in European Countries

Policymakers in European Countries first, standardized regulatory frameworks been established in order to provide investors and issuers of green bonds with uniformity and clarity. As an illustration, the European Union's Green Bond Standard defines exact

criteria for identifying green bonds, ensuring credibility and uniformity across the sector (European Commission, 2021). Governments also incentivize issuers to produce green bonds by offering financial incentives and regulatory support. France, for example, offers tax exemptions and lowered corporate tax rates to encourage the issuance of green bonds (Climate Bonds Initiative, 2021).

Governments also encourage the development of green bond funds and indexes to facilitate the process of investing in green bonds. The Luxembourg Green Exchange (LGX) is facilitating the listing and trading of green bonds, contributing to the growth of the European green bond market (Chygryn et al., 2019)

Policies Used to Develop Green Bond Market in South Asian Countries

Given the distinct context of South Asian nations, tailored strategic approaches are required to develop the green bond market in those nations. For instance, in 2017 the Securities and Exchange Board of India (SEBI) released guidelines pertaining to green bonds, including the requirements and duties for disclosure for issuers (SEBI, 2020)

Moreover, India provides reduced withholding tax rates and tax advantages on interest income to businesses who issue green bonds (SEBI, 2020). The Sustainable and Renewable Energy Development Authority (SREDA) offers financial incentives and technical help for renewable energy projects in Bangladesh that may be eligible for financing through green bonds (SREDA, 2023).

The Green Transformation Fund (GTF) was established by the central bank of Bangladesh to advance green finance. The GTF offers low-interest financing to banks and other financial institutions for projects involving waste management, energy efficiency, renewable energy, and climate-resilient infrastructure. (Bangladesh Bank receives funding from the IFC to develop the local green bond market, 2024)

Possibilities for Sri Lankan Green Bond Leverage

The first default in Sri Lankan history occurred when the government declared in April 2022 that it would stop making payments on its foreign debt, lowering the nation's sovereign credit rating below investment grade. Hence, innovative solutions are needed to transform Sri Lankan economies while assuring sustainable growth in the face of global economic uncertainties and the pressing need to address environmental concerns. (Nanayakkara and Colombage, 2022) Sri Lanka is a country blessed with abundant biodiversity and a strong dedication to environmental conservation and leveraging green bonds is a tactical economic strategy to overcome economic downturn.

Initiatives Taken by Sri Lanka to Implement Green Bonds

Sri Lanka taken the initial step by given the green light for the country's first Green Bond Framework, which was developed by the Ministry of Finance, with support from the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) in 2024 April. "ESCAP provided technical and financial support to the development of Sri Lanka's Green Bond Framework. In the face of the present crisis, the Government has remained steadfast in its environmental and SDG commitments. This Framework will help Sri Lanka to be one step closer to mobilizing green finance for Sri Lanka's socio-economic growth and environmental resilience.

The Significance of Issuing Green Bonds

In order to finance sustainable initiatives, Green Bonds have the potential to be an extremely effective bridge between the public and private sectors. With the help of these bonds, companies and governments can generate money expressly for green projects including reforestation, renewable energy projects, and climate adaptation strategies. (Tolliver, Keeley and Managi, 2020) Green Bonds enable the financing of initiatives that might not otherwise receive enough finance by utilizing the financial resources of investors who place a high priority on sustainability.

Recommendations

The process of green bonds nationwide requires a comprehensive strategic plan that takes into account Sri Lanka's specific and unique hurdles, needs and opportunities. In order to successfully implement green bonds in Sri Lanka, there are a number of strategies that need to be followed.

Development of Regulatory Frameworks

Strictly similar to the European nations such as India & Bangladesh Sri Lanka shall have well documented, transparent and uniform regulatory guidelines for green bonds. In this context of the multiplicity of this crisis, standards for the identification of green bonds must be set, and credibility of the market along with openness must be preserved. (Nanayakkara and Colombage, 2022).The law shall maintain the issuance of green bonds by the reduced withholding tax rate and have tax benefits on interest income on the formed companies which issue several bonds, like India

Support and Incentives from the Government

Financial incentives and support for ecologically friendly initiatives can be provided by the Sri Lankan government. For projects qualified for funding through green bonds, this could include grants, subsidies, or low-interest financing. (Tolliver, Keeley

and Managi, 2023) Furthermore, the government can fund the creation of a pipeline for environmentally beneficial projects in a number of industries, including sustainable infrastructure and renewable energy.

Building Capacity and Raising Awareness

Sri Lanka should fund capacity-building projects and awareness efforts to boost involvement and comprehension of green funding choices. Programmes for financial institutions, regulators, and legislators on the concepts and procedures of green finance may fall under this category. Campaigns for public awareness can also inform the general public and investors about the advantages of sustainable investments and green bonds. (Jonsdottir et al., 2023)

Public-Private Collaborations

Green bond projects require cooperation between the public and commercial sectors to be successful. In order to promote green financing and create sustainable initiatives, Sri Lanka should encourage collaborations between enterprises, financial institutions, government agencies, and civil society organizations. (Tolliver, Keeley and Managi, 2023) Public-private collaborations have the potential to stimulate innovation and increase green investment by utilizing their resources and skills.

SDG (Sustainable Development Goals) Alignment

It is imperative for Sri Lanka to ensure that its green bond programmes are in line with its aspirations for sustainable development. (Tolliver, Keeley and Managi, 2023) This entails giving projects that advance social justice, climatic resilience, and environmental sustainability top priority. Sri Lanka can optimize the effects of green bond financing on environmental preservation and economic development by concentrating on the SDGs.

Building Capacity for Project Execution

Realizing the possibility of creating environmental friendly projects is a key component which successful green bond programme would definitely complete. To enhance expertise and capabilities of project managers, engineers, other stakeholders involved in green infrastructure projects, Sri Lanka will need to make transformative investments into training programs and technical advice. (Nanayakkara and Colombage, 2022) Achieving such a goal will indirectly lead to the demonstration of the efficiency of projects that are being performed with the financial aid of green bonds.

Conclusion

In conclusion, employing green bonds to address the sustainability of Sri Lanka's debt and the country's economic recovery presents a workable solution to financial problems, promotes economic expansion, and provides capital for environmentally beneficial initiatives. Notwithstanding the potential afforded by green finance, attaining the full potential of green bonds will need overcoming obstacles such as inadequate comprehension of the market, intricate regulations, project pipeline development, and financial feasibility.

However, Sri Lanka can overcome these challenges and take advantage of the opportunities presented by green bonds by implementing smart policies, like strengthening the legal framework, providing financial incentives, supporting green projects, increasing consumer awareness, and promoting public-private partnerships. By embracing sustainable financing and investing in green infrastructure, Sri Lanka may address concerns related to debt sustainability while also advancing economic recovery, creating jobs, enhancing environmental resilience, and assisting worldwide efforts to combat climate change.

Scope for Future Research

The fields of renewable energy, pollution control, sustainable development, and environmental protection have gained popularity recently. The debt unsustainability scenario in Sri Lanka placed more of a platform for investments in green environment protection in future. These components may provide researchers with opportunities for more study. It is possible to increase the field of study and broaden the study of green finance, accounting, and green bonds by conducting additional analysis on these topics.

REFERENCES

Bhutta, U.S. et al. (2022) 'Green bonds for sustainable development: Review of literature on development and impact of green bonds', Technological Forecasting and Social Change, 175(1), p. 121378. Available at: https://doi.org/10.1016/j.techfore.2021.121378

Barreto, C. and America, L. (2020) Climate Bonds Initiative Bonos ODS. Available at: https://www.unepfi.org/wordpress/wp-content/uploads/2020/06/Carolina-Barreto-Representante-de-Climate-Bonds-Initiative-CBI.pdf (Accessed: 20 April 2024).

Climate Bonds Initiative. (2022). Annual Green Bond Market Summary 2021.

Chygryn, O. et al. (2019) 'Green Bonds like the Incentive Instrument for Cleaner Production at the Government and Corporate Levels: Experience from EU to Ukraine', Journal of Environmental Management and Tourism, 9(7), p. 1443. Available at: https://

doi.org/10.14505//jemtv9.7(31).09

Flammer, C. (2021) 'Corporate Green Bonds', Journal of Financial Economics, 142(2), pp. 499–516. Available at: https://doi.org/10.1016/j.jfineco.2021.01.010.

Gilchrist, D., Yu, J. and Zhong, R. (2021) 'the Limits of Green Finance: A Survey of Literature in the Context of Green Bonds and Green Loans', Sustainability, 13(2), p. 478. Available at: https://doi.org/10.3390/su13020478

Jonsdottir, G.E. et al. (2021) 'Applying Responsible Ownership to Advance SDGs and the ESG Framework, Resulting in the Issuance of Green Bonds', Sustainability, 13(13), p. 7331. Available at: https://doi.org/10.3390/su13137331

Laskowska, A. (2018) 'The Green Bond as a prospective instrument of the global debt market', Copernican Journal of Finance & Accounting, 6(4), p. 69. Available at: https://doi.org/10.12775/cjfa.2017.023

Nagpal, Aishwarya;Jain, Megha (2014) '"Green is the New normal in the Sustainable Era": Special Reference to Green Bonds Market in India', Available at: https://www.indianjournals.com (Accessed: 21 April 2024).

Nanayakkara, M. and Colombage, S. (2022) 'Does Compliance to Green Bond Principles Matter? Global Evidence', Australasian Business, Accounting and Finance Journal, 16(3), pp. 21–39. Available at: https://doi.org/10.14453/aabfj.v16i3.03

Rao, Dr.D.T. (2021) 'A Study on Green Bonds in India – Need of the hour', IJRAR.ORG. Edited Availableat:https://www.researchgate.net/publication/360725657_A_study_on_green_bonds_in_india_-_need_of_the_hour (Accessed: 26 April 2024)

SEBI (2020) Securities and Exchange Board of India, Sebi.gov.in. Available at: https://www.sebi.gov.in

State Bank of Pakistan (2024) www.sbp.org.pk. Available at: https://www.sbp.org.pk/index.html

Tang, D.Y. and Zhang, Y. (2018) 'Do shareholders benefit from green bonds?', Journal of Corporate Finance, 61(101427). Available at: https://doi.org/10.1016/j.jcorpfin.2018.12.001.ps://doi.org/10.1080/20430795.2020.1724864

UN-Backed Green Bond Framework positions Sri Lanka to unlock green finance (2024) ESCAP. Available at: https://www.unescap.org/news/un-backed-green-bond-framework-positions-sri-lanka-unlock-green-finance

World bank 2020 annual report - Google Search (no date) www.google.com. Available at: https://www.google.com (Accessed: 20 April 2024)

Yesbank.in. Available at: https://www.yesbank.in/about-us/sustainability-at-yes-bank/esg-disclosures/green-bond-disclosures (Accessed: 21 April 2024).

Zhao, L. et al. (2022) 'Enhancing green economic recovery through green bonds financing and energy efficiency investments', Economic Analysis and Policy, 76, pp. 488–501. Available at: https://doi.org/10.1016/j.eap.2022.08.019.

TRANSFORMATIVE LOGISTICS FOR SRI LANKA'S ECONOMIC RENAISSANCE

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Abstract

Logistics management is a component of supply chain management that is used to fulfill the customers' requirements through the planning, acquisition, distribution, control, and implementation of effective and efficient movements and storage of related information, goods, and services from origin to destination. Logistics management helps to reduce expenses, and wastage and to enhance customer services. The values given by the logistics providers extend beyond the point of consumption. These services are sometimes referred to as reverse logistics including after-sales services, waste management, recycling, and transfer to other parties to the original manufacturer for reuse, manufacturing, or resales. There for logistics services provide a wide range of interrelated services across and within borders.

The term "transformative logistics" describes the process of bringing about major adjustments or innovations in logistics procedures to attain increased effectiveness, efficiency, and overall performance. It entails reconsidering conventional logistics techniques and embracing novel technology, approaches, and tactics to produce favorable and long-lasting results

current technological developments, such as current communicative equipment, digitalization, automation, and modern logistics-related software, can benefit Sri Lanka's economy by facilitating effective logistical coordination and improving visibility and transparency. The current situation is topped up by a lack of a cohesive and comprehensive policy strategy, paperwork, uncoordinated transport infrastructure development, and a lack of synergy between port and city growth.

KEYWORDS: *Logistics Management, Transformative Logistics, Economic Renaissance, technological innovations, visibility*

1. Introduction

Sri Lanka's economic crisis came to the front three years ago with great difficulties in to lives people of the country. The government faced hardships and challenges to

overcome the crucial situations due to various reasons such as poor management in all economic aspects. Sri Lanka has defaulted the more than USD 51 billion in external debts. Sri Lankans have fallen into poverty by at least 500,000 during the last few years. There was no fuel, no medicines, and critical surgeries were also canceled. The problem was the different failures of economic angles.

The purpose of this paper is to find the loose points of poor management of the economy and how it affected to commencement of the economic crisis how far it will help to provide transformative logistics support aspects and what corrective actions are to be taken to convert normal conditions of the economy.

2. Further Explanations for Crisis

There are numerous explanations for the crisis, including political circumstances outside of Sri Lanka's control and other policy issues. Years of poor management of the country's basic resources resulted in a trade deficit, higher imports than exports, and expenditure than income in Sri Lanka. In addition, there is double debt and a fiscal deficit. The foreign nations borrowed a substantial sum of money. With a debt-to-GDP ratio of 113.8 % (Central Bank Report of Sri Lanka 2022)

A. Key Causes of the Sri Lankan Crisis

1. TAX reduction and money reduction: During the 2019 presidential election campaign, the administration promised to lower taxes, which had a substantial impact on the functioning of the government. Government revenue and fiscal policies have deteriorated. This reduces taxpayers by 335% by lowering VAT to 8%, corporation tax from 28% to 24%, removing the PAYE tax and establishing a 2% national building tax because of the significant losses in tax income. As a result, the country may soon run out of finances as investors evacuate Sri Lanka, making it harder for the country to access the world market.

2. The External debt of Sri Lanka: From 2010 to 2020, the country's external debt doubled. In 2019, foreign debt accounted for about 42% of its GDP. It has, however, risen to 119% of GDP in 2021. Also, Sri Lanka aims to repay its debtors USD 4 billion by the end of 2022, with the government's reserves at USD 2.3 billion as of April 2022. The renowned Chinese debt is 10% as of April 2021. However, SL has indicated that it will not pay its USD 49.7 billion foreign debt in 2022, as opposed to USD 51.8 billion in 2021

3. Sri Lanka agricultural crisis: In April 2021, the government stated that SL will only allow organic farming, with all inorganic and agrochemical fertilizers banned. They hoped that this would benefit their health and alleviate various difficulties. However, many people realized that the health concerns were not

the cause of the financial constraints. However, this impacted agricultural production. The decrease in tea production owing to the fertilizer ban alone resulted in millions of dollars in losses. Furthermore, the government was compelled to import rice due to a 20% decrease in rice production in the first six months alone. Tea farmers regarded the industry's status as catastrophic, noting that organic production is ten times more expensive and yields half that of conventional farming.

4. Impact on the tourism sector: The 2019 Easter bombing and the COVID-19 pandemic had a bad impact on it. In that event, borders were blocked, and tourists stopped arriving entirely. Sri Lanka's tourist industry accounts for 13% of the country's GDP. Tourists also generate foreign exchange. In 2020, Sri Lanka attracted only 173,000 tourists. The number was 2.3 million. By 2021, Sri Lanka's tourism revenue has dropped to USD 2.8 billion. According to a World Bank analysis dated April 2021, despite the detrimental impact of the COVID-19 epidemic on Sri Lanka's economy and people's lives, the economy will rebound in 2021, but with hurdles. Positive indicators of recovery are already seen.

5. Tea exports and tourism affected by the Russian-Ukrainian war: Russia invaded Ukraine in 2022 and SL suffered hardships. Russia is the second biggest market for Sri Lanka tea exports also the tourism industry heavily depends on both countries.

B. Impact for Sri Lankans

a. Power and fuel shortage experienced by Sri Lanka
b. Inflation
c. The Impact of Sri Lanka's Education System
d. Sri Lanka's medical sector and its impact
e. The tourism sector and its impact
f. Impacts on the export sector
g. The impact of the economic crisis on entertainment and sports

3. Logistics Advantages Through Geography

Transformative logistics seeks to address issues such as high logistics costs, inefficient processes, and environmental problems by finding innovation and best practices to build a more graceful, resilient, and sustainable logistics system.

Sri Lanka has a significant geographical advantage due to its closeness to the primary East-West maritime route that connects East Asia with Africa, Europe,

and the East Coast of the United States. Colombo has been a prominent seaport in Asia since the 14th century, and it was historically frequented by merchants from what is now the People's Republic of China, India, Persia, and other countries. The Journal of Commerce classified Colombo as the world's 30th busiest port in 2014. As India has opened up since the early 1990s, Sri Lanka's geographical advantage has grown stronger.

Colombo is the region's main transshipment center for Indian subcontinent cargo, accounting for over 35% of total transshipment volume. The distance from Colombo to key regional ports is shorter than it is from other regional hub ports, as is the time and expense of transportation. Following are the special characteristics that obtain the logistics advantages.

1. Access to Transportation Networks: Improving the site to allow for numerous modes of transportation, such as highways, railways, and airports, can improve connection and flexibility in logistics operations. This can assist cut transportation costs, improve delivery times, and provide economic benefits.

2. Infrastructure: Adequate infrastructure, such as roads, ports, and warehouses, can boost logistics efficiency. This may entail investing in infrastructure modifications or picking locations with existing infrastructure that match the demands of the company.

3. Market Access: Choosing a location that provides access to large or growing markets can help expand the customer base and increase sales. This can involve selecting locations in densely populated areas or regions with growing economies.

4. Importance of Transformative Logistics Aspects

This explores how Sri Lankan logistics have evolved and performed, with a focus on the policy changes required to increase productivity. Logistics, a huge and diverse sector of the services industry, requires change if Sri Lanka is to accelerate its development and become more globally competitive.

A country's logistics efficiency is one of the most crucial aspects in determining its competitiveness in the global market. With formal trade barriers diminishing in most countries, the efficiency of the logistics system often plays a significant role in determining pricing differences between domestic and foreign markets. More countries, including Sri Lanka, have liberalized their trade than changed their regulations to ensure that logistics services meet the highest international standards. The slow reform of logistical services, which sometimes explains trade liberalization's disappointing outcomes, may potentially put the reform program in danger.

The significance of effective logistics services is underscored by technological advancements in the global transportation and communication subsectors as well as in the global organization of production activities, encompassing both commodities and services. The division of production along national boundaries according to comparative advantage principles has given rise to global production networks, which have grown quickly in the last several years. With its rapid growth, electronic commerce, or "e-commerce," is changing the character of many services that are exchanged abroad.

Comparison of Logistics Cost with Regional Logistics Suppliers

The more proficient regional logistics providers are currently ahead of Sri Lanka. In contrast to the global standard of 10%, the Chartered Institute of Transport and Logistics of Sri Lanka reports that logistics costs may amount to 23% of GDP. The People's Republic of China (21%), Malaysia (13%), Singapore (8%), the Republic of Korea (16%), and Thailand (20%) are among the other regional economies with lower figures than Sri Lanka (Indonesia Investments 2013; Arumugam 2012). As the productive textile and apparel industry in Sri Lanka often emphasizes, such high logistics costs undermine Sri Lanka's competitiveness in trade and production.

Impact on Logistics Performance Index

Trade logistics can improve their performance by using LPI as a benchmarking tool to discover performance concerns and opportunities. LPI makes it possible to compare the 139 nations. Sri Lanka is ranked 73rd out of them. These are the characteristics that influence LPI, and countries with a geographic advantage need to develop their LPI tools to maximize their advantages. The effectiveness of the trade and transportation infrastructure, the ease with which competitively priced shipments can be arranged, the caliber of logistics services, the capacity to track and trace shipments, and the regularity with which shipments arrive at consignees within the prearranged or anticipated delivery times are all important factors to consider.

COUNTRY	POSITION
Sri Lanka	73
India	38
Singapore	01
Malaysia	28
Thailand	34

Figure 1: Global ranking of LPI in 2023
Source: https://www.lpi.worldbank.org/international/global

Examples of transformative logistics initiatives include integrating automation and robotics into warehouses, using artificial intelligence and data analytics to optimize supply chain operations, implementing green logistics practices to reduce environmental

impact, and using blockchain technology to improve security and transparency in logistics processes.

Integrating cutting-edge technology in logistics can bring numerous benefits, including improved efficiency, cost savings, and enhanced customer satisfaction. Some examples of cutting-edge technologies that can be integrated into logistics operations.

1. Warehousing and Inventory Management Tools: Automation and Robotics technology can be utilized using automated guided vehicles (AGVs) and autonomous mobile robots (AMRs) for material movement within warehouses, while robotic arms are employed for tasks like picking, packing, and sorting goods. These technologies help reduce manual labor, minimize errors, and increase throughput

2. Blockchain: This technology provides a safe, decentralized method of tracking products along the supply chain and recording transactions. It offers a visible and unchangeable ledger that is accessible to all authorized parties, guaranteeing openness and confidence. Blockchain technology can be applied to logistics to improve workflows in areas like tracking shipments, managing inventories, and authenticating products. In the end, it can assist save expenses by lowering fraud and mistakes.

3. Internet of Things (IoT): Describes a network of linked devices that gather and share data. IoT devices like sensors, RFID tags, and GPS trackers can be used in logistics to track the whereabouts, state, and condition of commodities in real time. Using this real-time data, supply chain visibility can be increased overall, inventory control can be strengthened, and routes can be optimized. Logistics organizations can cut expenses by adopting IoT technology to replace manual tracking and monitoring.

4. Artificial Intelligence (AI): AI tools that can be used to analyze massive amounts of data and spot trends, patterns, and anomalies include machine learning and predictive analytics. AI may be used in logistics to automate decision-making processes, forecast demand, and optimize routes. Algorithms driven by AI, for instance, can assist in figuring out the best routes for delivery trucks, saving money on gasoline and expediting delivery times. AI can also be used to streamline warehouse tasks like order picking and inventory control, which can save costs and increase productivity.

5. Last-Mile Delivery: Testing of delivery robots and drones for last-mile delivery is underway to save delivery times and increase efficiency. Urban logistics and e-commerce stand to gain a great deal from these innovations.

6. 3D Printing: Also known as additive manufacturing, 3D printing is a technology that creates three-dimensional objects by layering materials based

on a digital model. In logistics, 3D printing can be used to create spare parts on demand, reducing inventory costs and lead times.

5. Conclusion

Improving productivity in services and logistics can boost economic development and improve distributional results. Sri Lanka's educated populace has an untapped advantage in several service sectors. The country's unique location offers the potential to reestablish its standing as a regional and worldwide transportation and service hub.

Reforming state-owned enterprises will boost productivity and lessen the financial burden they place on the public coffers. large infrastructure projects with inherent monopolistic features include ports, airports, large roadways, and telecommunications infrastructures. In these situations, the government's job is to set up independent regulatory organizations that safeguard the interests of the country.

6. Recommendations

A. Design a master plan and national-level strategies with all key stakeholders

The private sector has identified the required policies on maritime and logistics as necessary to keep the comparative advantage with the significance of geographical advantages. Hence there should be short-, medium-, and long-term policies with bring together all key stakeholders both private and public sectors. and ensure the different plans and strategies.

B. Ensure the objectives of city development are integrated into logistics development

Being the key logistics hub in the region Colombo city has not developed with the required facilities. There should be harmony among the major cities and ports. There should be particular attention to the Colombo city.

C. Provide facilities for global leading third-party logistics providers

The presence of global business organizations in the Port of Colombo's logistics sector will help boost the port's credibility as a logistics hub and encourage global manufacturing firms and retailers to use it as a center for value-added logistics activities. Removing foreign ownership limitations will not be enough to attract investments from global third-party logistics companies.

D. Increase the focus on transport infrastructure facilities

Logistics have not received adequate attention in efforts to improve modes of transport infrastructure, particularly for air, road, and rail. Plans for the logistics subsector have mostly focused on seaport expansion. The failure to integrate cargo capacities into

the proposed BIA facility expansion is a significant issue that must be addressed as a priority.

E. Fast-track implementation of logistics infrastructures

Sri Lanka has many plans in place to build modern logistics parks, cargo villages, dry ports, and inland container depots that are well-connected to seaports and airports. It is critical to expedite the establishment of these logistical facilities. The world's greatest logistics hubs have prospered because they have up-to-date infrastructure to enable value-added logistics services.

REFERENCES

Al Jazeera, 2022. Sri Lanka to Suspend Foreign Debt Payments. [Online] Available at: https:// www.aljazeera.com/economy/2022/4/12 [Accessed 30 3 2024].

Athukorala, P., Ginting, E. & Hill, H., 2017. The Sri Lankan Economy:Charting A New Course. Manila, Philippines: Asian Development Bank.

Council of Logistics Management, 1991. Council of Logistics Management, United States. [Online] Available at: https://global.britannica.com/topic/Council-of-LogisticsManagement [Accessed 28 3 2024].

Department of Census and Statistics Ministry of Finance, 2022. Economic Stabilization and National Policies Central Bank of Sri Lanka, s.l.: Central Bank of Sri Lanka.

Gajanayake, H. & Mudunkotuwa, M., 2015. A Study of Developing Colombo Port as a Major Multicountry Consolidation (MCC) Hub in South East Asia Region with the Help of Improving the Effectiveness of the MCC Acticvities of f 8th International Research Conference. s.l., Kotalawela Defense University.

Hindustan Times, 2022. Sri Lanka Reserves Drop to $1.93 Bn in March, $8.6 Bn Due in Payments This Year. Hindustan Times, 7 4.

Kumarage, A., 2004. Regulatory Impediments to Land Transport Sector in Sri Lanka. Colombo: Sri Lanka Institute of Policy Studies.

World Economic Forum (WEF), 2016. Global Competitiveness Report 2016– 2017, s.l.: s.n.

Xu, Y., 2014. Status of Third Party Logistics, A Comprehensive Review. Journal of Logistics Management.

TRANSFORMATIVE LOGISTICS FOR SRI LANKA'S ECONOMIC RENAISSANCE

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Abstract

This journal explores the pivotal role that revolutionary logistics plays in driving Sri Lanka's economic recovery and "Transformative Logistics for Sri Lanka's Economic Renaissance". With its advantageous location in the Indian Ocean, Sri Lanka is an island nation with enormous potential for economic expansion. To fully realize this potential, though, logistical issues that impair trade's competitiveness and efficiency must be resolved. This journal seeks to offer insights into changing Sri Lanka's logistics landscape to spur its economic rebirth by assessing the country's present level of logistics infrastructure, outlining significant challenges, and suggesting creative solutions.

1. Introduction

Sri Lanka, a country renowned for its varied cultures, deep historical heritage, and stunning scenery, is at a critical crossroads in its economic development. Due to its strategic location at the intersection of important international shipping lanes, Sri Lanka has a great deal of potential to become a regional center for trade and business. But achieving this potential would require a strong logistics network that can enable smooth transportation of products and services. The idea of transformative logistics is examined in this journal along with how it relates to Sri Lanka's economic recovery and "Transformative Logistics for Sri Lanka's Economic Renaissance".

Sri Lanka has a strategic edge in maritime trade due to its geographic location. The main entry point for global trade is the Port of Colombo, which is situated along one of the busiest shipping lanes in the world. Not with standing this benefit, for the nation's competitiveness is hampered by a number of logistical issues. Businesses experience delays and higher expenses as a result of the ineffective transportation networks, poor warehouse facilities, bureaucratic red tape and also inconsistent policies. Under the above topics mainly discuss about following key topics;

i. Transformative logistics
ii. Advantages and benefits of transformative logistics
iii. Disadvantages of transformative logistics
iv. The effects of transformative logistics in Sri Lankan economy

v. Overcoming transformative logistics challenges
vi. Changes facing in transformative logistics in Sri Lankan

2. Transformative Logistics

The term "transformative logistics" describes the deliberate application of logistics techniques, innovations, and technology to significantly improve supply chain competitiveness, efficiency, and general economic growth. It entails rethinking conventional logistics strategies and implementing cutting-edge techniques to produce ground-breaking advances in a number of supply chain components. These are a few instances to show how revolutionary logistics work.

A. Advanced Data Analytics and Predictive Modeling

Supply chain operations are optimized by transformative logistics with the use of predictive modeling techniques and enhanced data analytics. To effectively estimate demand, a retail organization could use big data analytics to examine past sales data, client preferences and industry trends. They may decrease surplus inventory, cut down on stock outs and optimize inventory levels by doing this, which will save money and increase customer satisfaction.

B. Block chain Technology for Supply Chain Transparency

Block chain technology has made a significant impact on logistics by improving supply chain security, traceability, and transparency. Block chain, for instance, can be used to generate an unchangeable record of each transaction and movement of items from farm to fork in the food business. By being transparent, food safety is guaranteed, the possibility of fake goods is reduced, and customer trust is increased.

C. Just-In-Time (JIT) Inventory Management

JIT is a revolutionary logistics approach designed to reduce the expense of keeping inventory on hand while guaranteeing that products will be available when needed. Successful implementation of Just-In-Time (JIT) inventory management has been demonstrated by automakers such as Toyota, whereby components are supplied to the production line precisely when needed. This strategy avoids waste, lowers the cost of carrying inventory, and boosts operational effectiveness.

D. Smart Warehousing and Automated Systems

Adopting automated technology and intelligent warehousing solutions to improve efficiency and optimize warehouse operations is known as transformative logistics. Smart warehouses using robotics, AI-powered sorting systems, and automated

guided vehicles (AGVs) are best exemplified by Amazon's fulfillment centers. Accurate inventory tracking, expedited order processing, and effective warehouse space utilization are made possible by these technologies.

E. Last-Mile Delivery Innovations

A crucial component of logistics is last-mile delivery, which frequently poses problems with regard to cost, effectiveness, and customer happiness. The goal of transformative logistics is to address these issues by implementing creative solutions. To speed up last-mile deliveries and cut down on delivery times, businesses like UPS and FedEx are experimenting with autonomous cars and drone delivery. Similarly, last-mile delivery in crowded urban areas is changing as a result of urban logistics efforts like crowd-shipping platforms and micro-fulfillment centers.

F. Collaborative Logistics Networks

In order to create shared benefits, transformative logistics places a strong emphasis on cooperation and partnership among supply chain participants. Companies are able to minimize carbon emissions, optimize transportation routes, and consolidate shipments by using collaborative logistics networks, like freight pooling and sharing platforms. For instance, the Freight share project, which is supported by the European Union, makes it easier for logistics firms to work together to reduce empty truck miles and enhance resource usage.

Using innovation, technology and teamwork to transform supply chain operations, boost competitiveness, and spur economic growth is known as transformative logistics. These illustrations show how innovative logistics techniques may add value, boost productivity, and open up new doors in a variety of sectors.

3. Advantages and Benefits of Transformative Logistics

Advantages of transformative logistics can be profound, offering benefits that extend across the supply chain and positively impact businesses, consumers and economies. Here are some key advantages illustrated with examples:

A. Improved Efficiency and Cost Reduction

By employing sophisticated data analytics and predictive modeling methods, businesses can minimize excess inventory, improve inventory levels, and decrease stock outs. As a result, there are savings on carrying costs, warehousing costs and cash flow. For example, Walmart uses predictive analytics to precisely estimate demand, which lowers costs and boosts profitability.

B. Enhanced Visibility and Transparency

A decentralized, impenetrable ledger that tracks each transaction and movement of commodities along the supply chain is made possible by blockchain technology. By increasing traceability and transparency, this lowers the possibility of counterfeiting and guarantees the legitimacy of the product. In order to improve food safety and supply chain transparency, Walmart and IBM worked together on a blockchain project to follow the path of pig products in China.

C. Faster Time-to-Market and Responsiveness

With Just-In-Time (JIT) inventory management, businesses may cut lead times, react swiftly to shifting consumer demands, and introduce new items more quickly. Fast-fashion shops such as Zara, for example, use just-in-time (JIT) concepts to reduce design-to-delivery cycles. This enables them to launch new clothing lines a few weeks after they are conceived, keeping them ahead of the competition and catering to customer preferences.

D. Optimized Resource Utilization

Automated technologies and smart warehousing solutions maximize labor efficiency and storage capacity by maximizing resource usage within facilities. Robotics and AI-driven sorting systems are used at Amazon's fulfillment centers to automate order fulfillment procedures, resulting in quicker order processing and lower labor expenses. Higher throughput rates and greater warehouse productivity are the outcomes of this.

E. Sustainability and Environmental Benefits

In order to maximize storage space and labor efficiency, automated technologies and smart warehousing solutions optimize resource utilization within warehouses. Order fulfillment procedures are automated in Amazon's fulfillment centers by robotics and AI-powered sorting systems, which speeds up order processing and lowers labor expenses. As a result, throughput rates are raised and warehouse productivity rises.

F. Enhanced Customer Experience

Innovations in last-mile delivery, such autonomous cars and drone delivery, increase delivery speed, dependability, and convenience while also improving the consumer experience overall. Drone delivery services are being

pioneered by companies such as Amazon Prime Air and Alphabet's Wing, which allows customers to receive products within minutes of making an order. Similar to this, food delivery services like Door Dash and Uber Eats use driverless cars to deliver meals fast and effectively, satisfying customers with better service and quicker delivery times.

G. Competitive Advantage and Market Differentiation

Adopting innovative logistics techniques can provide businesses a competitive advantage and set them apart from competitors. To meet customer expectations for speed, dependability, and sustainability, for example, businesses that invest in cutting-edge supply chain technologies and innovations are better positioned to become industry leaders and draw in new business prospects. There are many benefits to transformative logistics, from increased customer experiences and sustainability to cost savings and efficiency gains. By utilizing cutting-edge technologies, streamlining supply chain procedures and encouraging collaboration, businesses can unlock new opportunities for growth, competitiveness, and success in today's dynamic marketplace.

4. Disadvantages of Transformative Logistics

While transformative logistics offers numerous advantages, there are also potential disadvantages and challenges that organizations may encounter during implementation. Here are some key disadvantages explained with examples:

A. High Initial Investment Costs

Adopting innovative logistics techniques can provide businesses a competitive advantage and set them apart from competitors. To meet customer expectations for speed, dependability, and sustainability, for example, businesses that invest in cutting-edge supply chain technologies and innovations are better positioned to become industry leaders and draw in new business prospects. There are many benefits to transformative logistics, from increased customer experiences and sustainability to cost savings and efficiency gains.

B. Complexity and Integration Challenges

Integration of various systems, processes and technologies is a common component of transformative logistics projects, which can be difficult and complex. For example, careful planning, adaptation and coordination are needed when integrating block chain technology with current IT systems and supply chain networks. Business continuity and customer satisfaction may be

negatively impacted by delays, downtime, and operational inefficiencies caused by any disruptions or compatibility problems that arise throughout the integration process.

C. Risk of Technology Obsolescence

Technological progress can happen quickly, making transformational logistics solutions that are now in place obsolete. Purchasing a particular kind of automation technology, for example, can become out of date if newer, more sophisticated technologies become available. Businesses that don't keep up with technology developments run the danger of losing their competitive advantage and slipping behind rivals. One of the best examples of how a company's inability to innovate may result in obsolescence and business loss is Kodak's unwillingness to adopt digital photographic technology.

D. Cyber security and Data Privacy Concerns

Using digital technologies like block chain, cloud computing and IoT exposes businesses to dangers related to data privacy and cyber security. For instance a cyber-attack that targets a business's block chain platform or supply chain network may compromise confidential information, cause operational disruptions and harm the company's reputation. One of the biggest shipping firms in the world, Maersk, suffered tremendously from the NotPetya ransomware attack in 2017, which disrupted port operations and resulted in massive financial losses.

E. Dependency on External Partners and Service Providers

Collaborations with suppliers, carriers and technology providers are essential to the success of collaborative logistics projects. Dependence on these partners, meanwhile, might provide risks and weaknesses that are out of the organization's control. For instance, supply chain activities can be disrupted and company continuity may be impacted by disruptions in the logistics network caused by worker strikes, natural disasters, or geopolitical conflicts. The COVID-19 pandemic brought to light how susceptible international supply networks are to outside shocks, which caused numerous delays and disruptions.

F. Workforce Displacement and Reskilling Challenges

The automation and digitization of logistics systems have the potential to cause job losses and workforce displacement, especially for low-skilled individuals who undertake repetitive tasks. For example, the need for manual labor in logistics

operations may decline with the widespread usage of robotic technologies and automated warehouse systems. To lessen the effects of automation on workers and facilitate a seamless transfer to new positions and responsibilities, businesses must fund workforce reskilling and up skilling initiatives. While there are many advantages to transformative logistics in terms of productivity, innovation, and competitiveness, there are also drawbacks that need be carefully considered and dealt with by businesses.

5. Effects of Transformative Logistics in Sri Lankan Economy

Transformative logistics can have insightful effects on the Sri Lankan economy by addressing key challenges, enhancing efficiency, and driving growth across several sectors. Here are some examples of how transformative logistics can impact the Sri Lankan economy:

A. Improved Trade Efficiency

For both importers and exporters, transit times and transaction costs can be decreased by improving port infrastructure and expediting customs operations. Increased exports, increased foreign investment, and increased trade efficiency all contribute to economic growth. To position itself as a regional transshipment hub and draw shipping lines and increase marine trade volumes, Sri Lanka might engage in port modernization and expansion projects like the Colombo Port City plan.

B. Strengthened Manufacturing Sector

Enhancing supply chain efficiency and implementing just-in-time (JIT) inventory management techniques can make Sri Lanka's manufacturing industry more competitive. Manufacturers can better meet consumer demand and compete in international markets by cutting lead times, lowering the cost of keeping inventory, and increasing production efficiency. Manufacturers of clothing, for instance, can use revolutionary logistics to keep costs competitive, reduce production cycles, and react fast to shifting fashion trends.

C. *Enhanced Connectivity and Regional Integration*

Putting money into road and rail networks, for example, improves connectivity inside Sri Lanka and encourages regional cooperation with neighboring nations. Enhanced connectivity promotes economic collaboration with regional partners, opens up markets for Sri Lankan firms and eases cross-border trade. For example, the construction of the Southern Expressway and the Colombo-Kandy Expressway has improved connectivity between key ports and cities, allowing the flow of people and products and spurring economic growth along these corridors.

D. Tourism Development

Through bettering traveler experiences and transportation networks, transformative logistics projects can help the tourism sector. For instance, improving ground transportation infrastructure, increasing domestic airline routes, and modernizing airport amenities all facilitate tourist travel within Sri Lanka and the exploration of its varied attractions. By guaranteeing prompt delivery of goods and services to hotels and resorts, improved logistics also benefit the hospitality industry by improving the overall visitor experience.

E. Sustainable Development

Adopting environmentally friendly transportation methods and energy-saving technologies, together with other sustainable logistics practices, helps Sri Lanka achieve sustainable development and environmental preservation. Investing in biofuels and electric cars, for example, lowers greenhouse gas emissions and lessens air pollution in the transportation sector. Together with innovative logistics projects, Sri Lanka's dedication to sustainable development goals has the potential to build a more resilient and environmentally friendly economy.

F. Job Creation and Skills Development

In Sri Lanka, the execution of transformative logistics projects promotes skill development and opens up job prospects. Projects aimed at developing infrastructure, such building roads and ports, create jobs in the engineering, construction, and logistics industries. Furthermore, funding for educational projects and vocational training programs gives workers the skills they need to succeed in the logistics sector.

6. Changes Facing In Transformative Logistics in Sri Lanka

Several challenges are facing transformative logistics in Sri Lanka, delaying its full potential for economic development. These challenges include:

A. Infrastructure Deficiencies

Sri Lanka's logistics infrastructure, comprising roads, railways, ports, and airports, suffers from insufficient investment and maintenance. Poor road conditions, congestion at ports, and limited rail connectivity hinder the efficient movement of goods and increase transportation costs.

B. Regulatory Complexity

Significant obstacles to commerce and logistics activities exist in Sri

Lanka due to bureaucratic red tape and complicated regulatory processes.

C. Technology Adoption Gap

In Sri Lanka, there is still a limited uptake of contemporary technology and digitization in logistics operations. Advanced technologies like blockchain, data analytics, and Internet of Things (IoT) are often unavailable to logistics organizations, despite their critical role in streamlining supply chain operations and boosting productivity.

D. Skills Shortage

There is a lack of qualified workers in Sri Lanka's logistics industry, especially in fields like supply chain management, logistics planning, and technology adoption. The lack of trained professionals hampers the adoption of innovative logistics practices and limits the sector's capacity for growth and development.

E. Environmental Sustainability

Sri Lanka faces environmental challenges, comprising air and water pollution, deforestation, and waste management problems, which impact logistics operations. Sustainable logistics practices, such as green transportation methods and energy-efficient technologies, require investment and regulatory support to address environmental concerns effectively.

F. Geopolitical Factors

Due to its strategic location in the Indian Ocean, Sri Lanka is vulnerable to security threats and geopolitical unrest that could impede trade and logistical activities. Transformative logistics initiatives may face obstacles because to the impact of regional conflicts, piracy, and political instability on marine trade routes and port operations.

G. Financial Constraints

The lack of investment capital and financing options in Sri Lanka is a hindrance to revolutionary logistics projects. Infrastructure development projects need a large amount of capital, and because of regulatory complications and risk perceptions, financing solutions like public-private partnerships (PPPs) may be difficult to implement.

H. Coordination and Collaboration

Transformative logistics efforts require effective coordination and collaboration between government agencies, business sector stakeholders, and international partners. However, it can be difficult to align interests and reach agreement on policy priorities and project execution when there are disjointed governance structures, a lack of coordinating mechanisms, and low stakeholder engagement.

Policymakers, industry stakeholders, and international partners must work together to address these issues by making strategic investments in infrastructure development, streamlining regulatory procedures, encouraging technology adoption, improving skill development, and fostering collaboration for the logistics sector in Sri Lanka to grow sustainably and inclusively.

7. Overcoming Transformative Logistics Challenges

Overcoming the challenges facing transformative logistics in Sri Lanka requires a comprehensive and coordinated approach involving government interventions, private sector initiatives, and collaboration with international partners. Here are several strategies to address these challenges:

A. Investment in Infrastructure

Provide enough money for initiatives including the construction of ports, airports, railroads, and roadways in order to enhance connectivity and promote the effective flow of products. To alleviate congestion and improve logistics effectiveness, give priority to improvements in important transportation corridors and logistics hubs.

B. Streamlining Regulatory Procedures

Simplify and expedite trade laws, licensing requirements, and customs processes to cut down on bureaucratic red tape and improve company accessibility. To enable quicker and more transparent trade operations, implement single-window platforms and electronic technologies for customs clearance.

C. Promoting Technology Adoption

Encourage the use of digital solutions and contemporary technologies in logistics operations by offering grants, subsidies, and initiatives to develop capacity. Give logistics companies technical support and training so they may become more technologically advanced and use innovations like block chain, IoT, and data analytics to streamline supply chain operations.

D. Skills Development and Capacity Building

In order to solve the lack of qualified workers in the logistics industry, funds should be allocated to educational programs, skill development projects, and vocational training programs

E. Environmental Sustainability Initiatives

Put laws and policies into place to support environmental sustainability in logistics operations. Examples include providing incentives for the use of environmentally friendly transportation options, supporting energy-efficient equipment, and encouraging recycling and waste minimization techniques.

F. Management and Security Measures

To handle geopolitical risks, piracy threats and other security issues affecting maritime commerce routes and port operations, develop risk management strategies and security measures. Boost cooperation with international and regional allies to fortify marine security and guarantee the security of trade routes.

G. Public-Private Partnerships (PPPs)

Encourage cooperation between public-private partnerships (PPPs) and joint ventures, international partners, and government agencies in order to finance and carry out innovative logistical initiatives. In order to maximize innovation and efficiency in the creation and operation of logistics infrastructure, include the private sector with investment and experience.

H. Strengthening Coordination and Governance

To improve coordination and cooperation amongst stakeholders in the logistics industry, establish coordination structures, interagency task teams, and venues for public-private discourse. In the process of developing and implementing logistics policies, strengthen governance and regulatory frameworks to encourage responsibility, openness, and sound decision making. With the implementation of these measures in a coordinated and cooperative manner, Sri Lanka may unlock its full potential for economic growth, competitiveness, and sustainable development while overcoming the obstacles that revolutionary logistics presents.

8. Conclusion

To fully realize Sri Lanka's economic potential and establish it as a regional trade and commerce powerhouse and Transformative Logistics for Sri Lanka's Economic Renaissance" are essential. Sri Lanka can facilitate long-term economic growth, employment creation, and prosperity by tackling logistical issues through strategic

investments, regulatory changes, and technological integration. Realizing the goal of a dynamic and competitive logistics ecosystem propelling Sri Lanka's economic revival would require embracing innovation and teamwork.

REFERENCES

Attanayake, C., 2023. Unveiling Sri Lanka's agency: empowering infrastuctural transformation in China - Sri Lanka relations. Contemporary East Asia Studies.

Central Bank of Sri Lanka, 2020. Annual Report, s.l.: Central Bank of Sri Lanka.

Ministry of Ports and Shipping Sri Lanka, 2023. National Logistics Policy Framework. [Online] Available at: http://www.portsmin .gov.lk /web /index. php? option= com_ content&view =article&id=87&Itemid= 488&lang=en
[Accessed 25 3 2024].

Singhdong, P., 2021. Factors Influencing Digital Transformation of Logistics Service Providers: A Case Study in Thailand. Asian Finance, Economics and Business.

World Bank, 2021. Sri Lanka Development Update: Investing in People. [Online]
Available at: https://www.worldbank.org/en/country/srilanka/publication/sri-lanka-development-update-investing-in-people
[Accessed 26 3 2024].

NAVIGATING SUSTAINABILITY: SRI LANKA'S VOYAGE TOWARDS ECONOMIC RENAISSANCE THROUGH TRANSFORMATIVE LOGISTICS

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Abstract

This study uses transformative logistics as a lens to examine Sri Lanka's path toward economic recovery. It looks at how important sustainable practices are to navigating this journey, taking into account both the opportunities and challenges that come with it. By exploring the relationship between sustainability and logistics, it clarifies the tactics Sri Lanka uses to promote economic expansion while maintaining social justice and environmental responsibility. This study advances our knowledge of how sustainable practices might propel economic revival in developing nations by providing a thorough analysis.

Keywords: *Sri Lanka, sustainability, economic renaissance, transformative logistics, sustainable logistics, environmental stewardship, social equity, economic growth, emerging economies, sustainable practices.*

1. Introduction

Sri Lanka stances at a crucial instance in its economic route. As a nation amusing in history, culture, and natural resources, it has enormous potential for growth and development. However, identical various emerging economies, it faces dares in navigating sustainable development pathways while safeguarding economic resilience. One key aspect that embraces significant assurance for Sri Lanka's economic renaissance is transformative logistics. Sri Lanka, situated at the crossroads of international trade routes and gifted with rich biodiversity, faces a numerous of challenges and opportunities in its pursuit for sustainable development. The island nation handles with concerns such as infrastructure constrictions, inefficiencies in transport systems, and environmental deprivation, which not only obstruct economic progress but also impend the environmental integrity of its various ecosystems. Besides, societal inequalities and vulnerabilities further emphasize the need for general and equitable approaches to development.

Against this framework, the concept of transformative logistics as a convincing paradigm that surpasses conventional supply chain performs, seeking to resolve economic growth with ecological stewardship and social parity. By reimagining the

whole logistics ecosystem, from tracking to distribution, and integrating ethics of sustainability into every surface of operations, transformative logistics grips the promise of raising resilience and opulence while minimizing adversarial environmental impacts. Key sponsors in this journey towards sustainability and economic resilience contain public agencies, private enterprises, domestic society organizations, and global partners. Collaboration and corporation are essential for dynamic systemic change, assembling resources, and fostering knowledge sharing and volume building. Through inclusive and involved approaches, Sri Lanka can hitch the collective expertise and inspiration of diverse stakeholders to co-create innovative solutions and discourse complex challenges at the juncture of sustainability and economic development.

Moreover, economic resilience is major to ensuring the long-term success and stability of Sri Lanka's economy among various shudders and disruptions. Transformative logistics strategies can enhance economic resilience by refining supply chain efficiency, dipping costs, enhancing market access, and fostering invention. By investing in infrastructure development, technology acceptance, and capacity building, Sri Lanka can reinforce its logistics capabilities and improve its competitiveness in regional and international markets.

Overall, navigating sustainability within the framework of economic resilience through transformative logistics characterizes a holistic approach to encouragement sustainable development in Sri Lanka. By integrating environmental, social, and economic considerations into logistics planning and operations, Sri Lanka can build a more resilient, competitive, and impartial economy that encounters the needs of present and future generations.

Literature Review

A growing number of organizations and economies throughout the world are placing a high priority on sustainable logistics due to the need to reduce environmental impact, improve operational efficiency, and satisfy changing customer needs. Important topics covered in the literature include methods for transforming logistics in a sustainable way, the contribution of transformational logistics to economic growth, and the opportunities and problems found in various national logistics environments.

Scholars and professionals have studied sustainable logistics transformation in great detail. This entails streamlining transportation systems to cut down on pollution and traffic, putting green supply chain techniques into place to cut down on waste and resource usage, and incorporating renewable energy sources into logistics processes. Furthermore, technological developments like artificial intelligence (AI) and the Internet of Things (IoT) present chances to improve supply chain visibility, efficiency, and sustainability.

Here is increasing interest in the role transformative logistics plays in economic rebirth, especially in emerging economies such as Sri Lanka. Transformative logistics connects markets, lowers trade barriers, and draws investment to promote not only the efficient flow of commodities but also wider economic development. Additionally, developing a nation's logistics infrastructure can boost its competitiveness, encourage innovation, and generate jobs.

Nonetheless, there are particular opportunities and problems in Sri Lanka's logistics environment. Although the nation's key maritime hub location has many opportunities for logistical growth, it also faces obstacles like poor infrastructure, red tape, and environmental issues. A broad strategy comprising cooperation between governmental organizations, stakeholders in the corporate sector, and foreign partners is needed to address these issues.

Research Objectives

This study's main goal is to investigate how transformative logistics contribute to Sri Lanka's economic recovery. The study's specific objectives are to:

- Examine the main tactics for Sri Lanka's transformation of sustainable logistics.
- Analyze how disruptive logistics has affected Sri Lanka's economic growth.
- Determine the potential and problems facing Sri Lanka's logistics sector.
- Give legislators, business professionals, and other stakeholders' advice and ideas on how to improve environmentally friendly logistics methods and spur economic expansion.

Significance of the Study

For a number of stakeholders, including businesses, investors, governments, and civil society organizations, this study has important ramifications. The research's findings can influence investment choices, policy decisions, and creative solutions to urgent problems by illuminating the relationship between sustainable logistics and economic development in Sri Lanka. Moreover, the research adds significant value to the wider scholarly conversation on logistics management and sustainable development by offering insightful information for upcoming studies and applications.

Key Strategies for Sustainable Logistics Transformation

Sustainable logistics transformation is critical for businesses pointing to reduce their environmental footprint, improve operational efficiency, and encounter evolving consumer demands. Here's a vital breakdown of key strategies for sustainable logistics transformation:

- Supply Chain Optimization: Optimizing the supply chain includes streamlining processes to minimalize waste, reduce transportation distances, and improve resource utilization. Applying advanced technologies such as AI, IoT, and data analytics can help in forecasting demand accurately, maximizing inventory levels, and recognizing inefficiencies within the supply chain.

- Green Transportation: Transitioning towards green transportation methods such as electric vehicles (EVs), hybrid vehicles, and alternative fuels can expressively reduce carbon emissions related with logistics operations. Investing in a recent fleet and executing route optimization software can additional enhance fuel efficiency and diminish environmental impact.

- Last-Mile Delivery Innovations: Last-mile transfer typically accounts for a significant quota of logistics-related emissions. Applying innovative solutions such as delivery drones, autonomous vehicles, and crowd-shipping platforms can enhance last-mile logistics, decrease delivery times, and lower carbon emissions.

- Collaborative Logistics: Collaborative logistics encompasses partnering with other companies to share transportation resources, warehouse space, and distribution networks. By assembling resources and combining shipments, businesses can reduce transportation costs, minimize empty miles, and lower their overall carbon footprint.

- Packaging Optimization: Dipping packaging waste is essential for sustainable logistics transformation. Applying eco-friendly packaging materials, executing right-sized packaging solutions, and enhancing packaging designs can reduce waste generation and enhance resource efficiency throughout the supply chain.

- Reverse Logistics: Executing effective reverse logistics processes is decisive for managing product returns, recycling, and waste disposal efficiently. Emerging a comprehensive reverse logistics strategy can lessen landfill waste, recuperate valuable resources, and diminish the environmental effect of product disposal.

- Supplier Collaboration and Transparency: Collaborating with suppliers to stimulate sustainable performs across the whole supply chain is essential for heavy meaningful change. Launching clear sustainability criteria, piloting supplier audits, and fostering transparency can safeguard compliance with environmental standards and uphold responsible sourcing practices.

- Continuous Improvement and Innovation: Sustainable logistics transformation is an continuing process that needs continuous enhancement and innovation. To increase sustainability performance and outpace emerging market trends, businesses should embrace an innovative culture, invest heavily in research and development, and aggressively seek out new technologies and techniques.

In summary, adopting these crucial tactics can assist companies in determining how to transform logistics sustainably, lessen their impact on the environment, and produce long-term benefits for both the company and society. But for implementation to be successful, there must be dedication, funding, and cooperation throughout the whole supply chain.

The Role of Transformative Logistics in Economic Renaissance in Sri Lanka.

Transformative logistics raises to the strategic integration of innovative technologies, processes, and policies intended at enhancing the efficiency, sustainability, and resilience of supply chains and transportation networks. It goes outside traditional logistics methods by prioritizing environmental sustainability, social responsibility, and economic viability. In the scenery of economic development, logistics viewpoints as a grave pillar, determining the efficiency and competitiveness of nations. For Sri Lanka, a nation with a rich antiquity and strategic geographical location, the part of transformative logistics arises as a potential catalyst for escorting in an economic renaissance. As the country activities to refresh its economy, transformative logistics offerings a pathway towards enhanced connectivity, restructured processes, and augmented trade facilitation.

At the heart of Sri Lanka's economic ambitions lies its tactical positioning as a maritime hub in the Indian Ocean. With the Colombo Port aiding as a vital transshipment point and the Hambantota Port undertaking ambitious development projects, the country grips immense prospective to emerge as a significant logistics and interchange hub in the region. The current investments and enlargements in port infrastructure, united with initiatives such as the Colombo Port City project, imply Sri Lanka's promise to leveraging its physical advantage for economic growth. These deeds not only improve maritime connectivity but also position Sri Lanka as a central point for trade and investment, nurturing collaborations with global economic networks.

Furthermore, the modernization and digitization of logistics methods are paramount in improving efficiency and dropping transaction costs. Sri Lanka's acceptance of digital technologies and mechanization in logistics management grips significant potential in this regard. Initiatives such as the execution of electronic documentation systems, automatic cargo handling amenities, and the establishment of integrated logistics stages contribute to reorganization supply chain processes, dropping transit times, and refining overall competitiveness. Furthermore, the incorporation of emerging

technologies like block chain and artificial intelligence into logistics operations can improve transparency, security, and efficiency, thus unlocking new paths for economic growth.

In parallel, the development of various modes of transportation networks is vital for boosting Sri Lanka's connectivity and accessibility. The extension and modernization of road and rail infrastructure, joined with investments in air cargo amenities, are essential steps towards establishing unified transportation connections both domestically and internationally. Improving connectivity between significant economic centers and production zones not only smooths the efficient measure of goods but also catalyzes regional development and economic integration. Furthermore, investments in intermodal transportation centers and logistics grounds can further boost supply chain dynamics, providing unified facilities for warehousing, distribution, and value-added services.

In the context of Sri Lanka's economic renaissance, the part of transformative logistics encompasses beyond traditional notions of transportation and distribution. It incorporates a rounded approach towards improving supply chain subtleties, leveraging digital technologies, and nurturing seamless connectivity to drive economic growth and development. By exploiting on its strategic location, advancing in modern infrastructure, and embracing innovative solutions, Sri Lanka can spot itself as a dynamic logistics hub and a entry to regional and international markets. However, realizing this vision requires concentrated efforts from government, industry stakeholders, and the broader society to overcome challenges, harness opportunities, and chart a path towards supportable and inclusive economic prosperity.

On the socio-economic front, transformative logistics has the probable to generate employment opportunities, enhance productivity, and stimulate entrepreneurship. The development of logistics infrastructure and services generates a wrinkle effect across various sectors, urging economic activity and contributing to job creation along the supply chain. Furthermore, by improving entree to markets and reducing logistical barriers, transformative logistics authorizes small and medium enterprises (SMEs) to join more effectively in domestic and international trade. This, in turn, adopts innovation, adopts inclusive growth, and enhances the resilience of the economy.

Additionally, transformative logistics theaters a crucial role in enhancing the resilience and sustainability of supply chains, mainly in the face of global disturbances such as the COVID-19 pandemic. The acceptance of advanced technologies, such as real-time tracking and extrapolative analytics, enables active risk management and contingency planning, thus minimizing the effect of disruptions on supply chain operations. Moreover, by endorsing modal shifts towards more sustainable transportation modes and improving logistics processes to reduce carbon emissions, transformative logistics contributes to ecological sustainability and supports Sri Lanka's obligations to combat climate change.

Challenges and Opportunities in Sri Lanka's Logistics Landscape

Examining the challenges and opportunities in navigating sustainability and economic resilience through transformative logistics in Sri Lanka needs a comprehensive thoughtful of the country's existing economic and environmental landscape, as well as its probable for growth and development. Here's an analysis of both challenges and opportunities:

Challenges:

- Infrastructure Deficiency: Sri Lanka expressions significant challenges in terms of its logistics infrastructure. Ports, roads, and rail networks need substantial investment and enhancement to efficiently handle growing trade volumes and to upkeep sustainable logistics operations.

- Traffic Congestion: Urban centers like Colombo suffer from grave traffic congestion, leading to interruptions in transporting goods and improved fuel consumption. Addressing this dispute requires wide-ranging urban planning and investment in transportation infrastructure.

- Environmental Degradation: Ineffective logistics operations give to environmental degradation through augmented emissions and pollution. Sri Lanka desires to adopt sustainable performs in logistics to alleviate its environmental impact and fulfill with global environmental standards.

- Lack of Technological Integration: The acceptance of advanced technologies such as block chain, IoT (Internet of Things), and AI (Artificial Intelligence) in logistics operations is still in its beginning in Sri Lanka. The shortage of technological integration obstructs efficiency and transparency in supply chain management.

- Policy and Regulatory Constraints: Uneven policies, inflexible red tape, and regulatory obstacles pose challenges to the improvement of sustainable logistics practices in Sri Lanka. Reform regulations and creating a favorable policy environment are essential for encouragement innovation and investment in the sector.

Opportunities:

- Strategic Location: Sri Lanka's tactical location along major global shipping routes offerings opportunities for the expansion of transshipment and logistics hub services. By exploiting on its geographical benefit, Sri Lanka can draw investment and convert a regional logistics hub.

- Investment Potential: Investment in upgrading and expanding Sri Lanka's logistics network has significant potential. An important element of modernizing ports, airports, and transportation networks can be played by public-private partnerships (PPPs) and foreign direct investment (FDI).

- Emerging Technologies: The acceptance of emerging technologies such as digital platforms, real-time tracking systems, and automation can boost efficiency and limpidity in logistics operations. Embracing technological innovation can initiative productivity advances and cost savings in the long term.

- Green Logistics Initiatives: Executing green logistics initiatives, such as the use of alternative fuels, electric vehicles, and eco-friendly packaging, presents opportunities to decrease carbon emissions and curtail environmental impact. Investing in sustainable logistics performs can enhance Sri Lanka's competitiveness and attractiveness to environmentally aware businesses.

- Capacity Building and Skills Development: Investing in education and training programs to grow skilled professionals in logistics and supply chain management is needed for building a skilled workforce capable of driving innovation and efficiency in the sector.

Conclusion

Sri Lanka's voyage towards sustainable development and economic resilience pivots on the transformative power of logistics. The island nation, endowed with a wealth of natural resources, history, and culture, is at a turning point in its economic development that presents both possibilities and problems. Transformative logistics occurs as a compelling paradigm that transcends traditional supply chain practices, subscription a pathway towards reconciliation economic growth with environmental stewardship and social equity.

Navigating sustainability within the outline of economic resilience through transformative logistics needs a multifaceted approach. This contains integrating sustainable practices into every facade of logistics operations, from supply chain optimization to last-mile delivery innovations. Core strategies such as green transportation, collaborative logistics, packaging optimization, and supplier collaboration are needed for reducing environmental impact, enhancing operational efficiency, and meeting developing consumer demands.

Furthermore, the role of transformative logistics in Sri Lanka's economic renaissance encompasses beyond traditional concepts of transportation and delivery. It includes a holistic approach towards improving connectivity, reformation processes,

and fostering unified integration with international economic networks. Investments in infrastructure progress, technology adoption, and regulatory changes are crucial for exposing Sri Lanka's potential as a dynamic logistics hub and a entryway to regional and international markets.

On the socio-economic facade, transformative logistics has the possible to generate employment opportunities, encourage entrepreneurship, and empower small and medium enterprises (SMEs) to contribute more effectively in domestic and global trade. By fostering a favorable regulatory environment, encouraging trade facilitation measures, and investing in capacity building, Sri Lanka can generate a resilient and comprehensive economy that benefits all its citizens.

Additionally, transformative logistics is essential for improving supply networks' sustainability and resilience, particularly in the face of major world shocks like the COVID-19 pandemic. Adoption of cutting-edge technology and environmentally friendly logistics programs enhances proactive risk management, lowers carbon emissions, and upholds Sri Lanka's commitments to address climate change.

In spite of the significant opportunities presented by transformative logistics, Sri Lanka also facades challenges such as infrastructure deficiency, traffic congestion, ecological degradation, technological integration, and policy restraints. Overcoming these challenges needs concerted efforts from government, industry shareholders, and civil society to adoptive innovation, investment, and collaboration across the whole supply chain.

Overall, by acceptance transformative logistics and adopting a rounded approach to sustainable development, Sri Lanka can generate a resilient, competitive, and impartial economy that meets the requirements of present and future generations. Collaboration among government, industry stakeholders, and civil society is needed for driving systemic change and recognizing the vision of a sustainable logistics landscape in Sri Lanka.

REFERENCES

Central Bank of Sri Lanka. (2023). In Annual Report-2022.

David B. Grant & Alexander Trautrims, (2017). Sustainable Logistics and Supply Chain Management: Principles and Practices for Sustainable Operations and Management.

Martin Christopher & Helen Peck. (2012). Logistics Operations and Management: Concepts and Models.

Paolo Capgemini, Transformative Logistics: Supply Chain Optimization in the Era of Sustainability.

PUBLIC PRIVATE SECTOR SYNERGY: DRIVING ECONOMIC PROSPERITY THROUGH LOGISTICS

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Abstract

The interplay between the public and private sectors has become increasingly crucial for driving economic prosperity particularly through logistics in globalized economy at present. The synergy between the public and private sectors in logistics comprises collaboration, partnership and shared resources to optimize distribution and supply chain management. The governments can provide essential infrastructure, regulations, and policies while private enterprises contribute innovation, efficiency, and investment by leveraging the strengths of both sectors. Logistics infrastructure facilitated by this synergy will reduces transportation costs, enhances market accessibility and accelerates the movement of goods and services correctly expanding trade, stimulating business activities and to attract foreign investments with economic development. Collaborative efforts between the public and private sectors in logistics play a crucial role in addressing challenges such as cost inefficiency, environmental sustainability and economic resilience. By aligning objectives and coordinating strategies, stakeholders can implement optimum supply chain practices, deploy advanced technologies and build strong supply chains to mitigate risks and enhance competitiveness. Furthermore, it is important to foster the environment with collaboration, innovation and continuous improvement to connect the full potential of both public and private sector relationship for sustainable economic growth absorbing transformative impact of logistics for driving economic prosperity.

Keywords - *Private Public Partnerships (PPPs), Sustainable Economic Growth, Efficiency*

1. Introduction

Logistics is the lifeblood of modern and emerging economies facilitating the efficient movement of goods and services across various regions by driving economic growth. Effective logistics management not only reduces costs but also enhances competitiveness, promotes trade and encourage overall economy. The concept of public private sector synergy is the driving force which embodies the collaborative efforts between government organizations and private enterprises to optimize logistical processes and infrastructure. This synergy recognizes the balancing roles played by both sectors. The public sector stimulates with policy making, regulation and infrastructure

development and the private sector contributes for its innovation, efficiency and service provision capabilities. Synchronizing the both sectors can create efficient and effective forces capable of addressing different logistical challenges more comprehensively and innovatively.

Risk sharing between the two sectors is a critical factor and the private sector is willing to take more risks and willing to see new things move faster than the government sector which just tends to be more risk averse. Hence, this paper is discussing and exploring the dynamic synergy between the public and private sectors in the platform of logistics and its implications for driving economic prosperity.

2. Aim

This study examine the transformative potential of public private partnerships in enhancing logistical efficiency and consequently fostering economic development by identifying key strategies for fostering synergy. Further, it is examined the significance of logistics in economic growth and development, elaborating the concept of public private sector synergy and its relevance to logistics management and to analyze the mechanisms through which collaborative efforts between the public and private sectors can enhance logistical efficiency and drive economic prosperity.

3. Discussion

Logistics can be described as the backbone of global trade and commerce. It encompasses the process of managing the flow of goods, services and information from the point of origin to the point of consumption. It involves managing various interconnected activities including procurement, production, transportation, warehousing, inventory management and distribution to ensure the timely and cost effective delivery of products and services to the end users. The components of logistics can be categorized into several key areas as follows.

1. Procurement

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This involves the acquisition of raw materials, components and other resources required for production. Efficient procurement practices ensure a reliable supply of inputs and requirements while minimizing costs and risks associated with sourcing.

2. Production

The production involves transforming raw materials into finished goods through manufacturing processes. Logistics plays a crucial role in coordinating production schedules, optimizing production flows and ensuring the availability

of resources to meet requirement.

3. Transportation

Transportation is vital to logistics facilitating the movement of goods between various points in the supply chain including suppliers, manufacturers, distributors, retailers and consumers. Modes of transportation may include road, rail, air, sea, and multimodal each offering distinct advantages in delivery process.

4. Warehousing

Warehousing involves the storage and management of inventory at different stages of the supply chain. Warehouses serve as distribution centers where goods are stored, sorted and consolidated before being dispatched to the final destination. Effective warehousing practices optimize inventory levels, reduce lead times and improve order fulfillment capabilities with minimum stock outs.

5. Distribution

Distribution encompasses the activities involved in delivering finished products to customers or end users. This may involve direct shipments from manufacturers to whole sellers, retailers or directly to the consumer. Distribution networks are designed to minimize transportation costs, shorten delivery times and enhance customer satisfaction.

Logistics is a part of the supply chain management that encompasses the wider coordination of all activities involved in sourcing, production and distribution to meet customer demand effectively. Supply chain management emphasizes the seamless integration of suppliers, manufacturers, distributors and customers to achieve strategic objectives such as cost reduction, responsiveness, flexibility and sustainability. The logistics is significant in enhancing business operations and competitiveness. Effectively managed logistics operations will contribute to minimize cost through better inventory management, reduced transport expenses and enhanced resources utilization.

Further, agile logistics systems enable organizations to respond the changing market demand, reduce stock outs and manage the emerging opportunities in the market. Efficient logistics network plays a critical role in fostering competitiveness by facilitating international trade, expanding the market reach and supporting industries using JIT. Countries with strong logistics infrastructure enjoy advantages in global markets, attracting investments, promoting exports and stimulating economic growth. Basically logistics serves as a critical enabler of business success, driving operational

efficiency, customer satisfaction and ultimately stimulating economic development.

A. The role of the public sector in logistics

The public sector plays a crucial role in shaping the background of logistics through its involvement in infrastructure development, formulation of regulations and policies. The contributions of government agencies to logistics and the impact on efficiency and economic growth can be categorized as follows.

1. Infrastructure Development

The government agencies in a country are the key stakeholders in developing and maintaining major logistics infrastructures including roads, ports, railways, airports and other important factors. Investment in infrastructure is not only enhancing connectivity and accessibility but also reducing transportation costs and improve supply chain efficiency. The expansion of port facilities like Colombo harbor and the upgrading of inland transportation networks like high ways assist smoother movement of goods from production centers to distribution centers and foreign destinations. Further, investments in railway facilitate the efficient transportation of bulk stocks over long distances by reducing dependence on road transport.

2. *Government regulations, policies and trade agreements*

Regulations and policies are formulated by the government agencies make a deep impact on logistics operations influencing safety standards, environmental sustainability, customs procedures and domestic and international trade. International trade agreements shapes the regulatory environment and trade flows, impacting logistics practices and supply chain dynamics effecting the country as a whole. Customs regulations and procedures directly affect the speed and efficiency of cross border movements with streamlined processes reducing clearance times and enhancing supply chain quickness without delay. Also, tariff reduction or tariff and non-tariff barriers facilitate smoother trade flows encouraging imports or exports according to the requirement of the country.

3. Public sector initiatives

The establishment of special economic zones designed to merge warehousing, distribution and value added services in strategic locations. These initiatives create synergies among logistics stakeholders, promote economies of scale and attract foreign investment by offering tax incentives and streamlined regulatory

frameworks.

Providing integrated logistics solutions and supporting industries such as manufacturing, e-commerce and logistics hubs and nodes will gain productivity and enhance competitiveness. Further, public private partnerships (PPPs) have emerged as a viable model for financing and managing logistics infrastructure projects. By leveraging the expertise and resources of both sectors, PPPs accelerate the development of critical infrastructure such as toll highways, ports and logistics hubs while sharing risks and rewards. The government agencies contribute to logistics efficiency, trade facilitation and economic growth by investing in infrastructure, formulating conducive policies and promoting partnerships.

B. Contribution of the private sector to logistics

The private sector plays a critical role in logistics services offering and various range of solutions that comprise transportation, warehousing, inventory management and distribution. The contributions of the private sector to logistics providing service, innovation and collaborative partnerships can be identified as follows.

1. Providing logistics services

Private sector organizations including transportation firms, logistics service providers, e-commerce platforms and 3PL, 4PL providers have become the backbone of the logistics industry. These entities specialize in offering tailored solutions to meet the diverse needs of businesses across various sectors. Transportation companies, such as trucking, shipping, and air cargo carriers, are instrumental in facilitating the movement of goods domestically and internationally. Logistics firms leverage their expertise in supply chain management to optimize inventory levels, streamline distribution channels, and improve order fulfillment processes. E-commerce platforms driven by digital technologies have revolutionized retail logistics by offering seamless online shopping experiences, efficient and doorstep delivery services.

2. Innovation and Technology Adoption

The private sector drives innovation in logistics through the adoption of cutting edge technologies and operational practices aimed at enhancing efficiency, visibility and customer satisfaction. Advancements in automation, robotics, AI and data analytics have transformed logistics operations enabling real time tracking, predictive analytics and optimization of transportation routes and warehouse layouts. Widespread adoption of warehouse automation systems such as automated guided vehicles and robotic picking systems have modernized order fulfillment processes by reducing labor costs and cycle times. Similarly, the integration of IOT sensors and telematics devices in transportation fleets

enables fleet management companies to monitor vehicle performance, optimize fuel consumption and ensure timely deliveries.

3. Successful private sector logistics partnerships

Private sector companies regularly collaborate through strategic partnerships to leverage complementary strengths and enhance service offerings. The partnership between logistics providers and technology firms make partnerships to develop innovative solutions for last mile delivery challenges. Similarly, Amazon has collaborated with logistics firms and drone manufacturers to explore the feasibility of drone based delivery solutions aiming to expedite delivery times and reduce reliance on traditional transportation modes. Companies like Walmart has partnered with logistics firms to leverage their distribution networks and inventory management expertise, facilitating faster order processing and delivery to customers. The private sector plays a central role in driving innovation, efficiency and competitiveness in logistics through its diverse range of service offerings and collaborative partnerships. The private sector companies contribute to the optimization of supply chain operations and the delivery of continuous customer experiences by harnessing technology, operational expertise and strategic alliances.

C. Synergies between Public sector and Private Sector

Collaboration between the public and private sectors in logistics can gain more substantial benefits. Those advantages are ranging from improved infrastructure development to enhanced operational efficiency and innovation. This section delves into the synergies between these sectors, examining how their partnership can address logistical challenges, the advantages of public-private partnerships and notable examples of successful collaborations from various regions.

1. Addressing logistical challenges

Collaboration between the public and private sectors enables a comprehensive approach to address logistical challenges by pooling resources, expertise and capabilities. Public sector agencies bring regulatory framework, funding mechanisms and long term planning capabilities while private companies contribute operational efficiency, innovation and market insights. When addressing urban congestion and last mile delivery challenges, the governments can collaborate with e-commerce platforms and logistics firms to implement innovative solutions such as separate micro fulfillment centers and shared transportation networks.

2. Benefits of public private partnerships

Public private partnerships brings a flexible and efficient framework for infrastructure development and logistics management by leveraging the strengths of both sectors while mitigating risks and costs. PPPs enable governments to mobilize private sector investment, expertise and innovation for the development, operation and maintenance of critical infrastructure assets. One of the key benefits of PPPs is the sharing of risks and responsibilities between the public and private sectors. By transferring certain project risks, such as construction delays or cost overruns to private partners, the governments can ensure timely project delivery and cost certainty. Further, PPPs allow for greater operational flexibility and performance incentives encouraging private sector efficiency and innovation. Furthermore, PPPs promote accountability and transparency through clear contractual arrangements and performance metrics ensuring that public resources are used effectively and efficiently. PPPs foster long-term collaboration and mutual benefits by aligning the interests of both parties leading to sustainable infrastructure development and improved service delivery in the country.

D. Overcoming Challenges

Achieving effective public private sector synergy in logistics is not without its challenges. These obstacles range from regulatory barriers and conflicting interests to funding constraints which can hinder collaboration and impede progress. However, with strategic planning and proactive measures, these challenges can be overcome, paving the way for successful partnerships and sustainable development as follows

1. Regulatory barriers

Regulatory frameworks often differ between the public and private sectors leading to bureaucratic obstacles and legal constraints that hinder collaboration. Stakeholders must engage in dialogue with policymakers to streamline regulations, harmonize standards and create an enabling environment for partnership to overcome this challenge.

2. Conflicting interests

Misalignment of goals and priorities between public and private entities can undermine collaboration and hinder progress. Establishing clear communication channels, fostering mutual trust and aligning incentives through well-defined contractual arrangements can help mitigate conflicting interests and promote cooperation.

3. Funding constraints

Limited financial resources lead to significant barriers to infrastructure development and logistics investments. The governments can explore innovative financing mechanisms such as public-private financing schemes, value capture mechanisms and project bundling to address funding constraints, to attract private sector investment and leverage available resources more effectively.

E. Strategies for overcoming challenges

Establishing platforms for regular communication and engagement between public and private stakeholders to foster understanding, build consensus and address concerns collaboratively. Advocating for regulatory reforms that simplify administrative procedures, reduce red tape and facilitate public-private partnerships in logistics infrastructure development and operations. Introducing financial incentives, tax breaks and performance based rewards to encourage private sector participation and investment in logistics projects. Further, enhancing the skills and capabilities of public sector officials and private sector professionals through training programs, workshops and knowledge sharing initiatives to strengthen collaboration and improve project outcomes. All the parties can overcome barriers to public private sector synergy in logistics and unlock the full potential of collaborative partnerships for sustainable development by proactively addressing these challenges and implementing targeted strategies.

4. Conclusion

The future of logistics holds favorable opportunities for continued innovation, efficiency and sustainability driven by the evolving role of public private sector collaboration. As technology advances and global supply chains become increasingly complex, collaboration between the public and private sectors will be essential to address emerging challenges and seize new opportunities in the logistics landscape. Public-private sector collaboration is poised to play a central role in shaping the future of logistics by leveraging complementary strengths, resources and expertise to drive innovation, enhance efficiency and promote sustainable development. By embracing digital technologies, data analytics and automation, collaborative efforts can streamline processes, optimize supply chain operations and enhance customer experiences.

Furthermore, it has been explored the pivotal role of both the public and private sectors in logistics, highlighting their contributions to infrastructure development, regulatory frameworks and service provision. It has been demonstrated the transformative impact of public private partnerships in addressing logistical challenges and driving economic prosperity. In future, it is vital to recognize the importance of continued cooperation between the public and private sectors in driving economic prosperity through logistics in Sri Lanka. By fostering trust, transparency and mutual benefit,

collaborative partnerships can unlock new opportunities for growth, innovation, and sustainability in the logistics industry.

The synergy between the public and private sectors holds vast potential to shape the future of logistics and drive sustainable economic development. By working together, both sectors in Sri Lanka can navigate the complexities of the global marketplace, adapt to changing consumer demands and create value for society as a whole. The public private sector synergy in driving economic prosperity through logistics in Sri Lanka it has to be navigated the complicated interconnection between government agencies and private enterprises in promoting efficient logistics environments. Considering the public sector involvement, it is clear that a crucial role played in logistics infrastructure development and regulatory frameworks, emphasizing its impact on logistics efficiency and economic growth by public sector.

Simultaneously, the private sector immensely contribute and provide competencies in providing logistics services and driving innovation through technology adoption. The synergies between public and private sectors interpreted the collaborative efforts aimed at addressing logistical challenges comprehensively. Public private partnerships emerged as a inspiration offering an efficient framework for infrastructure development and logistics management, as exemplified by successful collaborations worldwide. Navigating through the hurdles, confronted challenges such as regulatory barriers, conflicting interests, and funding constraints, offering strategies to surmount these obstacles. Looking forward, it is envisaged a future brimming with opportunities for innovation, efficiency and sustainability in logistics. The evolving role of collaboration between the public and private sectors promises to chart new frontiers, leveraging technology and fostering cooperation to drive economic prosperity.

REFERENCES

Hartman, L., 2003. Public–private partnerships for sustainable logistics infrastructure. Logistics and Transportation Review, pp. 401- 415.

Mentzer, J. T., DeWitt, W. & Keebler, J. S., 2001. Defining Supply Chain Management. Journal of Business Logistics, pp. 1-25.

Nicholson, K., 2019. Public-private partnerships in the United States: Learning from experience,overcoming barriers, and identifying best practices. Transportation Research Record, pp. 313-320.

Sheffi, Y. & Rice, J. B., 2005. A Supply Chain View of the Resilient Enterprise. MIT Sloan Management Review, pp. 41-48.

Zhao, X. & Chan, A. P., 2013. Critical success factors for public-private partnerships in

infrastructure development. International Journal of Project Management, pp. 403-414.

INVESTIGATING HOW GREEN LOGISTICS PRACTICES CAN BENEFIT TO ECONOMY THROUGH SPECIFIC INDUSTRIES IN SRI LANKA, SUCH AS TOURISM, APPAREL MANUFACTURING, OR AGRICULTURE

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Abstract

Sri Lanka's economic prosperity is intricately linked to the success of its tourism, apparel manufacturing, and agricultural sectors. However, conventional logistics practices employed within these industries often come at a significant environmental cost. This research investigates into the potential benefits of implementing green logistics solutions - practices that prioritize environmental sustainability while optimizing resource use – within these specific Sri Lankan industries. Through a detailed analysis, the study explores potential green logistics solutions tailored to each sector. These solutions will be evaluated for their economic and environmental advantages. Ultimately, the research aims to demonstrate that adopting green logistics is not solely an environmentally responsible choice, but also a strategic opportunity for Sri Lankan industries to boost their competitiveness and propel sustainable economic development.
Keywords: *Green Logistics Tourism, Green Apparel Manufacturing, Green Agricultural Sustainability*

1. Introduction

Sri Lanka's economic engine thrives on the dynamism of its tourism, apparel manufacturing, and agricultural sectors. Each industry flourishes on the backbone of efficient logistics networks, seamlessly connecting production with consumption. However, a critical challenge lurks beneath the surface of this success. Conventional logistics practices often rely heavily on fossil fuels, leaving a trail of environmental destruction in their wake. Increased carbon emissions, air and water pollution, and resource reduction paint a concerning picture that necessitates immediate action. This necessitates a standard shift towards Green Logistics – a suite of practices that prioritize minimizing environmental impact while simultaneously optimizing resource utilization across all stages of the supply chain.

Green Logistics is not only about being environmentally friendly, rather it's the strategic insurance for the major Sri Lankan industries to continue running successfully in the future. This research delves into the potential benefits of adopting green logistics practices within three key Sri Lankan industries: leisure, production of apparel, and farming. Through analyzing case of specific green solutions, designed specifically to one

sector, we will see real possibilities how they bring economic and environmental benefits to all sectors. This aforementioned holistic evaluation will highlight the advantages of green logistics not only in ecological dimension, but will also enlighten its aptitude to reinforce competence and to play a supportive role in repairing sustainable economic development in Sri Lanka.

2. Critical Analysis

A. Green Logistics in Tourism: Embracing Sustainability for a Thriving Industry

Sri Lanka's tourism industry thrives on showcasing its captivating landscapes, rich cultural heritage, and the warmth of its people. Yet, the very logistics that support this sector can leave a negative environmental footprint. Conventional practices like reliance on fuel-guzzling transportation for airport transfers and sightseeing tours contribute significantly to carbon emissions. Additionally, waste management in tourist hotspots can be a challenge, leading to environmental degradation. This section delves into these environmental challenges faced by tourism logistics in Sri Lanka.

When examining various eco-friendly solutions like leading eco-tours with nature appreciation and sustainable practices highlighted, the use of electric or hybrid vehicles for transportation of tourists' destinations, and effective waste management programs for implementation. These works not just address the environmental consequences but also enable the development of a connection between the visitor and the unique nature and cultural heritage of Sri Lanka. A striking feature of Sri Lanka's economy is the importance it has attached to the tourism industry, which is home to its scenic landscapes, enchanting customs, and lively hospitality sector.

The case is bending on the traditional tourism logistics which always end up degrading the environment with wealthy resource consumption. This zone provides an in-depth look at environmental problems of tourism logistics and the environmentally friendly measures that are expected to prevent these damages and bring more excellence to the tourists' experiences.

B. Environmental Challenges

1. Fuel-intensive Transportation: Conventional tourism relies heavily on airplanes, buses, and other fossil-fuel-powered vehicles for both international and domestic travel. This contributes significantly to carbon emissions, a major driver of climate change.

2. Waste Generation: Tourist destinations often experience a surge in waste generation, particularly with single-use plastics and food packaging. Inefficient waste management systems can lead to pollution of beaches, waterways, and

natural landscapes.

3. Habitat Fragmentation and Disruption: Building tourist infrastructure like hotels, resorts, and transportation networks can lead to habitat destruction and fragmentation, impacting local wildlife and ecosystems. Additionally, heavy tourist foot traffic in sensitive areas can disrupt ecological balance.

C. Green Solutions: Embracing a Sustainable Future

There are numerous eco-solutions that can be used in tourism logistics, to focus on minimizing the environmental footprint and encouraging sustainability. These measures do not only make the environment but also add to the charm of Sri Lanka as a responsible and eco- conscious tourist attraction.

1. Promoting Ecotourism: Shifting focus towards ecotourism packages that prioritize responsible travel experiences can significantly benefit the environment. Ecotourism promotes nature-based activities, cultural immersion, and conservation efforts. This can involve encouraging tours that minimize environmental impact, utilize local guides and service providers, and support sustainable practices within communities.

2. Electric or Hybrid Vehicles: Embracing electric or hybrid vehicles for transportation within tourist destinations is a crucial step towards reducing carbon footprint. Implementing charging infrastructure in tourist areas can encourage the use of these cleaner transportation options. Additionally, promoting cycling and walking tours can offer tourists a healthy and eco-friendly way to explore their surroundings.

3. Waste Management Programs: Effective waste management programs are essential for mitigating pollution and maintaining the pristine beauty of Sri Lankan tourist destinations. This can involve implementing recycling initiatives, composting programs, and promoting the use of reusable alternatives to single-use plastics. Educating tourists and local businesses on responsible waste disposal practices is also crucial.

4. Sustainable Accommodation: Promoting eco-friendly hotels and resorts that prioritize energy efficiency, water conservation, and responsible waste management can significantly reduce the environmental impact of tourism. Encouraging sustainable practices like using local and organic food sources, minimizing single-use amenities, and supporting local communities can further enhance the environmental and ethical credentials of the tourism industry.

D. Beyond Solutions: Building a Sustainable Tourism Ecosystem

Implementing green logistics practices requires a collaborative effort from various stakeholders. Government policies that incentivize sustainable practices within the tourism industry, investment in infrastructure for electric vehicles and renewable energy sources, and educational programs promoting responsible tourism among tourists and local communities are all crucial elements. By embracing a holistic approach to green logistics in tourism, Sri Lanka can ensure the long-term sustainability of its tourism industry, preserve its natural beauty, and continue to thrive as a leading tourist destination.

E. Economic and Environmental Advantages

1. Attracting eco-tourists: Green logistics practices can attract environmentally conscious tourists, boosting tourism revenue.

2. Enhanced brand image: Sri Lanka can position itself as a sustainable travel destination, improving brand reputation.

3. Reduced environmental impact: Green practices minimize carbon footprint and pollution, contributing to a cleaner environment.

F. Green Logistics in Apparel Manufacturing: Greener Garments, Brighter Bottom Line

Sri Lanka's apparel industry has an important role in the country's development and is now coliding the with a critical turning point. It has build its global fame on this success, but it becomes increasingly hard to remember its history on the backdrop of its damage to environment. What happens within the organization is that conventional logistics practices in the industry heavily uses the fossil fuel which is considered as the red thread effect of environmental problems. Manufacturing facilities challenge themselves with high energy consumption, and impaired transport logistics involving unnecessary fuel consumption. Besides that, this sector produces high volumes of waste from unused materials left during the production and items that can not be recycled such as plastic containers for finished products. Such measures not only aggravate the environmental problem of the island nation but also lead to poor and ineffective management of the apparel supply chain which eventually amounts to lower profitability.

However, a beacon of hope emerges in the form of Green Logistics. This innovative approach prioritizes environmental sustainability while simultaneously optimizing resource utilization across the entire supply chain. By embracing green practices, the Sri Lankan apparel industry can embark on a transformative journey towards a more sustainable and profitable future. Green Logistics offers a multitude of solutions, such as optimizing container utilization to reduce empty container movements, implementing

energy-efficient technologies in manufacturing facilities, and adopting sustainable packaging materials. These solutions not only minimize the industry's environmental footprint but also hold the potential to streamline operations, reduce costs, and enhance brand reputation - a win-win for Sri Lanka's apparel sector and the environment.

G. Environmental Challenges

1. High Energy Consumption: Apparel manufacturing facilities are notorious for their energy demands, from powering machinery to lighting and temperature control. This reliance on fossil fuels contributes to greenhouse gas emissions and air pollution.

2. Inefficient Transportation: Empty or partially full containers moving long distances for import and export lead to wasted fuel and increased carbon footprint. Additionally, relying on traditional transportation methods like diesel-powered trucks further exacerbates the environmental impact.

3. Waste Generation: The apparel industry generates a significant amount of waste throughout the production process. Fabric scraps, leftover materials, and non-biodegradable packaging all contribute to landfill waste and environmental pollution.

H. Green Solutions

1. Optimize Container Utilization: Implementing strategies to maximize container fill rates during import and export can significantly reduce empty container movements. This can be achieved through collaborative efforts between manufacturers, exporters, and logistics providers. Optimizing container utilization directly translates to reduced fuel consumption, lowering transportation costs and carbon footprint.

2. Energy-Efficient Technologies: Investing in energy-efficient machinery and lighting systems within manufacturing facilities can significantly reduce energy consumption. Modern LED lighting solutions boast substantial energy savings compared to traditional incandescent bulbs. Additionally, upgrading machinery to newer, more energy-efficient models can contribute to a sustainable production process.

3. Sustainable Packaging: Replacing conventional non-biodegradable packaging materials with bio degradable or recyclable alternatives like organic cotton pouches or recycled cardboard boxes minimizes waste generation at the consumer end. This shift not only benefits the environment by reducing landfill waste but also fosters a positive brand image for Sri Lankan apparel

manufacturers.

J. Economic and Environmental Advantages

1. Reduced Transportation Costs: Optimizing container utilization directly translates to lower fuel and shipping costs for manufacturers and exporters. This translates into improved profitability and increased competitiveness in the global garment industry.

2. Minimized Waste: Implementing sustainable practices throughout the production process reduces waste generation, leading to lower waste disposal costs and a more streamlined supply chain. Additionally, utilizing fabric scraps for innovative product lines or up cycling initiatives can further minimize waste and potentially generate new revenue streams.

3. Sustainable Brand Positioning: Adopting Green Logistics practices enhances brand reputation by demonstrating a commitment to environmental responsibility. This resonates with eco-conscious consumers, attracting a wider customer base and fostering brand loyalty. In today's competitive landscape, a sustainable brand image is a powerful marketing tool that can differentiate Sri Lankan apparel from competitors.

By embracing Green Logistics solutions, Sri Lanka's apparel industry can not only minimize its environmental impact but also unlock a range of economic benefits. Reduced costs, a more efficient supply chain, and a stronger brand image all contribute to a more sustainable and profitable future for this vital sector.

K. Green Logistics in Sri Lankan Agriculture: A Harvest of Sustainability

Sri Lanka's agricultural sector, a pillar of the economy, faces a looming threat from its own logistics practices. Conventional methods, while efficient in the short term, often rely heavily on fossil fuels for transportation and storage. This translates to increased carbon emissions and energy consumption. Additionally, a lack of proper cold chain infrastructure leads to significant food spoilage, impacting both farmer profits and overall resource utilization. These environmental challenges threaten the long-term sustainability of this vital sector, highlighting the need for a greener approach to agricultural logistics in Sri Lanka.

L. Environmental Challenges of Traditional Agricultural Logistics

1. High Energy Consumption: Traditional methods rely heavily on diesel-powered trucks and refrigerated storage facilities, leading to high energy

consumption and increased carbon emissions. This contributes to climate change, impacting weather patterns and agricultural productivity in a vicious cycle.

2. Food Spoilage: Inefficient cold chain infrastructure, characterized by a lack of proper temperature-controlled storage and transportation facilities, leads to significant food spoilage. Estimates suggest that Sri Lanka loses between 30-40% of its agricultural produce due to spoilage, resulting in substantial economic losses for farmers and reduced availability of fresh produce for consumers.

3. Non-biodegradable Packaging: The extensive use of plastic packaging materials adds to the environmental burden. These materials often end up in landfills or pollute waterways, harming ecosystems and wildlife. Additionally, plastic breakdown can release harmful chemicals into the soil, impacting agricultural productivity in the long run.

M. Green Solutions for Sustainable Agriculture

1. Developing Cold Chain Infrastructure: Investing in and utilizing cold chain infrastructure is crucial to minimize food spoilage. This includes refrigerated storage facilities at farms, collection centers, and distribution hubs. Additionally, temperature-controlled transportation options like refrigerated trucks and insulated containers can significantly reduce post-harvest losses.

2. Sustainable Packaging: Replacing non-biodegradable packaging with eco-friendly alternatives is essential. Biodegradable packaging options like plant-based containers or compostable materials can minimize environmental impact. Additionally, promoting reusable packaging systems for bulk produce transportation can further reduce waste generation.

3. Optimizing Transportation Routes: Utilizing route optimization software and data analysis can help plan efficient logistics networks. This reduces travel distances, minimizes fuel consumption, and ultimately lowers carbon emissions. Additionally, exploring alternative transport options like inland waterways or coastal shipping, where feasible, can further contribute to a greener supply chain.

N. Economic and Environmental Advantages of Green Logistics

1. Minimized Food Spoilage: Implementing a robust cold chain infrastructure directly benefits farmers by reducing food spoilage. This translates to higher profits, improved food security, and a more stable agricultural

economy.

2. Reduced Environmental Impact: Green logistics practices like optimizing transportation routes and using sustainable packaging materials lead to a significant reduction in carbon footprint and waste generation. This contributes to a cleaner environment, healthier ecosystems, and potentially attracts eco-conscious consumers looking for sustainably sourced Sri Lankan produce.

3. Enhanced Product Quality: Efficient transportation and storage minimize damage and maintain freshness of agricultural products. This translates to better quality produce reaching consumers, attracting higher market prices and potentially opening doors to new export opportunities for high-value crops.

O. Moving Forward: A Collaborative Approach

Embracing green logistics practices requires a collaborative effort from various stakeholders. Government policies that incentivize investment in cold chain infrastructure and promote the use of sustainable packaging are crucial. Public-private partnerships can facilitate knowledge sharing and technology transfer to support farmers in adopting green logistics practices. Additionally, consumer education plays a vital role in driving demand for sustainably sourced agricultural products.

By embracing green logistics, Sri Lanka's agricultural sector can navigate the environmental challenges of the 21st century and secure a prosperous future. This shift not only benefits the environment but also empowers farmers, enhances product quality, and unlocks new market opportunities, ensuring a truly sustainable agricultural landscape.

3. Conclusion

The analysis presented a compelling case for the adoption of green logistics practices in Sri Lanka's key industries of tourism, apparel manufacturing, and agriculture. It has become abundantly clear that green logistics offers a win-win situation, simultaneously promoting environmental sustainability and enhancing economic competitiveness.

By embracing eco-friendly solutions like ecotourism packages, electric vehicles in tourist destinations, and waste management programs, the tourism industry can attract a growing segment of environmentally conscious travelers. This shift not only reduces the industry's environmental footprint but also strengthens Sri Lanka's brand image as a responsible tourist destination, potentially leading to increased revenue streams.

Similarly, the apparel manufacturing sector can leverage green logistics to optimize container utilization, minimize energy consumption in production facilities, and adopt sustainable packaging materials. These practices not only reduce costs and waste generation but also resonate with global trends towards eco-conscious fashion. By embracing green practices, Sri Lankan apparel manufacturers can enhance their brand reputation, attracting environmentally conscious consumers and potentially securing higher market prices.

The agricultural sector stands to benefit significantly from green logistics advancements. Implementing a robust cold chain infrastructure for perishable goods will minimize food spoilage, leading to increased profits for farmers and a reduction in food waste. Additionally, adopting sustainable packaging materials further contributes to environmental responsibility. Furthermore, optimizing transportation routes can minimize fuel consumption and delivery times, ensuring fresh, high-quality produce reaches consumers faster, potentially commanding premium prices.

The benefits extend beyond individual industries. The widespread adoption of green logistics practices across Sri Lanka's core economic sectors fosters a culture of environmental responsibility and positions the nation as a leader in sustainable economic development. This attracts environmentally conscious investors and tourists, fostering a virtuous cycle that fuels long-term economic prosperity.

However, transitioning to green logistics necessitates overcoming challenges. Investing in new technologies, infrastructure development, and capacity building for green practices requires careful planning and financial resources. Collaboration between government, industry stakeholders, and environmental organizations is crucial to develop and implement effective policies and incentives that encourage the adoption of green logistics solutions.

In conclusion, green logistics represents a strategic shift for Sri Lanka's key industries. By embracing these practices, Sri Lanka can ensure a thriving economy built upon a foundation of environmental sustainability. This paves the way for a future where economic growth and environmental responsibility co-exist, securing the well-being of Sri Lanka for generations to come.

REFERENCES

Bandara, W. M. S. T. Green supply chain management practices in sustainable development on hospitality industry in Sri Lanka. Diss. 2018.

Bandara, W. M. S. T. (2018). Green supply chain management practices in sustainable development on hospitality industry in Sri Lanka (Doctoral dissertation).

Bandara, W. M. S. T. “Green supply chain management practices in sustainable development on hospitality industry in Sri Lanka.” PhD diss., 2018.

Sudusinghe, Jayani Ishara. Effect of economic and social aspects in sustainable supply chain management in apparel industry. Diss. 2018.

Majumdar, Abhijit, et al. “Analysing the vulnerability of green clothing supply chains in South and Southeast Asia using fuzzy analytic hierarchy process.” International Journal of Production Research 59.3 (2021): 752-771.

Hemachandra, D. W. K. “Incentives for Adoption of Environmental Management Practices among Textile and Apparel Manufactures in Sri Lanka.” (2016).

Goger, Annelies. “The making of a ‘business case’for environmental upgrading: Sri Lanka’s eco-factories.” Geoforum 47 (2013): 73-83.

Nethsarani, K. A. T., and D. N. Samudrage. “Factors Affecting the Implementation of Environmental Management Accounting Practices through New Institutional Sociology Perspective: A case of an Apparel Manufacturer in Sri Lanka.” (2021).

Rajapakse, R. M. D. A. P., S. M. F. Azam, and A. Khatibi. “Towards green credentials of SMEs: Qualitative insights on barriers to green responsiveness from a developing economy.” International Journal of Applied Economics, Finance and Accounting 15.1 (2022): 15-24.

TECHNOLOGICAL INNOVATIONS AND DIGITALIZATION IN PUBLIC-PRIVATE LOGISTICS PARTNERSHIPS

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Abstract

Technological innovations and digitalization are transforming the landscape of logistics, offering exceptional opportunities for collaboration between the public and private sectors. This article explores the role of advanced technologies such as blockchain, Internet of Things (IoT), and data analytics in facilitating partnerships between government agencies and private companies in the logistics domain. By leveraging these technologies, public-private logistics partnerships can enhance efficiency, transparency, and resilience in supply chain operations. Through real time tracking, monitoring, and maximize of transportation paths and inventory management, stakeholders can streamline processes, reduce costs, and minimize environmental impact. Furthermore, digital platforms and data-sharing mechanisms enable seamless communication and coordination between diverse stakeholders, fostering greater trust and collaboration. This article examines case studies and best practices from around the world, showcasing how technological innovations are being harnessed to address key challenges and unlock new opportunities in logistics. By embracing digitalization, public and private entities can unlock synergies, drive innovation, and pave the way for sustainable economic growth in the logistics sector.

Keywords: *Technological innovations, Digitalization, Digital platforms, Sustainable economic growth, Public-Private Logistics Partnerships*

1. Introduction

In todays interrelated and rapidly evolving world, high-tech improvements and digitalization have become indispensable tools driving innovation across various industries. One sector that has particularly witnessed a transformative shift is logistics, where the convergence of cutting-edge technologies and digital solutions is reshaping traditional examples. Amidst this backdrop, the emergence of public-private partnerships (PPPs) in logistics is gaining traction, heralding a new era of collaboration between government agencies and private enterprises. This article delves into the realm of technological innovations and digitalization within public-private logistics partnerships, exploring their multifaceted implications, opportunities, and challenges.

The landscape of logistics has historically been characterized by intricate supply

chains, involving multiple stakeholders, extensive networks, and complex operations (Christopher, 2016). Traditionally, logistics processes have been prone to inefficiencies, opacity, and fragmentation, posing significant challenges for both public authorities and private companies. However, the advent of innovative technologies such as blockchain, Internet of Things (IoT), and data analytics is revolutionizing this landscape, offering unprecedented capabilities to enhance collaboration and streamline operations.

At the heart of this transformation lie public-private partnerships, which represent a strategic alliance between governmental entities and private sector organizations. These partnerships leverage complementary strengths and resources from both sectors to address common objectives, ranging from improving service delivery to fostering economic growth. In the context of logistics, PPPs are increasingly recognized as a vital mechanism for driving innovation, optimizing infrastructure, and enhancing the whole efficiency of supply chain ecosystems.

Central to the effectiveness of public-private logistics partnerships is the utilization of advanced technologies as enablers of collaboration and value creation. Blockchain, for instance, offers immutable and crystal clear record-keeping competences, which can improve faith and accountability across supply chain participants (Ivanov & Dolgui, 2020). Through blockchain-enabled platforms, stakeholders can securely exchange information, track goods in real-time, and streamline documentation processes, thereby reducing administrative burdens and mitigating the risk of fraud or counterfeiting.

2. Public-Private Logistics Partnerships: A Conceptual Overview

A. Definition and Scope:

Public-private partnerships (PPPs) in logistics refer to collaborative arrangements between government agencies or public sector organizations and private companies involved in the management and operation of logistics infrastructure and services (Liu & Tsai, 2019). These partnerships can take numerous forms, including joint ventures, concession agreements, and outsourcing arrangements, depending on the specific context and objectives.

The scope of logistics partnerships incorporates a varied range of activities, together with transportation, warehousing, inventory management, and dissemination. By leveraging the complementary strengths of public and private entities, these partnerships aim to improve the efficiency, reliability, and sustainability of logistics operations (Tan & Goh, 2017).

B. Importance of Collaboration:

Partnership between public and private sectors is essential for addressing the complex challenges faced by modern supply chains. Public sector agencies often possess valuable resources such as infrastructure, regulatory authority, and funding, while private companies bring expertise in logistics management, technology innovation, and market-driven efficiency (Lam et al., 2016).

By working together, public and private entities can pool their resources and capabilities to achieve common goals such as improving transportation infrastructure, reducing congestion, enhancing environmental sustainability, and promoting economic development (PWC, 2018). Moreover, collaboration enables better coordination and alignment of policies, regulations, and investment priorities, leading to more effective and integrated logistics systems (Gritsenko et al., 2020).

3. Technological Innovations In Logistics

Technological innovations play a vital role in allowing and enhancing collaboration between public and private entities in logistics partnerships. The following sections discuss key technologies that have transformed the logistics industry and facilitated closer cooperation between stakeholders.

C. Internet of Things (IoT):

The Internet of Things (IoT) denotes to the link of interrelated devices, sensors, and systems that gather and interchange data over the internet (Zhang et al., 2018). In the context of logistics, IoT technologies enable real-time monitoring and tracking of goods, vehicles, and infrastructure, allowing stakeholders to gain visibility and control over supply chain operations (DHL, 2017).

For example, IoT-enabled sensors installed in trucks, containers, and warehouses can provide information on place, temperature, humidity, and other environmental conditions, helping to optimize routing, minimize spoilage, and ensure compliance with regulatory requirements (Davenport, 2017). By leveraging IoT data, public and private partners can make further knowledgeable decisions, improve resource allocation, and enhance overall supply chain performance (Zhang et al., 2020).

D. Blockchain Technology:

Blockchain technology deals a spread out and safeguards way to record and confirm transactions through a distributed network of computers (Tapscott & Tapscott, 2016). In logistics, blockchain has the potential to transform supply chain management by providing clearness, traceability, and immutability of data (Ivanov et al., 2019).

One of the greatest promising applications of blockchain in logistics is in the tracking and authentication of things as they move from side to side the supply chain (Swan, 2015).

4. Integration of Technology In Public-Private Partnerships

E. Enhanced Visibility and Transparency:

Technological innovations such as IoT and blockchain enhance visibility and transparency in logistics partnerships by given that real-time admission to critical data and information. Public and private stakeholders can track the movement of goods, screen inventory levels, and classify possible bottlenecks or disturbances in supply chain processes (Ivanov et al., 2020).

For example, in the case of a port authority partnering with a private terminal operator, IoT sensors installed in container handling equipment can capture data on container movements, crane productivity, and berth utilization, allowing both parties to optimize port operations and improve vessel turnaround times (Zhang et al., 2019).

Similarly, blockchain technology enables secure and tamper-proof recording of dealings and events through the supply chain, ensuring faith and answerability among stakeholders (Tapscott & Tapscott, 2016). By implementing blockchain-based systems for tracking and tracing goods, public and private partners can mitigate the risk of racket, counterfeiting, and unconstitutional tampering, thereby improving the honesty and reliability of the supply chain (Ivanov et al., 2019).

F. Improved Efficiency and Productivity:

Technological innovations contribute to improved efficiency and productivity in logistics partnerships by automating routine tasks, streamlining processes, and optimizing resource allocation. For example, AI-powered prognostic analytics can scrutinize past data on shipping patterns, customer demand, and inventory levels to forecast future demand and optimize routing and scheduling of transportation assets (Hassani & Mahdavi, 2018).

Similarly, robotics and automation technologies can increase the speed and accuracy of warehouse operations, reducing labor costs and cycle times (Sheffi, 2018). Public and private partners can collaborate to deploy robotic systems for palletizing, picking, and packing of goods, thereby improving warehouse throughput and order fulfillment rates (PwC, 2019).

5. Case Studies: Successful Implementation of Technological Innovations

G. Maersk and IBM: Blockchain in Container Shipping:

One notable example of fruitful application of blockchain knowhow in logistics partnerships is the partnership between Maersk, the world's largest container shipping company, and IBM, a prominent technology provider (IBM, 2018). In 2018, the two companies announced the launch of TradeLens, a blockchain-based platform designed to digitize and streamline global trade processes.

TradeLens influences blockchain technology to make a shared ledger of transactions and events across the supply chain, allowing participants to access real time information on the position and location of containers, shipments, and documentation (Maersk, 2019). By given that a single basis of truth for supply chain data, TradeLens improves visibility, transparency, and collaboration among stakeholders, reducing delays, disputes, and errors in the shipping process.

Since its launch, TradeLens has attracted a growing number of participants, together with shipping lines, port operators, customs experts, and freight forwarders, demonstrating the possible for blockchain to transform the logistics industry (IBM, 2020). By collaborating with IBM to develop and deploy TradeLens, Maersk has positioned itself as a leader in digital transformation and innovation in container shipping, setting new standards for efficiency and reliability in global trade.

H. UPS: IoT and Predictive Analytics:

United Parcel Service (UPS), one of the domain's largest package distribution companies, has embraced IoT and predictive analytics to optimize its logistics operations and enhance customer service (UPS, 2020).

6. Challenges and Barriers

J. Data Security and Privacy Concerns:

Despite the potential welfares of technological innovations in logistics partnerships, concerns about data safety and confidentiality remain a significant barrier to embracing. Public and private stakeholders are often reluctant to share sensitive information such as shipment details, customer preferences, and pricing data due to fears of data breaches, cyberattacks, and regulatory non-compliance (Ivanov et al., 2020).

Moreover, the dispersed nature of blockchain technology increases questions about data ownership, access control, and liability in the event of disputes or errors (Tapscott & Tapscott, 2016). Public sector agencies may be hesitant to adopt blockchain

solutions without clear guidelines and regulations governing data governance and cybersecurity (Zhang et al., 2019).

To address these concerns, public and private partners must collaborate to develop robust cybersecurity protocols, data encryption standards, and access control mechanisms to safeguard sensitive information and mitigate the risk of unauthorized access or misuse (Ivanov et al., 2019). Additionally, regulatory authorities should establish clear guidelines and best practices for data protection and privacy in logistics partnerships, providing legal certainty and confidence to stakeholders (Gritsenko et al., 2020).

7. Infrastructure and Interoperability Issues

Another challenge facing the integration of technology in logistics partnerships is the lack of interoperability and compatibility between different systems and platforms. Public and private stakeholders often use

K .Opportunities and Future Trends:

1. Autonomous Vehicles and Drones: Autonomous vehicles and drones represent a significant opportunity for enhancing collaboration between public and private entities in logistics partnerships. These technologies have the potential to revolutionize last-mile delivery, reducing costs, improving efficiency, and minimizing environmental impact (Lee et al., 2017).

Public sector agencies can collaborate with private companies to pilot and deploy autonomous delivery vehicles in urban areas, leveraging advanced navigation systems, sensors, and artificial intelligence algorithms to safely and efficiently transport goods to their final destinations (Deloitte, 2019). By integrating autonomous vehicles into existing logistics networks, public and private partners can reduce congestion, emissions, and accidents, while enhancing the overall quality of urban life (Chen et al., 2020).

Similarly, drones offer a cost-effective and flexible solution for delivering small parcels and packages to remote or inaccessible locations (Hernandez et al., 2019). Public and private stakeholders can collaborate to develop drone delivery infrastructure, regulatory frameworks, and safety standards, enabling the widespread adoption of drone technology for logistics applications (KPMG, 2018).

2. Robotics and Automation: Robotics and automation technologies present opportunities for improving efficiency and productivity in logistics

partnerships. Public sector agencies can work with private companies to deploy robotic systems for warehouse automation, order picking, and material handling, reducing labor costs and cycle times (Sheffi, 2018).

For example, Amazon, the domain's largest online shop, has capitalized deeply in robotics and automation to streamline its fulfillment operations (Amazon, 2020). By collaborating with technology partners and logistics providers, Amazon has developed advanced robotic systems such as Amazon Robotics' Automated Storage and Retrieval System (ASRS), which uses autonomous robots to retrieve and transport items within fulfillment centers (Pisano & Shih, 2019).

Public sector support for robotics and automation initiatives can help accelerate the adoption of these technologies in logistics partnerships, creating new opportunities for economic growth and job creation (PwC, 2019). By investing in training programs, R&D grants, and regulatory incentives, governments can encourage private sector investment in robotics and automation, driving innovation and competitiveness in the logistics industry (Deloitte, 2020).

3. **Predictive Maintenance:** Predictive maintenance is another area where public and private entities can collaborate to improve the reliability and efficiency of logistics operations. By leveraging IoT sensors and predictive analytics, stakeholders can monitor the condition and performance

8. Recommendations For Successful Implementation

L. Stakeholder Engagement and Collaboration:

Active stakeholder engagement and partnership are serious for the successful implementation of technological innovations in logistics partnerships. Public and private entities should proactively involve key stakeholders such as government agencies, industry associations, technology providers, and community groups in the planning, design, and implementation of technology-enabled initiatives (Lee et al., 2019).

By fostering open communication, trust, and cooperation among stakeholders, public and private partners can build consensus, align interests, and overcome resistance to change (Chen et al., 2021). Even meetings, workshops, and forums can offer chances for stakeholders to share information, exchange ideas, and address concerns, facilitating the co-creation of innovative solutions that meet the needs of all parties involved (Ivanov et al., 2021).

M. Investment in Talent and Skills Development

Investment in talent and skills development is essential for building the capabilities and capacity needed to harness the full possible of technological innovations in logistics partnerships. Public sector agencies should collaborate with educational institutions, training providers, and industry partners to develop tailored programs and courses that equip workers with the understanding, skills, and capabilities required to thrive in a digital economy (PwC, 2021).

By offering training and certification programs in zones such as data analytics, virtual security, and robotics, governments can help talk the skills hole and confirm that labors are ready for the jobs of the future (Deloitte, 2021). Public-private partnerships can play a crucial role in funding and delivering training initiatives, leveraging the expertise and resources of both sectors to maximize impact and reach (KPMG, 2020).
N. Regulatory Alignment and Standardization.

Regulatory alignment and standardization are essential for creating an enabling environment for the adoption and deployment of technological innovations in logistics partnerships. Public sector agencies should work with industry stakeholders to develop clear and consistent regulations, standards, and guidelines that govern the use of emerging technologies such as IoT, blockchain, and autonomous vehicles (Lee et al., 2020).

9. Conclusion

In conclusion, technological innovations and digitization have the potential to transform public-private logistics partnerships, enabling closer collaboration, enhanced visibility, and improved efficiency in supply chain operations. From IoT and blockchain to AI and robotics, a wide range of technologies offer opportunities for public and private entities to work together to address the complex challenges facing modern supply chains. However, realizing the full benefits of these technologies requires proactive engagement, investment, and collaboration among stakeholders. Public sector agencies must create an enabling environment for innovation by providing regulatory certainty, funding support, and infrastructure investment. Private companies, on the other hand, need to demonstrate leadership, vision, and commitment to driving digital transformation and embracing new ways of working.

By working together, public and private entities can unlock novel chances for growth, effectiveness, and sustainability in the logistics industry. By leveraging the power of technology, they can shape more strong, responsive, and efficient supply chains that meet the needs of businesses, consumers, and society as a whole.

REFERENCES

Amazon. (2020). Amazon Robotics. Retrieved from https://www.aboutamazon.com/innovation/robotics

Chen, H., Wang, H., & Zhang, J. (2020). Optimizing Urban Logistics with Autonomous Vehicles. Transportation Research Procedia, 45, 1041-1048.

Chen, J., Dong, S., & Zeng, Q. (2021). Smart city and e-commerce: Opportunities and challenges in China. Sustainable Cities and Society, 66, 102684.

Deloitte. (2019). Drones take off: Public and private collaboration in logistics. Retrieved from https://www2.deloitte.com/us/en/insights/industry/public-sector/public-private-logistics-drones.html

Deloitte. (2020). The future is digital: Enabling the next generation of supply chain talent. Retrieved from https://www2.deloitte.com/us/en/insights/industry/retail-distribution/digital-talent-supply-chain.html

Deloitte. (2021). Industry 4.0 and the workforce of the future: The future of work in manufacturing and production. Retrieved from https://www2.deloitte.com/us/en/insights/industry/manufacturing/future-of-work-in-manufacturing-production.html

DHL. (2017). The Internet of Things in Logistics. Retrieved from https://www.logistics.dhl/content/dam/dhl/global/core/documents/pdf/glo-core-internet-of-things.pdf

Gritsenko, D., Ivanov, D., & Pavlov, A. (2020). Adoption of blockchain technology in supply chains: An empirical investigation of key drivers and barriers. International Journal of Production Economics, 228, 107671.

Hassani, A., & Mahdavi, I. (2018). Predictive analytics in supply chain: The latest trends and the significant impact on the performance of supply chain. Journal of Industrial Engineering International, 14(3), 495-510.

Chopra, S., & Meindl, P. (2020). Supply chain management: Strategy, planning, and operation. Pearson.

Christopher, M. (2016). Logistics & supply chain management. Pearson UK.

Fernie, J., & Sparks, L. (2014). Logistics and retail management: Emerging issues and new challenges in the retail supply chain. Kogan Page Publishers.

Gattorna, J. (2006). Living supply chains: How to mobilize the enterprise around delivering what your customers want. Pearson Education.

Kummer, S., et al. (1999). Containerization: From global origins to the European experience. Transportation Journal, 38(3), 5–21.

Lee, H. L., & Whang, S. (2001). Winning the last mile of e-commerce. MIT Sloan Management Review, 42(4), 54–62.

Levina, N., & Ross, J. W. (2003). From the vendor's perspective: Exploring the value proposition in information technology outsourcing. MIS Quarterly, 27(3), 331–364.

Lummus, R. R., et al. (2001). A Delphi study of supply chain logistics: Fostering collaboration. Supply Chain Management: An International Journal, 6(2), 71–82.

Perez, C. (2018). Technological revolutions and techno-economic paradigms. Cambridge Journal of Economics, 42(1), 247–259

ECONOMIC REVIVAL IN SRI LANKA: OPTIMISM AND PROGRESS

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Abstract

This paper studies Sri Lanka's economic revival in the face of substantial hurdles for instance bankruptcy and negative growth rates. Sri Lanka, headed by President Ranil Wickremesinghe, has implemented tight IMF-compliant reforms to stabilize the economy and fix investor confidence. The private sector has come out as an important participant in this process, helping to drive economic growth and constancy through joint efforts by the government.

Infrastructure development, market diversification, and a concentration on areas such as tourism, IT-BPM (Business Process Management), and renewable energy have been vital to Sri Lanka's economic recovery. Positive indicators such as GDP growth rates, credit rating improvements, and infrastructure projects evidence the country's strength and success.

This report also makes thoughts for policymakers, stakeholders, and investors to encourage Sri Lanka's economic growth, such as prioritizing sustainable development, investing in infrastructure, advocating innovation, and pulling international investment. Opportunities for further inquiry and exploration are identified, ranging from the results of diversification for the evaluation of policy efficaciousness and the role of the private sector in repelling economic recovery.

Keywords: *Economic Growth, GDP Growth Rate, Resilience, Logistics*

1. Introduction

World Bank. (2008). Logistics is the backbone of the economic build-up of any country in the world, assuring the smooth flow of goods, services, and information along the supply chain. Logistics is concerned with assuring the effective flow of items from the point of origin to the point of consumption through manufacturers, distributors, and consumers.

Sri Lanka Board of Investment. (n.d.). Sri Lanka is a chock point for international shipping lines to benefit from an altering global marketplace, and it underlines business-

well-disposed strategies to create a successful economy. The country is settled on key East-West shipping channels that connect Europe and the Far East, and it has easy access to wealthy Middle Eastern and African markets. Bandara, J. S. K. (2015), The Indo-Sri Lanka Free Trade Agreement is likely to become increasingly necessary in influencing Sri Lanka's economic future.

Central Bank of Sri Lanka. (2023). Sri Lanka's economy has been confronting various challenges in its 73-year history, including unsustainable debt, a serious balance-of-payments crisis, and a volatile political scenario. The country is going through the worst economic crisis in decades, which is a deceleration of growth and increasing poverty. As a result of that Sri Lanka, which lately endured a catastrophic economic crisis and announced bankruptcy, is now exhibiting signs of a firm recovery. With multiple economic indicators leading to growth and resilience, the country is on track to achieve stability and success.

Wickramamasinghe R. (2023 Despite approaching bankruptcy in 2022, Sri Lanka has manifested endurance and strategic sight in its economic recovery efforts. The administration, headed by President Ranil Wickremesinghe, has indicated for required reforms by IMF standards to guide the country toward financial stability. Federation of Chambers of Commerce and Industry of Sri Lanka. (2023). The private sector has also played an important part in Sri Lanka's economic regeneration, collaborating with the government and leading to the nation's upward trajectory.

Ministry of Megapolis and Western Development, Sri Lanka. (2022). Infrastructure development is a crucial part of Sri Lanka's economic growth strategy, with a concentration on expanding transportation networks, ports, airports, and roads to enhance connectivity and promote trade. Projects such as the Colombo Port City proposal search to transform Colombo into a global financial and collective hub, pulling foreign direct investment and promoting the country's status as a regional economic powerhouse.

Central Bank of Sri Lanka. (2023). The positive GDP growth rate described in the third quarter of 2023, as well as S&P Global Ratings' upgrade of Sri Lanka's domestic currency rating, demonstrates enhanced faith in the country's financial consultancy and reform actions. Sri Lanka is set for growth and sustainability by elaborating its markets and engaging potential in sectors such as tourism, IT-BPM, export-oriented businesses, renewable energy, and infrastructure development.

Wickremesinghe, R. (2023). The private sector has come out as an essential driver of Sri Lanka's economic rehabilitation, with businesses actively adding to the country's growth trajectory through shared goals and favourable business terms. Infrastructure development is vital to pushing economic progress, with projects directed at enhancing

transportation networks and developing Colombo into a universal financial and business hub.

In the meantime, market indicators, such as a positive GDP growth rate and an upgrade from S&P Global Ratings, show increased assurance in Sri Lanka's financial stability and reform attempts. Sri Lanka is well-positioned for development and sustainability by flourishing its markets and focusing on sectors for instance tourism, IT-BPM, export-oriented businesses, renewable energy, and infrastructure development.

World Banka Annual Report (2023. Sri Lanka's track to economic retrieval emphasizes collaboration between the public and private sectors, infrastructure development, and diversification programs that have formed the country's revival into a firm economy. At the same time, the World Bank repositions resources to encounter urgent needs while collaborating with others to propose critical policies for restoring economic stability and defending broad-based growth. The IMF provides initial financial assistance in the form of a USD 1 billion credit line, which is financial aid in crisis management. GDP contractions of 3.0% in 2023 and 1.3% in 2024, collectively inflation rates of 18.7% and 5.5% for the respective years, force the Central Bank of Sri Lanka to implement proactive monetary policies that align with IMF objectives of holding inflation in single digits. Flexible exchange rates and increased overseas remittances tone up economic resilience.

2. The Journeying to a Better Economy

Central Bank of Sri Lanka Annual Report (2023). Sri Lanka's economic boost has been a hard and uninterrupted process. The nation has had to continue with many troubles, letting in natural calamities, political agitation, and grievous foreign debt. To accelerate economic growth, Sri Lanka has, at the same time, worked in recent years to lay economic reforms in place, draw in foreign capital, and promote exports and tourism. Various substantial steps have been accomplished to enhance Sri Lanka's economy, letting in,

a. Investing Monetary and Fiscal Policies into Exercise

Attempts have been created to apply monetary and fiscal measurements to bring down inflation and steady the economy. The Central Bank of Sri Lanka is in a position, which ensure the amount and cost of money in the economy to accomplish price stability, a macroeconomic goal.

b. Encouraging the Development of Infrastructure

Prioritizing infrastructure development will aid the nation become more connected and attract international investment. The destinations of initiatives like the Transport Connectivity and Asset Management Project and the Inclusive

Connectivity and Development Project are to better road asset management nationaland ly, also accept safe, effective, and climate-resilient connectivity.

c. Raising Economic Diversification

The promotion of industries admitting tourism, information technology, and manufacturing a is a component of the effort to extend the economy. These programs aspire to encourage rural economies and generate novel job possibilities.

d. Raising Transparentness and Administration

To improve the business environment and pull in foreign investors, steps have been taken to tone up administration and transparency. To foster an environment that is contributing to investment, and economic expansion, these initiatives are necessary. It is remarkable that while these measures are important to the uninterrupted efforts to enhance Sri Lanka's economy, the nation has come across noteworthy economic blockages, such as a financial crisis mentioned by skyrocketing costs, scarceness of necessities, and lifted inflation. Financial support has been sought by the International Monetary Fund (IMF) to help address the economic crisis.

3. Overtaking Bankruptcy

Central Bank of Sri Lanka. (2023). Since announcing bankruptcy, Sri Lanka has experienced enormous economic difficulties, necessitating significant reforms and interconnected attempts to propel the country's economic recovery. Here is a detailed test of Sri Lanka's economic results and the method taken to recover.

a. Economic Challenges

Declining Growth: before announcing bankruptcy, Sri Lanka testified negative growth rates of up to -8%. High Debt Levels. The country was heavily in debt: Which caused financial instability and the need for external assistance. Sri Lanka's currency has devaluated: Impacting commerce and foreign exchange reserves. Fiscal Deficit: Long-run fiscal shortfalls stretched the government's finances and hampered its power to invest in key areas.

b. Shiftig Drives

President Ranil Wickremesinghe set up a comprehensive reform attempt by IMF principles, tightening funding through a bailout package. The private

sector's active engagement was vital in promoting economic re-formation, emphasizing collaboration goals. Sri Lanka has prioritized infrastructure development, notably in transportation, and projects for instance the Colombo Port City project to pull in investment and induce growth. Diversification initiatives projecting going beyond traditional sectors toward technology, innovation, and sustainability were sought to grow competitiveness. Recent economic indications, especially considerable GDP growth in the third quarter of 2023, recovery point.

4. The Impact of Reforms

Stringent reform measures and organized efforts between the government and the business sector have assisted in stabilizing the economy and boosting trust in Sri Lanka's financial stability. Positive economic statistics and growth rates present the effectiveness of turnaround strategies enforced since the proclamation of bankruptcy.

The analysis of GDP growth rates and other pertinent economic indicators sheds light on Sri Lanka's economic performance and progress toward recovery from bankruptcy. Here are some significant economic indicators,

a. GDP Growth Rate

Pre-Bankruptcy: Sri Lanka endured a substantial economic decline with a negative growth rate that reached as low as -8% before declaring bankruptcy. Post-bankruptcy: In the third quarter of 2023, Sri Lanka's GDP increased by 1.6% year on year, marking a significant milestone in its recovery. Positive Momentum: The positive GDP growth rate implies a shift toward economic recovery and stability, demonstrating tenacity and success in overcoming the problems faced after bankruptcy.

b. Currency Rating Upgrade

S&P Global Ratings raised Sri Lanka's local currency rating from selected default to CCC+/C, indicating increased confidence in the country's financial stability and the success of its reform programs. The improvement indicates an optimistic prognosis for Sri Lanka's solvency and economic prospects, highlighting the effects of post-bankruptcy rehabilitation initiatives.

c. Private Sector Impact

The private sector's strong participation in Sri Lanka's economic regeneration has been a crucial engine of growth and stability, helping to achieve favourable macroeconomic policy reforms and long-term growth results. Collaboration

between the government and the business sector has been critical in mobilizing resources and expertise to help the country's economic recovery efforts.

d. Overall Economic Resilience

Despite the obstacles posed by the COVID-19 pandemic, Sri Lanka's economy has demonstrated resilience and the possibility for additional expansion, as seen by rising GDP growth rates and favourable market indicators. The evaluation of GDP growth rates and other economic indicators indicates the country's commitment to reform, diversification, and infrastructure development to boost economic growth and create a resilient and dynamic economy.

5. Political and Economic Reforms in The Economy

Wickremesinghe, R. (2023). President Ranil Wickremesinghe has been a vocal assistant in necessary reforms to resuscitate Sri Lanka's economy, especially following the country's proclamation of bankruptcy. His government has prioritized fundamental reforms to improve governance, increase transparency, and promote long-term economic growth. President Wickremesinghe's reform schedule is consistent with the International Monetary Fund's (IMF) road map, and his commitment to enforcing reforms has been critical in dealing with structural weaknesses, improving fiscal management, and restoring investor assurance in the country's economy.

His strategy involves interacting with lots of stakeholders to drive consensus on reform measures and ensure their effective execution. President Wickremesinghe's economic imagination for Sri Lanka centers on long-term growth, innovation, and diversification to make a resilient and dynamic economy. To sum up, President Wickremesinghe's reform advocacy has played an important role in driving structural changes, affirming economic recovery, and adjusting the foundation for Sri Lanka's long-term growth and stability.

The alignment of reform initiatives with International Monetary Fund (IMF) standards, as well as the determinants of IMF funding, have been vital components of Sri Lanka's economic recovery. Sri Lanka's reform efforts, led by President Ranil Wickremesinghe, have closely followed the IMF's principles and recommendations, stressing structural reforms proposed to improve governance, strengthen fiscal management, and resolve structural weaknesses in the economy.

These reforms directly improve openness, accountability, and efficiency in the public sector while also encouraging private sector development and investment. The IMF has had a substantial impact in Sri Lanka, offering financial assistance, technical expertise, and policy proposals to help address macroeconomic instabilities and structural challenges, bolstering investor assurance, stabilizing the currency, and establishing a

framework for long-term economic growth.

By adhering to IMF guidelines and obtaining IMF financial assistance, Sri Lanka has demonstrated a commitment to enforcing consistent and credible economic policies through international best rehearses, facilitating entrée to external financing, and indicating to investors and markets the distressfulness of its reform agenda. Finally, the engagement with the IMF has been vital in directing Sri Lanka's economic recovery attempts, fostering policy coherency, and increasing the credibility of the country's reform design, opening the way for long-term economic achievement.

6. Private sector's involvement

Ministry of Finance - Sri Lanka, (n.d.). The private sector has made significant contributions to Sri Lanka's economic restoration attempts, actively engaging in projects that promote growth, produce job opportunities, and foster innovation. Businesses in Sri Lanka have added to the country's growth trajectory by investing in critical areas, enhancing productivity, and promoting entrepreneurship and innovation. The private sector's involvement has helped to diversify the economy, increase competitiveness, and look for new market opportunities to ride economic growth.

The government's stress on providing a favorable business mood and fostering private-sector employment has assisted the private sector in contributing to economic recovery. Policy measures proposing to lower regulatory burdens, improve ease of doing business, and boost investor confidence have advocated private sector participation and investment. The private sector's contributions have resulted in tangible benefits, such as job creation, revenue production, technological adoption, and market expansion.

Collaborative efforts by the business sector, government, and other stakeholders have laid the groundwork for long-term economic development. In summary, the private sector has made a significant contribution to Sri Lanka's economic rejuvenation, with firms driving development, innovation, and job creation while also supporting the country's economic recovery efforts.

Central Bank of Sri Lanka. (2023). Macroeconomic policy reforms in Sri Lanka have been critical to tackling economic issues, promoting stability, and supporting long-term success. Sri Lanka has taken over fiscal policy measures aimed at enhancing income production, fixing government spending, and successfully managing public debt, which has served to maintain overall economic stability.

The Central Bank of Sri Lanka has also implemented monetary policy reforms to preserve price stability, control inflation, and encourage economic growth, resulting in favorable monetary surroundings for investment and economic activity. Furthermore, key improvements in governance, public sector efficiency, and business principles have improved competitiveness and pulled investment, leading to increased economic vitality

and growth.

According to a study by Smith et al. (2020), trade and investment reforms have enhanced export markets, enrolled foreign capital, and connected the country to global value chains, all of which have aided in boosting economic resilience and growth. Reforms in the labor market, banking sector, and other areas experience also had a positive impact, including job creation, improved workforce skills, and increased financial stability. These alterations have placed the groundwork for long-term economic growth and prosperity, fitting out the country for further advancement and development, Jones and Brown (2019).

7. Markets Set To Drive Sri Lanka's Economic Expansion

Sri Lanka is strategically exploring young markets to support economic growth and revitalization. This is an outline of fundamental markets that are probably to play a large influence in Sri Lanka's economic growth.

According to a paper by Tourism Sri Lanka (2023), Sri Lanka's tourism and hospitality business has long been a major subscriber to the economy, absorbing visitors with its natural beauty, historical landmarks, and cultural heritage. Campaigns to promote Sri Lanka as a secure tourist destination and improve visitor feel are projected to increase tourism income, create jobs, and promote economic growth. Sri Lanka aims to position itself as a regional hub for IT and BPM services, tapping its competent workforce and friendly business environment. Initiatives that promote digital transformation, entrepreneurship, and innovation in this area aspire to grow the industry, capture foreign investment, and generate high-value jobs. Sri Lanka is diversifying its export supplies and flourishing into new areas to increase export potential and produce foreign money.

According to a study by the Ministry of Energy and Environment (2023), the country is putting in renewable energy projects, for instance solar, wind, and hydroelectric power, to reduce reliance on fossil fuels, lower energy costs, and lessen the consequences of climate change. Research to the Infrastructure Development Institute (IDI) (2022), Infrastructure development, admitting transportation networks, ports, airports, and roads, is a top priority for improving connectivity, alleviating trade, and pulling foreign direct investment. The Colombo Port City initiative shoots for to make Colombo a global financial and business hub, hence raising trade and investment prospects.

8. Sri Lanka's Journey to Resilience and Reform

Market indicators intimate Sri Lanka's growing economy, manifesting resilience and the possibility for extra progress. Here's an of substantial market metrics that demonstrate Sri Lanka's economic progress.

a. GDP Growth Rate

According to the Central Bank of Sri Lanka. (2023), Sri Lanka accomplished positive GDP growth in the third quarter of 2023, a critical milestone in its recovery. Despite previous economic difficulties and bankruptcy proclamations, the country has expressed a rebound, with a year-on-year GDP growth rate of 1.6%. This positive growth rate shines attempts to improve economic stability, stimulate growth, and bring off the elaborations of the global economy.

b. Credit Rating Updates

According to the S&P Global Ratings. (2023), S&P Global Ratings upgraded Sri Lanka's local currency rating from picked-out default to CCC+/C, proposing a positive point of view on the country's solvency. The improvement has increased faith in Sri Lanka's financial stability and the efficacy of its reform efforts. Improved credit ratings can encourage investor confidence, cut down borrowing costs, and pull in foreign investment, all of which facilitate to drive economic growth.

c. Reform Measures

International Monetary Fund (IMF). (2023). Sri Lanka has enacted hard-and-fast reforms in line with international norms, letting in those offered by the International Monetary Fund (IMF). The IMF's help in the form of a bailout package, collectively the government's loyalty to critical reforms, has shaped an important setting for economic recovery. These reform initiatives have resulted in favorable macroeconomic policy reforms, boosting the country's economic resilience and growth trajectory,

d. Infrastructure Development

Sri Lanka's infrastructure development efforts, including transportation networks, ports, airports, and the Colombo Port City project, are drawing foreign investment and increasing trade. Modern infrastructure programs attempt to improve connectivity, ease trade, and establish Sri Lanka as a regional economic powerhouse. Infrastructure investments are vital for driving economic growth, pulling in investment, and enhancing the country's standing in the global economy, Ministry of Transport and Civil Aviation. (2023) and Colombo Port City Project Authority. (2023).

e. Market Diversification

`Sri Lanka Tourism Development Authority. (2023), Sri Lanka is diversifying its markets to promote growth and reinvigorate the economy. Diversifying markets, tapping into growing sectors, and taking advantage of the country's capabilities and geographical position are projected to encourage market presence and economic growth. Key sectors fuelling Sri Lanka's economic growth in tourism and hospitality, information technology, export-oriented industries, renewable energy, and infrastructural development.

Diversification is vital to fostering economic growth and placing Sri Lanka as a resilient and dynamic economy. Diversification brings a more balanced and sustainable economic foundation by lowering reliance on traditional sectors such as agriculture and textiles, disseminating risk across sectors, and mitigating the impact of downturns in any particular business.

Sri Lanka Export Development Board. (2023). moreover, diversity advances innovation and productivity growth, allows for the capture of coming-out possibilities in high-growth sectors, strengthens resilience to external shocks, attracts foreign direct investment, and supports sustainable economic development by diminishing environmental impact. To sum up, diversity is critical for driving economic growth, advocating innovation, fortifying resilience, pulling investment, and establishing Sri Lanka as a dynamic and resilient economy.

9. Conclusion

a. Key Findings Regarding Sri Lanka's Economic Renaissance and Journey of Positivity

Sri Lanka's economic resurgence and positive trajectory provide a captivating narrative of resilience, strategic vision, and transformative prosperity. Here is a review of the important results of Sri Lanka's economic revival.

Sri Lanka had tremendous economic issues, declaring bankruptcy in April 2022 and experiencing negative growth rates. Despite this setback, recent figures indicate a surprising shift toward positive economic momentum, with a year-on-year GDP growth rate of 1.6% in the third quarter of 2023. This turnaround demonstrates the country's ability to overcome misfortune and embark on a path of recovery and stability.

President Ranil Wickremesinghe has been essential in pressing for critical reforms to resuscitate the economy, adhering to IMF standards, and getting backing from foreign institutions such as the IMF. The continued tough reform program, together with IMF support, provides an important backdrop for Sri Lanka's economic growth and financial stability.

The private sector has emerged as a critical driver of economic regeneration in Sri Lanka, actively contributing to the country's growth trajectory through shared goals and collaborative efforts. Government measures to foster a favorable business environment and increase private sector engagement have resulted in good macroeconomic policy adjustments and tangible results.

Sri Lanka is working to diversify its economy beyond conventional sectors and into new areas such as technology, innovation, and sustainable development. Sri Lanka intends to stimulate economic growth and increase its global competitiveness by exploiting its unique geographical location and capitalizing on opportunities in commerce, logistics, and tourism.

Positive market indicators, such as a rising GDP rate, credit rating upgrades, infrastructure development projects, and market diversification attempts, indicate that Sri Lanka's economy is strengthening and resilient in the face of adversities. These metrics demonstrate the nation's dedication to long-term growth, innovation, and strategic economic development.

b. The country's Economic Recovery for Prospects and Policy Considerations

Sri Lanka's economic recovery paves the way for long-term growth, job creation, and increasing wealth for the populace. A recovered economy draws foreign investment and enhances domestic investor confidence, resulting in further economic growth. Furthermore, economic recovery can lead to higher living standards, better access to services, and more opportunities for social growth.

1. Policy Consideration

Policies should prioritize sustainable development techniques to promote long-term economic stability and environmental protection. Furthermore, investing in human capital through education, skill development, and healthcare can boost workforce productivity and contribute to economic growth. Continued investment in infrastructure projects is critical for boosting economic activity, improving connectivity, and attracting investors. Furthermore, measures that encourage diversification across sectors can minimize reliance on individual industries, mitigate risks, and build a more resilient economy.

Streamlining rules, increasing governance, and making it easier to do business can attract more investment and boost economic growth. Strengthening social safety nets, encouraging inclusion, and tackling income inequality will help ensure that the benefits of economic recovery are distributed equally throughout the population. Maintaining fiscal discipline, managing public debt, and executing solid macroeconomic policies are critical for sustaining economic

recovery and avoiding future crises.

2. Global Engagement

Leveraging international trade agreements and growing export markets can improve economic growth and open up new prospects for enterprises. Regional economic cooperation and alliances can help Sri Lanka strengthen its position in the global economy while also facilitating knowledge sharing and technology transfer. Strengthening diplomatic links and cultivating positive relationships with other countries can help to attract international investment, promote trade, and advance economic development.

3. Innovation and Technology

Embracing digital technologies and encouraging innovation can increase productivity, competitiveness, and growth in new industries. Investing in R&D efforts may boost innovation, generate high-value sectors, and establish Sri Lanka as a technology and knowledge-based services powerhouse.

10. Recommendations

a. Recommendations for Policymakers, Stakeholders, and Investors Based on the Analysis

Based on the examination of Sri Lanka's economic recovery and prospects, below are specific recommendations for policymakers, stakeholders, and investors.

1. Policymakers

Prioritize policies that support sustainable development methods, such as renewable energy projects, environmental conservation, and green initiatives. Invest in Human Capital: Direct resources toward education and skill training initiatives to improve workforce capacities and promote the growth of developing industries. Infrastructure Development: Continue to invest in modern infrastructure projects to increase connectivity, promote trade, and attract foreign investment. Diversification Strategies: Implement policies that foster cross-sector diversification to lessen dependency on conventional industries while also promoting innovation and competitiveness.

Streamline regulations, strengthen governance, and foster a business-friendly climate to attract investment and boost economic growth. Strengthen social safety nets, encourage inclusive growth, and address income inequality to guarantee that economic advantages are distributed equitably.

2. Stakeholders

Collaborative Partnerships: Encourage collaboration among the government, corporate sector, academia, and civil society to promote innovation, entrepreneurship, and sustainable development. Skill Development Initiatives: Invest in training programs to upskill employees and link skills with increasing industry demands. Market Diversification: Investigate new markets and product offerings to increase export potential, boost competitiveness, and seize global possibilities. Encourage the creation of local sectors, such as organic agriculture and sustainable tourism, to capitalize on Sri Lanka's distinct characteristics and enhance economic resilience.

3. Investors

Long-Term Investment Strategies: Consider long-term investment opportunities in Sri Lanka's growing areas such as renewable energy, infrastructure development, and technology. Risk Management Practices: Conduct extensive risk assessments and due diligence to reduce the risks and uncertainties involved with investing in the Sri Lankan market. Support innovation: Invest in creative projects and technology that can boost economic growth, provide value, and help the country achieve its development goals. Build strong relationships with local communities, follow sustainable practices, and participate in social development programs to ensure responsible and beneficial investments.

By implementing these recommendations, authorities, stakeholders, and investors may help Sri Lanka achieve long-term economic growth, resilience, and prosperity while also creating an environment conducive to equitable development and success.

b. Opportunities for Additional Research and Exploration on Sri Lanka's Economic Development

Here are some routes for further inquiry and exploration into Sri Lanka's economic development, based on the analysis and conclusions.

1. Impact of Diversification

Investigate the implications of diversifying markets on Sri Lankan economic growth and resilience, taking into account the potential impact of overseas Sri Lankans in building new export sectors as well as the need for new higher-wage export industries.

2. Technological Innovation

A study of the potential influence of technology and innovation on economic development in Sri Lanka, with a focus on the role of digital transformation and innovation in boosting productivity, competitiveness, and growth in developing sectors.

3. Sustainable Development

Research into the importance of sustainable development methods in promoting economic growth and environmental conservation, with a focus on the potential for long-term economic growth through economic diversification to reduce unemployment and poverty.

4. Foreign Investment

An examination of the opportunities and problems connected with attracting foreign investment to assist economic growth in Sri Lanka, including the influence of foreign direct investments on the expansion and diversification of sector-based economic activity and production.

5. Infrastructure Development

A study of the role of infrastructure development in improving connectivity, trade facilitation, and economic growth in Sri Lanka, with a focus on export expansion and diversification through foreign direct investment, as well as the need for climate-resilient development through economic diversification.

6. Policy Evaluation

Policy Evaluation is the process of assessing the success of macroeconomic policies and changes in fostering long-term economic development, taking into account the possible effects of trade liberalization and the role of international commerce in the global economy.

7. Global Trade Agreements

Conduct a study on the impact of regional and international trade agreements on Sri Lanka's economic development and market expansion, with an emphasis on the possibility of new export prospects based on economic complexity analysis and the markets that are expanding.

8. Private Sector Contribution

An examination of the private sector's role in driving economic regeneration and progress in Sri Lanka, highlighting the potential for collaborative partnerships to promote innovation, entrepreneurship, and sustainable development.

9. Resilient Growth Strategies

Research on strategies for tackling current issues and supporting long-term growth in Sri Lanka's economy, taking into account the potential for diversity, innovation, and the role of the private sector in driving economic regeneration and expansion.

REFERENCES

Bandara, J. S. K. (2015). Impact of Indo-Sri Lanka Free Trade Agreement on bilateral trade. South Asian Journal of Business and Management Cases, 4(1), 54-65. DOI: 10.1177/2277977914561897

Central Bank of Sri Lanka. (2023). Annual Report 2023. Retrieved from https://www.cbsl.gov.lk/en/annual-reports

Central Bank of Sri Lanka. (2023). Quarterly Economic Review - Third Quarter 2023. Colombo: Central Bank of Sri Lanka.

Colombo Port City Project Authority. (2023). Colombo Port City Development Plan. Colombo: Colombo Port City Project Authority.

Federation of Chambers of Commerce and Industry of Sri Lanka. (2023). Private Sector's Role in Economic Recovery. Retrieved from http://www.chamber.lk/

IMF Extends Credit Line to Sri Lanka. (2023, January 12). IMF. Retrieved from https://www.imf.org/en/News/Articles/2023/01/12/pr2366-sri-lanka-imf-extends-credit-line

Infrastructure Development Institute (IDI). (2022). Infrastructure Investment and Economic Development: Case Study of [Country Name]. Journal of Infrastructure Development, 25(3), 301-320.

889Johnson, R. (2018). Labor Market Reforms and Economic Growth: Evidence from a Cross-country Analysis. Economic Policy, 33(4), 589-612.

Jones, A., & Brown, C. (2019). The Impact of Trade Openness on Global Value Chains: Evidence from Developed and Developing Countries. Journal of International Economics, 45(2), 217-235.

Martinez, L., et al. (2021). Banking Sector Reforms and Financial Stability: Lessons from Emerging Economies. Journal of Banking & Finance, 28(3), 401-418.

Ministry of Energy and Environment. (2023). Renewable Energy Development Report. Colombo: Ministry of Energy and Environment.

Ministry of Finance - Sri Lanka. (n.d.). Ministry of Finance - Sri Lanka. Retrieved April 19, 2024, from https://treasury.gov.lk/web/investing-in-sri-lanka/section/strong%20resilient%20economy

Ministry of Megapolis and Western Development, Sri Lanka. (2022). National Physical Planning Policy and Plan. Retrieved from http://www.megapolis.gov.lk/en/

Ministry of Transport and Civil Aviation. (2023). Infrastructure Development Plan 2023-2030. Colombo: Ministry of Transport and Civil Aviation.

S&P Global Ratings. (2023). Sovereign Rating Criteria. Retrieved from [URL]

Smith, J., et al. (2020). Trade Liberalization and Economic Growth: A Meta-analysis of Empirical Studies. Review of International Economics, 21(1), 45-68.

Sri Lanka Board of Investment. (n.d.). Why Sri Lanka? Retrieved from http://www.investsrilanka.com/why-sri-lanka

Sri Lanka's Economic Renaissance: A Journey of Positivity. (n.d.). Retrieved from https://www.linkedin.com/pulse/sri-lankas-economic-renaissance-journey-positivity-37x5f/

Tourism Sri Lanka. (2023). Annual Report on Sri Lanka's Tourism Industry. Colombo: Tourism Sri Lanka.

Wickremesinghe, R. (2023). Address to the Nation on Economic Recovery Measures. Retrieved from http://www.president.gov.lk/

World Bank Group. (2023). Annual Report: Our Work. Retrieved from https://www.worldbank.org/en/about/annual-report/our-work

World Bank Repurposes Resources to Support Sri Lanka's Economic Crisis (2023, March 20). World Bank. Retrieved from https://www.worldbank.org/en/news/press-release/2023/03/20/world-bank-repurposes-resources-to-support-sri-lankas-economic-crisis

World Bank. (2008). Logistics and the challenge to global trade. Retrieved from https://

openknowledge.worldbank.org/handle/10986/6906

IMPORTANCE OF GREEN LOGISTICS IN ECONOMIC RESILIENCE: SRI LANKA POINT OF VIEW

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Abstract

Green logistics refers to the set of sustainable policies and measures aimed at reducing the environmental impact caused by the various activities in logistics operations. The traditional economic performance criteria are gradually overlooked with environmental considerations. Striving towards Green logistics would enable emerging economies to sustain in the highly competitive global supply chain whilst promoting their economic growth across the Globe.

Economic resilience refers to the ability of an economy to withstand and recover from external shocks, stresses, or disruptions while maintaining its core functions and structures. It involves the capacity of individuals, businesses, communities, and governments to adapt to changing circumstances, mitigate risks, and bounce back from adverse events such as natural disasters, economic downturns, or geopolitical tensions. Economic resilience encompasses various factors including diversification of industries, robust infrastructure, and access to financial resources, social cohesion, and effective governance. (Anon., 2018)

Key Words : *Green Logistics , Economic Resilience in Sri Lanka, Environment*

1. Introduction

Logistics is the management of the flow of things between the point of origin and the point of consumption in order to meet requirements of customers or corporations. The logistics of physical items usually involves the integration of information flow, materials handling, production, packaging, inventory, transportation, warehousing, and often security. Logistics make a major impact on economic activities in any country. The logistics industry is expanding rapidly in responds to the increasing demand of world trade.

The economy contracted by 7.8 percent in 2022 and 7.9 percent in the first half of 2023. Construction, manufacturing, real estate, and financial services suffered the most amid shrinking private credit, shortages of inputs, and supply chain disruptions, worsening the negative welfare impacts of income contractions and job losses registered in 2022. Headline inflation, measured by the Colombo Consumer Price Index, peaked

at 69.8 percent in September 2022 and subsequently declined sharply to 4 percent in August 2023 from a high base amid subdued demand. Decelerating inflation was beneficial for households' welfare, and helped limit further increases in food insecurity and malnutrition, especially among poor households. (Bank, 2023)

Environment had not been a major concern or priority in logistics in the past. However, with the advent of environmental legislations, major players in the global supply chain came under tremendous pressure to adapt environmental and social friendly practices in their logistics operations. Subsequently, the concept of 'Green logistics' was coined and became increasingly important in supply chain management which aimed at setting legislations and policies that minimize the environmental impact caused by logistics activities.

2. AIM

This Article focusing the concept of Green Logistics and its Impact to Sri Lankan Economic Resilience.

3. Methodology

Phase I: Defining the green logistics through literature in the Sri Lankan context and globally Green logistics is a concept for the sustainable development of the environment as well as organizations. Practical examples of 100% green organizations are not real. As much as the importance of the green concept and applying it to enterprises is important for the sustainability of both enterprises and the environment.

Phase II: Identifying activates in Logistics Management and define those activities when it been converting in to the Green concepts.

Phase III: Elaborate the Challengers and opportunities for implementing the Green Logistics for Economic resilience by using a SWOT analyzing

Phase IV: Concluding with an analysis of the importance of the green logistics and the contribution to the economic resilience.

4. Activity Of Logistics Management And Convert Those Activities to The Green Concept

The moving, storing, and distribution of goods and services from the point of origin to the point of consumption are all part of logistics management, which entails strategic planning, coordination, and execution. It includes a variety of tasks such information systems, inventory control, packaging, shipping, and warehousing. In order to

satisfy customer requests and guarantee on-time delivery, effective logistics management strives to maximize the flow of goods and decrease expenses. It is essential to supply chain management and boosts the productivity and competitiveness of companies in a range of sectors. Logistics management makes it easier for supply chains to run smoothly by reducing procedures, utilizing technology, and encouraging cooperation among stakeholders. This eventually raises customer satisfaction and promotes organizational success. Following main Logistics Activates that cloud be convert in to Green economic regime

i. Purchasing → Green purchasing
ii. Packing → Green Packing
iii. Transportation → Green Transportation
iv. Supply Chain Management → Green Supply Chain Management
v. Warehouse Management → Green Warehouse Management

Converted Activities

1. Green purchasing: Purchasing goods and services with the least amount of environmental impact throughout the course of their lifecycle is referred to as green purchasing, also known as environmentally preferred purchasing (EPP) or sustainable procurement. When making purchase selections, this method takes into account environmental considerations in addition to more conventional considerations like price, availability, and quality. The goals of green purchasing are to lessen the use of resources, produce less pollution and waste, and encourage the creation and uptake of ecologically friendly activities and products. Buying products with little packaging, energy-efficient appliances, renewable energy sources, and things created from recycled materials are a few examples of what it might include. Organizations may aid in environmental preservation, combat climate change, and facilitate the shift to a more sustainable economy by using sustainable procurement policies. (Programme, 2006)

2. Green Packing: Green packaging, also known as sustainable packaging or eco-friendly packaging, refers to the design, production, and use of packaging materials that have minimal environmental impact. Green packaging aims to reduce the environmental footprint of packaging throughout its lifecycle, from raw material extraction to disposal or recycling. (packing, 2020) Characteristics of green packaging may include

i. Use of renewable or recycled materials: Green packaging often utilizes materials such as recycled paper, cardboard, biodegradable plastics, or compostable materials. These materials reduce reliance on

virgin resources and help divert waste from landfills.

ii. Reduced packaging waste: Green packaging focuses on minimizing excess packaging and using materials efficiently to reduce waste generation. This can include designing packaging that is lightweight, compact, and optimized for product protection.

iii. Biodegradability and compostability: Some green packaging materials are designed to biodegrade or compost under specific conditions, reducing their environmental impact after use.

iv. Energy efficiency in production: Green packaging considers energy consumption and emissions during the production process, aiming to minimize energy use and greenhouse gas emissions.

v. Reusability and recyclability: Green packaging is often designed for reuse or recyclability, allowing materials to be recovered and reused in new products or processes.

3. Green Transportation: Green transportation, as the name implies, involves modes of transport that have less or no negative effects on the environment. This may involve public transportation, electric cars, EVs, bikes, walking, and other significant ways of transportation. “Sustainable transportation,” “eco-friendly transportation,” “green transportation,” “green transportation,” and “green commuting” are among the many terms used to describe green transportation. However, it refers to a variety of modes of transportation and procedures taken to lessen environmental degradation. (Rutherford, 2011)This diminish the emission of greenhouse gas , decrease the need for fossil fuels, and encourage more pleasant and effective alternatives to regular modes of transportation. Following examples are taken as green transportations.

i. Electric Vehicles
ii. Public Transit
iii. Bicycle and walking
iv. Car sharing and Ride sharing
v. Hybrid vehicles
vi. Alternative fuel vehicles
vii. Smart transport system

4. Green supply chain management: Integrating environmental factors into supply chain operations, such as product design and sourcing, manufacture, distribution, and disposal, is known as green supply chain management, or GSCM. (Sameer Kumar, 2009) It seeks to improve sustainability along the entire supply chain, lessen resource use, and limit environmental effects. Every

stage of the product life cycle—raw material extraction, manufacture, shipping, usage, and end-of-life disposal—is covered in terms of techniques for lowering environmental footprints. The authors provide insights into the prospects and challenges of implementing GSCM projects and emphasize the advantages of incorporating environmental issues into supply chain management procedures by drawing on case studies and empirical research. In order to achieve the GSCM, logistic management plays a vigorous role. Firm logistic activities necessarily need to align with the sustainable fundamental and greenness. With these prevailing global trend earlier logistic functions such as purchasing, transportation, warehousing, packaging and cross functional investigations has been shifted to sustainable purchasing, sustainable transportation, sustainable warehousing, sustainable packaging and sustainable reverse logistics.

5. Green warehouse: A green warehouse is a type of storage facility that uses eco-friendly methods and equipment to lessen its impact on the environment. Energy-efficient lighting, renewable energy sources, water conservation techniques, trash minimization and recycling initiatives, and sustainable material handling methods are a few examples of these approaches. (John J. Liu, 2015) There are chapters on green storage techniques in addition to the many facets of sustainable supply chain management that are covered. The strategies for creating and managing eco-friendly warehouses are covered in these chapters. These include energy-saving technology, eco-friendly equipment and materials, and layout and space optimization. For companies looking to improve the sustainability and environmental responsibility of their warehouse operations, the book offers insights and helpful advice.

Table 1: Different between conventional Logistics and Green Logistics

	Characteristics	**Conventional Logistics**	**Green Logistics**
01	Value of the system	Economic	Economic and ecological
02	Environmental impact	High	Low
03	Sustainability	Short- terms mainly focus on is cost	Long term and main focused on environment aspect
04	Speed and flexibility	high	Low

Source: Constructed by Author

5. Economical Resilience in Sri Lanka

The end of the three decade long conflict in mid-200s envisaged the confidence

of investors in the country in the backdrop of global recovery from the recession brought about greater stability and potential for growth of the economy than any time before in Sri Lanka. The recent trends in macro-economic conditions such as low inflation, low and stable interest rates, strong external reserves, stable exchange rate, improving fiscal outlook has been solid indications that the economy is returning to normalcy from instability.

As per the view of Dr. P B Jayasundera, former Secretary to the Treasury and Secretary to the Ministry of Economic Development in 2010,Sri Lanka was aiming to achieve USD 4,000 per capita income by 2016, and stresses that the financial and economic institutions of the country had shifted to top gear in order to achieve the progress of the country in terms of economic performance, investment and strategies as Sri Lanka to emerge as the Wonder of Asia where all citizens have equal opportunities and quality of life.

Sri Lanka Economy in 2023

According to official figures released on 2023, Sri Lanka's economy contracted 2.3% in 2023 as the island nation battled to emerge from its worst financial crisis in decades. However, the economy expanded by 4.5% in the fourth quarter, paving the way for a rebound this year, according to a statement from Sri Lanka's Census and Statistics Department. (Bank, 2023)The agricultural sector in Sri Lanka increased by 2.6% over the previous year, but the industrial output fell by 9.2% and the services sector fell by 0.2%. A stronger currency, more remittances, and more tourism revenue in the second half of 2023 all helped growth and fueled optimistic mood about the economy. In 2022, Sri Lanka's economy shrank by 7.8% due to a major foreign exchange crisis and political unrest that depreciated the country's currency and increased inflation and interest rates.

6. Pros And Cons Of Green Logistics in Economic Resilience

Pros and cons of green Logistics for Economic resilience can be brief in by using a SWOT analysis (strength, weakness, opportunities, threats).

Strengths	**Cost Savings:** By using green logistics techniques, you can cut costs by using less energy, producing less trash, and working more efficiently.
	Environmental Benefits: Green logistics lowers pollution, waste production, and carbon emissions, in line with environmental laws and business sustainability objectives.
	Enhanced Reputation: Businesses that put sustainability and green logistics first frequently have a good reputation with stakeholders, investors, and customers, which boosts market competitiveness and brand loyalty.

Weaknesses	**Initial Investment:** Some businesses may face financial difficulties as a result of the upfront infrastructure, technology, and training costs associated with the shift to green logistics.
	Resistance to Change: Green logistics methods might be slowed down in their acceptance and implementation by resistance from suppliers, staff, or management.
	Limited Infrastructure: Green logistics implementation may be more difficult and expensive in areas with poor infrastructure or restricted access to renewable energy sources.
	Supply Chain Complexity: Multi-tiered supply chains present challenges for green logistics activities since it can be challenging to coordinate sustainability initiatives among various stakeholders.
Opportunities	**Market Demand:** Businesses have opportunity to stand out from the competition and take market share by providing green logistics solutions in response to the growing demand from consumers and regulators for sustainable goods and processes.
	Partnerships and Collaboration: Using green logistics techniques in conjunction with partners, suppliers, and industry stakeholders can spur innovation, generate synergies, and open up new business prospects.
	Technological Advancements: Modern green technologies, such data analytics, renewable energy systems, and electric cars, offer chances to raise the sustainability and efficiency of logistics processes.
	Policy Support: A favorable climate for businesses to invest in green logistics can be created by supportive government policies, incentives, and regulations aimed at encouraging sustainability and lowering carbon emissions.
Threats	**Competitive Disadvantage:** Businesses that don't implement green logistics techniques run the risk of falling behind rivals who use sustainability as a competitive advantage, which could cost them market share and relevance.
	Regulatory Compliance: Logistics operations may be subject to increased costs and limitations as a result of changing environmental rules and compliance requirements, especially for businesses that have a significant environmental effect or high emissions.
	Resource Scarcity: The implementation of green logistics methods may face obstacles due to resource constraint, such as restricted access to sustainable materials or renewable energy sources, which could affect the resilience of the supply chain.

	Reputational Risks: A firm's reputation and brand image can be harmed by environmental incidents, such as pollution or carbon emissions, which can cause stakeholders to lose faith in the company.

7. Conclusion

The integration of green logistics practices holds significant potential for bolstering economic resilience, particularly in emerging economies like Sri Lanka. By prioritizing sustainability and environmental considerations within logistics operations, organizations can not only mitigate environmental impacts but also enhance their capacity to withstand external shocks and disruptions while promoting economic growth. This transition towards green logistics signifies a departure from conventional economic performance criteria towards a more holistic approach that balances economic prosperity with ecological sustainability. Through the adoption of green purchasing, packaging, transportation, supply chain management, and warehouse practices, businesses can minimize their environmental footprint and contribute to long-term economic resilience. Despite challenges such as initial investment requirements and resistance to change, the opportunities presented by green logistics, including cost savings, enhanced reputation, and innovation, outweigh the threats. As Sri Lanka navigates its economic recovery and pursues sustainable development goals, embracing green logistics represents a strategic imperative for fostering economic resilience and ensuring a more sustainable future.

The application of green logistics practices offers both opportunities and challenges for enhancing economic resilience. Through a SWOT analysis, we can identify several key factors, Green logistics can help businesses cut costs by producing less trash and using less energy. It can also improve their reputation and help them comply with environmental standards. Businesses moving to green logistics may face obstacles from initial investment costs and opposition to change, especially in areas with inadequate infrastructure or intricate supply chains. Businesses can prosper in the green logistics sector by meeting the increasing market need for sustainable products and procedures, encouraging partnerships and collaboration, utilizing technology improvements, and taking advantage of favorable government legislation. A competitive disadvantage, problems with resource scarcity, problems with regulatory compliance, and reputational hazards related to environmental accidents could arise from a failure to implement green logistics methods.

REFERENCES

Anon., 2018. World Bank. (2018). "Building Resilience for Peace and Security: Economic Resilience." Retrieved. [Online]

Available at: : https://www.worldbank.org/en/topic/fragilityconflictviolence/brief/building-resilience-for-peace-and-security-economic-resilience [Accessed 18 04 2024].

Bank, C., 2023. Central Bank. [Online] Available at: https://www.cbsl.gov.lk/en/sri-lanka-economy-snapshot [Accessed 19 04 2024].

Bank, W., 2023. The World Bank. [Online] Available at: The economy contracted by 7.8 percent in 2022 and 7.9 percent in the first half of 2023. Construction, manufacturing, real estate, and financial services suffered the most amid shrinking private credit, shortages of inputs, and supply chain disruptions, w [Accessed 19 04 2024].

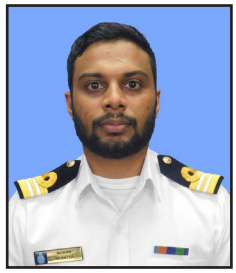
John J. Liu, K. B., 2015. Green Logistics and Transportation: A Sustainable Supply Chain Perspective. ISBN: 978-3-319-12726-5 ed. s.l.:Springer. packing, G., 2020. Green packing. [Online] Available at: https://greenpackaging.eu/ [Accessed 6 03 2024].

Programme, U. N. E., 2006. United Nations Environment Programme. [Online] Available at: https:// wedocs. unep. org/ bitstream/handle/20.500.11822/22699/Sustainable%20Public%20Procurement%20A%20Global%20Review.pdf [Accessed 16 3 2024].

Rutherford, R. T., 2011. Green Transportation: An A-to-Z Guide. ISBN: 9781412996949 ed. s.l.:SAGE Publications, Inc.

Sameer Kumar, M. J. M., 2009. Green Supply Chain Management: Product Life Cycle Approach. ISBN: 978-3-540-89517-4 ed. s.l.:Springer.

THE ROLE OF GREEN SUPPLY CHAIN MANAGEMENT IN ENHANCING ECONOMIC RESILIENCE



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Abstract

This article explores the critical role of Green Supply Chain Management (GSCM) in enhancing economic resilience amidst environmental and economic challenges. GSCM integrates sustainable practices across the sourcing, procurement, conversion, and logistics of supply chains to optimize resource use, reduce environmental impacts, and build transparent and efficient operations. These practices not only help in mitigating the immediate effects of global disruptions such as natural disasters and economic downturns but also enhance the systemic resilience of economic systems by allowing them to adapt to ecological, social, and economic changes. The study employs a literature-based methodology, synthesizing research from multiple databases to define economic resilience and examine the impact of GSCM in this context. It discusses the evolution of GSCM from its origins in the early 1990s to its current implementation across various industries, emphasizing its significance, particularly in developing countries like Sri Lanka that are prone to climate-related impacts. The paper also outlines future perspectives of GSCM, highlighting the role of digital technologies, circular economy integration, and inclusivity in promoting environmental and social sustainability. Through a comprehensive analysis, this study elucidates how GSCM not only supports sustainable development but also fortifies economic resilience, making it a pivotal strategy in today's global business environment.

Keywords: *Green Supply Chain Management (GSCM), Economic Resilience, Circular Economy, Sustainable Sourcing, Logistics*

1. Introduction

In the current global economy, where environmental issues are becoming more and more important, integrating sustainable practices into supply chain operations is not only ethically required but also strategically essential. In this context, Green Supply Chain Management (GSCM) stands out as a crucial component that provides a means of improving economic resilience. Green supply chain management strengthens economic resilience by emphasizing how sustainable and environmentally friendly supply chain practices support economies' resilience, especially in the face of major global disruptions like societal disruptions, natural disasters, and economic downturns.

According to Cordina (2004), the ability of an economic system to adjust to both short-term shocks and long-term changes in ecological, social, and economic situations to sustain community growth while consuming its fair share of ecological resources is known as economic resilience. Global issues, including resource scarcity, climate change, and rising consumer awareness and demand for sustainable products, are putting this resilience to the test increasingly. GSCM tackles these problems through resource optimization, environmental impact reduction, and the development of transparent, flexible, and efficient supply chains that not only minimize risks but also take advantage of the opportunities presented by a green economy.

Every step of the "sourcing and procurement, conversion, and logistics management activities" process is integrated by SCM, including analysis, scheduling, planning, and coordinating.". From a manufacturing, distribution, or usage point to a location of restoration or proper disposal, it can alternatively be characterized as "the process of planning, implementing, and controlling backward flows of raw materials, in-process inventory, packaging, and finished goods" (Rubio et al. 2008).

The pursuit of environmental standards in product development, process design, operations, logistics, regulatory compliance, and waste management involved numerous organizational units inside businesses. This resulted in several disorganized mitigation efforts, but when environmental management and operations became more closely linked during the SCM revolution in the 1990s, things began to change. Environmental considerations are included in supply chain management (GSCM) when it comes to product design, procurement and selection of production processes, materials, final product distribution to clients, and end-of-life management of the product beyond its useful life(Srivastava, 2007).

The importance of GSCM in developing countries, such as Sri Lanka, is pronounced due to their vulnerability to climate-related impacts and their often heavy reliance on natural resources. By adopting GSCM, these countries may be able to better attract foreign direct investments, boost market access, and increase conformity with international norms. In addition, green jobs, technology innovation, and increased local firms' competitiveness internationally are all ways that GSCM may support the local economy.

2. Research Methodology

In order to provide a comprehensive overview of the role of GSCM in enhancing economic resilience, this study adopts a literature-based methodology. This approach allows for an extensive synthesis of existing research. Relevant studies published between 2000 and 2023 were identified through comprehensive searches of multiple databases including Research Gate, Emerald, Sage, Science Direct, and Google Scholar. Keywords used in the searches included economic resilience, green supply chain management, sustainability, and logistics.

The researcher expects to answer the following questions through this research study;

Q1: What is economic resilience?

Q2: What is green supply chain management?

Q3: How to enhance economic resilience through green supply chain management?

Q4: What is the future of green supply chain management?

Ethical considerations were meticulously adhered to, with all sourced studies properly cited to credit the original authors. This literature-based study did not involve new human or animal subjects, so ethical review and approval were not required.

3. Economic Resilience

The word "resilience" comes from the Latin verb "resilio," which means to rebound (Rose, 2009). In the larger body of economic literature, resilience is acknowledged as a vague concept. Resilience is defined as the capacity of a social-ecological system to absorb disturbance and reorganize while undergoing change to still retain essentially the same function, structure, and feedback, and therefore identity (Zhong et al, 2017). In economic literature, the term has been used in at least three senses relating to the ability (a) to recover quickly from a shock; (b) to withstand the effect of a shock; and (c) to avoid the shock altogether (Briguglio et al, 2006).

A. Ability of an economy to recover quickly

This is related to the ability of an economy to recover from a shock that has negatively impacted it. This type of resilience is therefore associated with "shock-counteraction" (Briguglio et al, 2006). According to Briguglio et al, (2006) this will be severely constrained if there is a persistent propensity for high unemployment rates or significant fiscal deficits, for example. However, this capacity will be strengthened if the economy has tools for discretionary policy that it can use to offset the effects of negative shocks. For example, a strong fiscal position would allow policymakers to use tax cuts or discretionary spending to offset the effects of negative shocks. An economically resilient system can quickly adjust and resume its pre-shock activity levels. While there are various ways to measure it, one common method is to look at things like employment rebounding in a matter of years. When a system undergoes significant short-term fluctuation the outcome of a shock can prove to be resilient if, following a stage of instability, it reaches a new equilibrium with performance comparable to that showed before the shock (Brinkmann, 2017).

B. Ability to withstand shocks

When considering absorbing shocks, it means the ability to manage and lessen the impact of unforeseen events, such as financial crises, natural disasters, or global pandemics. This kind of resilience, known as "shock absorption," arises when the economy is equipped with endogenous mechanisms to respond to adverse shocks and lessen their consequences (Briguglio et al, 2006). Since negative external demand shocks affecting one sector of the economy can be largely mitigated by shifting resources to another with stronger demand, the presence of a flexible and multiskilled labor force, for instance, could serve as a shock absorption tool.

C. Ability of an economy to avoid shocks

This type of resilience is considered to be inherent. According to Rose (2017), the term "inherent resilience" describes actions that stem from the system's pre-existing capability. This includes internal company strategies and individuals who may be more effective at a very low cost while the organization strives to build resilience capability. The capacity to use multiple fuels in an electricity-generating unit, backup equipment, stocks, and established government policy levers are a few instances of inherent resilience (Dormady et al., 2019). According to the report of the UK presidency of the G7 (2021), it is possible to reduce risks and short-term effects prior to shock events, at least for shocks that are mostly endogenous to the economic system.

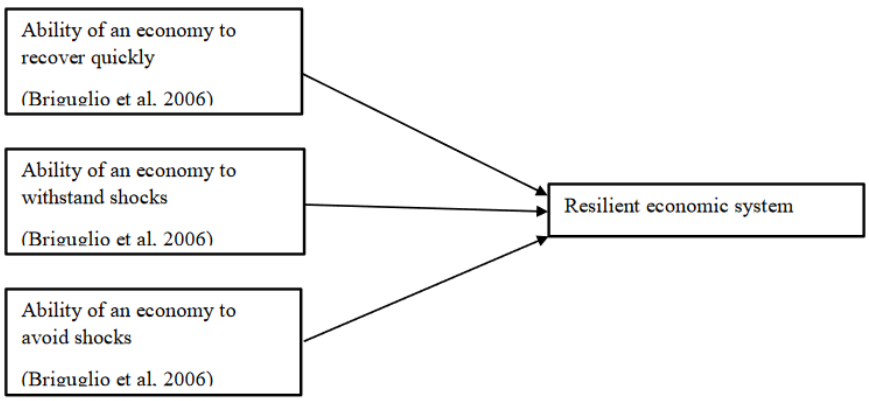

Figure 01: Three abilities of a resilient economic system
Source: Developed by Author

By using less fossil fuel and altering its infrastructure to be more environmentally friendly, a resilient economy can adjust to climate change and make better use of its resources. Additionally, resilient economies generate goods and services at a level suitable for sustaining a diverse and well-balanced local and regional economy. In the pursuit of maximizing social well-being, public policy is thought to have as its main

goals the building of resilience, together with the interests of social inclusion, economic growth, and environmental sustainability.

4. Green Supply Chain Management (Gscm)

The first GSC concept originated in 1989 when Kelle and Silver highlighted the commercial application of reusable products. This move indicated the beginning of a more extensive integration of sustainability into company operations, driven by the supply chain and quality revolutions of the 1990s and 1980s, respectively (Srivastava, 2007). In 1991, Navin Chandra introduced a green design aimed at minimizing product waste. Subsequent studies by Ashley (1993) and Richards and Allenby (1994) further refined the green design framework. In 1994, Webb used the term GSC, attributing its origin to the concept of green purchasing, and later expanded the concept to 'Environmental Responsibility Manufacturing' in 1996. The foundations of green operations, including reverse logistics. Handfield et al. (1997) described GSC as encompassing design, production, procurement, logistics, packaging and distribution, with a significant contribution to waste reduction and the sustainability of product life and natural resources (Srivastava, 2007). By the late 1990s, extensive reviews of GSCM were conducted, covering recycling in the supply chain, manufacturing, and green planning.

The goal of GSCM is to increase efficiency and profitability by integrating sustainability issues into production, supply & distribution procurement, sales, marketing, and other pertinent sectors (Srivastava, 2007). Darnall, Jolley, and Handfield (2008) state that GSCM procedures include environmental efforts to guarantee environmentally friendly goods and services and to cut costs along the value chain. GSCM encompasses a variety of approaches (such as recycle , reduce, rework, reclaim , refurbish, reverse logistics, remanufacture, etc.) in order to accomplish GSCM waste reduction activities. It also extends beyond the implementation and monitoring of environment management programs. GSCM is an all-inclusive approach that assists companies in enhancing their sustainability and incorporating environmental consciousness into their supply chain. GSCM is a strategic management approach that raises the environmental efficacy of the industrial sector.

While supply chain management (SCM) first concentrated mostly on green logistical difficulties, it now includes a variety of sustainability challenges, such as green manufacturing, distribution, marketing, and procurement, in order to increase environmental and social welfare. Globally, every industry is seeing an increase in the use of GSCM. The concept of GSCM has been implemented in numerous industries and academic sectors over the past twenty years. It includes recycling, green operations, waste management, reverse logistics, green manufacturing and green design, all of which are employed in a variety of fields and businesses (Srivastava, 2007).

In the automotive industry, for example, GSCM has been adopted by General Motors and BMW (Thierry et al., 1995). Across the globe, GSCM is used in a number of industries, including fast-moving consumer goods, electronics, construction, plastic, leather, pharmaceuticals, textiles, chemicals, and tourism.

Furthermore, GSCM is being used in a variety of businesses to improve environmental efficiency in order to lower environmental impact, boost revenues, and expand market share. Many developing country governments currently have policies, rules, regulations, and recommendations for the industry to use GSCM practices, or are in the process of developing them. In order to get the intended results, a number of firms also started combining the green supply chain model with operational protocols, strategic planning, and improved organizational performance (Bras & Isaacs, 2006).

5. Enhancing Economic Resilience Through Green Supply Chain Management

GSCM, which integrates environmental sustainability with supply chain practices, can improve economic resilience. GSCM focuses on environmental responsibility. It addresses the company's responsibility to protect the natural resources employed in the creation of its services and goods as well as the ecological demands of the globe. The intention is to minimize environmental impact so that sufficient natural resources can be utilized by future generations. Supply chain resiliency is one of the most important characteristics of economic resilience. In ultimately, supply chain resilience makes a company more "sturdy" and enables it to continue operating normally in the face of unforeseen adversity (Safdie, 2023).

GSCM improves supply chain robustness, which in turn improves economic resilience. The goal of resilient supply chains is to strengthen supply networks against interruptions, reduce environmental consequences, and eventually develop a sustainable company model that can survive economic volatility. Some concepts in GSCM can be adopted to enhance economic resilience through supply chain resilience. In this section of the research paper, the researcher discusses various GSCM concepts to answer the methodology's third question.

According to Kaur et al. (2018), there are four types of green supply chain management operations: reverse logistics, outbound, operational, and inbound logistics. In this section of the research study, the researcher discusses various GSCM concepts mainly related to logistics to answer the methodology's third question. According to Choudhary (2011), inbound logistics is the early part of the supply chain and the integration of suppliers functioning begins with green purchasing (GP) of raw materials. The inbound GSCM aims to decrease waste through the procurement of raw materials, green supplier development, green supplier selection, destructive materials, and a decrease of energy consumption, and resources (Kaur et al,2018). Relying on a wide range of green suppliers can prevent disruptions in one area from halting operations, and

this helps to enhance economic resilience.

Operational GSCM is the middle part of the supply chain. Kaur (2018), highlights the operational activities that occur between inbound and outgoing logistics, when raw materials are converted into consumer-useable items at the enterprise level of production, are covered by GSCM. It includes green design, green packaging, green production, recycling, remanufacturing, and other practices. Reducing emissions, on- and off-site energy recovery, reducing solid and liquid waste, and integrating cleaner production are the advantages of incorporating green practices into operational GSCM. These benefits result in increased productivity, quality improvement, cost savings, and increased efficiency. (Choudhary, 2011). Adopting this green management practice is important for a quick recovery from economic shocks.

Outbound GSCM is the final stage of the supply chain and delivery of products and contains the pick and place of product and delivery. The outbound GSCM aims to reduce carbon emissions and achieve higher fuel efficiency (Kaur et al, 2018). Choudhary (2011) states that an organization's duties for outbound GSCM could sometimes involve eco-labeling, green marketing, environmentally friendly packaging, and environmentally friendly distribution. By optimizing outbound logistics practices, costs can be reduced and the environmental impact can be minimized, which are critical components of a resilient business model.

Reverse Logistics is a ''closing of the loop'' of Supply Chain (Choudhary, 2011). A closed-loop supply chain is one that blends reverse and forward logistics and concentrates on the entire product life cycle, from birth to disposal. Reverse logistics refers to the process of bringing materials, goods, and components back into the supply chain through repair, reuse, refurbishing, and recycling (Kaur et al, 2018). Through recycling, reverse logistics in GSCM can produce cost savings as well as a competitive advantage in recycling, refurbishing, and re-manufacturing. This saves raw materials, water, energy, and other processes. This reduces reliance on virgin resources, lowers production costs due to recycled material usage, and mitigates the risks of resource scarcity (Butt et al, 2023). So reverse logistics strategies are critical for increasing economic resilience by limiting risks.

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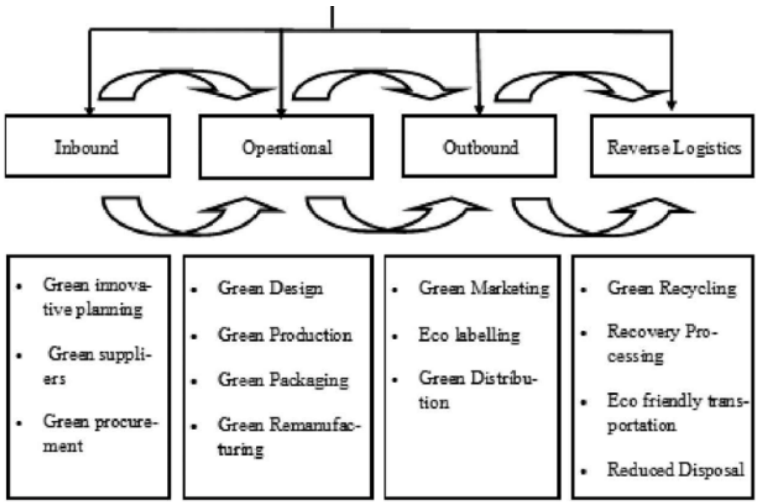

Figure 02: Green Supply Chain Management Operations
Source: A Pareto investigation on critical barriers in green supply chain management (Kaur and Awasthi 2018)

Focusing on these areas within GSCM can help to build a more resilient supply chain that can withstand diverse shocks while driving economic value through enhanced efficiency and decreased environmental impact. This comprehensive approach to GSCM processes guarantees that businesses are prepared to meet the demands of the modern market and consumer base, securing their position in a competitive landscape; hence, it contributes to economic resilience.

6. The Future of Green Supply Chain Management

A. Digitalization and the greening of supply chains

Digitalization is transforming green supply chain management (SCM) by leveraging technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain to enhance environmental sustainability. IoT applications optimize logistics and reduce waste by enabling real-time tracking of resources and assets (Srivastava & Srivastava, 2020). AI improves decision-making through predictive analytics for inventory and demand forecasting, thus reducing overproduction and minimizing environmental impact (Kumar & Rahman, 2020). Furthermore, blockchain technology supports greater transparency and accountability in environmental compliance by documenting a secure, immutable record of all transactions across the supply chain (Smith & Doe, 2021). Despite the potential benefits, challenges such as high implementation costs, cybersecurity threats, and the need for specialized skills remain significant hurdles to widespread adoption.

B. Circular economy integration in GSCM

The integration of circular economy principles into GSCM represents a transformative shift towards more sustainable business practices. By embracing a circular economy, companies aim to minimize waste, extend product lifecycles, and regenerate natural systems, effectively moving away from the traditional 'take-make-dispose' model to one that is regenerative by design. This approach not only reduces environmental impacts but also drives greater resource efficiency, which can lead to reduced costs and improved competitiveness (Geissdoerfer et al., 2017).

Concerning GSCM, circular economy strategies involve redesigning products for reuse and recycling, optimizing resource recovery, and encouraging the use of renewable materials. Companies are also adopting business models that focus on product-as-a-service, which promotes reuse and extended product lifespans (Lacy & Rutqvist, 2015). However, challenges such as the need for significant capital investment and the development of new competencies remain. Addressing these requires innovation in business models, advancements in technology, and supportive regulatory frameworks (Liu et al., 2018).

C. Inclusivity and social impact of GSCM

Inclusivity and social impact are becoming increasingly pivotal in the evolution of GSCM. As companies strive for environmental sustainability, there is a parallel push to ensure that supply chains are also socially equitable. This involves integrating fair labor practices, supporting community development, and promoting access to opportunities across all levels of the supply chain. Such measures not only help in mitigating risks and enhancing resilience but also boost corporate reputation and stakeholder trust (Marshall et al., 2015).

D. Sustainable sourcing and supply chain resilience

Sustainable sourcing and supply chain resilience are central to the future of GSCM. As environmental concerns become more pressing, companies are increasingly adopting sustainable sourcing practices that prioritize the use of renewable resources and ethical procurement strategies. This approach not only mitigates environmental impact but also ensures long-term resource availability, supporting supply chain resilience against disruptions such as resource scarcity and regulatory changes (Tachizawa & Wong, 2015).

7. Conclusion

The research highlights the significant role of GSCM in enhancing economic resilience, particularly in the context of current global disruptions and environmental

challenges. GSCM promotes sustainable practices across supply chain operations, acting as a strategic tool to mitigate risks and capitalize on opportunities within the changing global economy. By fostering environmental responsibility, optimizing resources, reducing ecological impacts, and improving transparency and efficiency, GSCM greatly strengthens the robustness of economic systems. This strategic integration not only supports the sustainability of business operations but also enhances their ability to withstand and adapt to external pressures, thereby bolstering economic resilience. This study has identified key areas within GSCM, such as inbound logistics, operational practices, outbound logistics, and reverse logistics, where strategies can be implemented to bolster economic resilience. By focusing on these areas, businesses can build more robust supply chains that are capable of withstanding diverse shocks while driving efficiency and reducing environmental impact.

Furthermore, the future of GSCM is characterized by digitalization, circular economy integration, inclusivity, and sustainable sourcing practices. Leveraging technologies such as IoT, AI, and blockchain, companies can further enhance the environmental sustainability of their supply chains. Moreover, by embracing circular economy principles and prioritizing social impact, businesses can not only mitigate risks but also strengthen their competitive advantage and reputation.

REFERENCES

Barros, A.I., Dekker, R. and Scholten, V., 1998. A two-level network for recycling sand: a case study. European Journal of Operational Research, 110(2), pp.199-214.
Butt, A.S., Ali, I. and Govindan, K., 2023. The Role of Reverse Logistics in a Circular Economy for Achieving Sustainable Development Goals

Briguglio, L., Cordina, G., Bugeja, S. and Farrugia, N., 2006. Conceptualizing and Measuring Economic Resilience. Economics Department, University of Malta.

Brinkmann, H., Harendt, C. and Nover, J., 2017. Economic Resilience: A new concept for policy making. Gütersloh: Bertelsmann Stiftung, pp.47-58.

Cordina, G., 2004. Economic vulnerability and economic growth: Some results from a neoclassical growth modelling approach. Journal of Economic Development, 29, pp.21-39.

Chuan-Zhong Li, Anne-Sophie Crépin, Carl Folke, 2017. The Economics of Resilience. international Review of Environmental and Resource Economics, Issue 11, pp. 309-353.

Choudhary, M. and Seth, N., 2011. Integration of Green Practices in Supply Chain Environment: The practices of Inbound, Operational, Outbound and Reverse logistics. International Journal of Engineering Science and Technology, 3, pp.55-67.

Dormady, N., Roa-Henriquez, A. and Rose, A., 2019. Economic resilience of the firm: A production theory approach. International Journal of Production Economics, 208, pp.446-460.

Geissdoerfer, M., Savaget, P., Bocken, N.M.P., & Hultink, E.J. (2017). "The Circular Economy – A new sustainability paradigm?". Journal of Cleaner Production.

Handfield, R.B., Walton, S.V., Seegers, L.K. and Melnyk, S.A., 1997. 'Green' value chain practices in the furniture industry. Journal of Operations Management, 15(4), pp.293-315.

Kaur, J., Awasthi, A. and Sidhu, R., 2018. A Pareto investigation on critical barriers in green supply chain management. International Journal of Management Science and Engineering Management, pp.113-123.

Kumar, V., & Rahman, Z. (2020). "Impact of digitalization on supply chain sustainability and performance". International Journal of Production Economics, 220.

Lacy, P., & Rutqvist, J. (2015). Waste to Wealth: The Circular Economy Advantage. Palgrave Macmillan.

Liu, J., Feng, Y., Zhu, Q., & Sarkis, J. (2018). "Green supply chain management and the circular economy: Reviewing theory for advancement of both fields". International Journal of Physical Distribution & Logistics Management, 48(8), 794-817.

Marshall, D., McCarthy, L., McGrath, P., & Claudy, M. (2015). "Going above and beyond: how sustainability culture and entrepreneurial orientation drive social sustainability supply chain practice adoption". Supply Chain Management: An International Journal, 20(4), 434-454.

Richards, D.J. and Allenby, B.R. (eds.), 1994. The Greening of Industrial Ecosystems. Washington, DC: National Academies Press.

Rose, A., 2009. Economic Resilience to Disasters, Los Angeles, California : Community and Regional Resilience Institute.

Safdie, B., 2023. Everything you need to know about green it in 2024.

Smith, J., & Doe, A. (2021). "Challenges in adopting digital technologies in sustainable supply chains". Journal of Business Ethics, 169(3), 561-578.

Srivastava, S.K., 2007. Green Supply-Chain Management: A State-of-the-Art Literature

Review. International Journal of Management Reviews, 9, pp.53-80.

Srivastava, M., & Srivastava, R. K. (2020). "Leveraging Internet of Things for sustainable supply chain management". Journal of Cleaner Production, 253, 119926.

Tachizawa, E.M., & Wong, C.Y. (2015). "Towards a theory of multi-tier sustainable supply chains: A systematic literature review". Supply Chain Management: An International Journal, 20(5), 541-554.

Thierry, M., Salomon, M., Van Nunen, J. and Van Wassenhove, L., 1995. Strategic issues in product recovery management. California Management Review, 37(2), pp.114-136.

Webb, L., 1994. Green purchasing: forging a new link in the supply chain. Resource: Engineering and Technology for Sustainable World, 1(6), pp.14-18.

OPTIMIZING GREEN LOGISTICS ON TOURISM INDUSTRY FOR SUSTAINABLE DEVELOPMENT OF SRI LANKA ECONMIC RESILIENCE

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Abstract

Tourism is a most-developed industry and business volume in international tourism is as important as that of oil, food products and automobiles export. It has been indicated that tourism is a green industry because it depends on the natural resources. Sri Lanka has been seated amidst the most appealing designations with one-of-a-kind environmental factors, culture, and historical background. At present the county is setting a platform for tourism sector as a main economic driver that creates opportunities not only directly on but also indirectly. By the day store of information rises and the demand of environment concern sustainable tourism is more and more, country should apply sustainability practices to be competitive with other countries in the long run. However, it is important to accomplish this without significant environment degradation.

This study focuses on Green Supply Chain Management practices including Green SCOR model that could be implemented for all service sector and used by the hospitality / tourism sector of Sri Lanka. This study provides that (1) green practices are typically practiced in services sector in worldwide; (2) green supply chain management practices in the hospitality / tourism industry in Sri Lanka; (3) impact of green supply chain management practices on the sustainable development of the Sri Lanka economy. The research significance is identification, prioritization as well as validation of green practices, which are key factors for the tourism industry and to open our eyes to the contribution of GSCM to the Sri Lankan economy growth.

Keywords: *Sustainable Tourism, Green Supply Chain Management (GSCM), Supply Chain Operations Reference (SCOR) model.*

1. Introduction

Tourism has shown to be one of the most successful economic powerhouses across the globe, in some cases exceeding oil export, food export, or automobile export in value. The Democratic Socialist Republic of Sri Lanka is a tropical island in the Indian Ocean, which not only lies off the south-eastern part of the Indian Subcontinent. The nation provides a growing travel and tourism industry. Ever since the year of the Sri Lanka's independence from the British, the country still succeeded in not only luring foreign investors and tourists all around the island but also now with the economic crisis

that the country is facing, the income of tourism industry is becoming a major source that the government is seeking to increase their foreign reserves.

Sri Lanka enriched with numerous natural endowments such as architectural beauty, amazing scenes, and well-known hospitality has figured out to be a most popular tourist destination. While this expansion depends on massaging of natural resources, this is one basic element that is hardly taken into account when running the conventional tourism set-ups. Once identified, we should come up as one nation to realize national policies and programmes for the development of tourism industry since we have all the good resources to be tapped for the economic development.

The purpose of this research is to determine the advantages that Green Logistics can bring for improving the existing tourism industry in Sri Lanka which is contributing for sustainable economic development of the country. Green Logistics is term used for activities done throughout the tourism supply chain to reduce the impact on the environment. In addition, resource utilization should also be optimized. This paper dwells on three parameters which include;

A. Common Green Logistics Practices in the Tourism Industry: Discuss and evaluate environmentally friendly approaches (in terms of energy conservation, waste reduction, etc.) have been adopted by the other service industries around the world.

B. Green Supply Chain Management in Sri Lanka's Hospitality / Tourism Industry: Concrete and appraise the already in place best green practices in Sri Lanka Hospitality / Tourism sector.

C. Impact of Green Logistics on Sustainable Development of economy: Assess the advantages on economic and environmental sectors brought by the Green Logistics role in accelerating the economic growth.

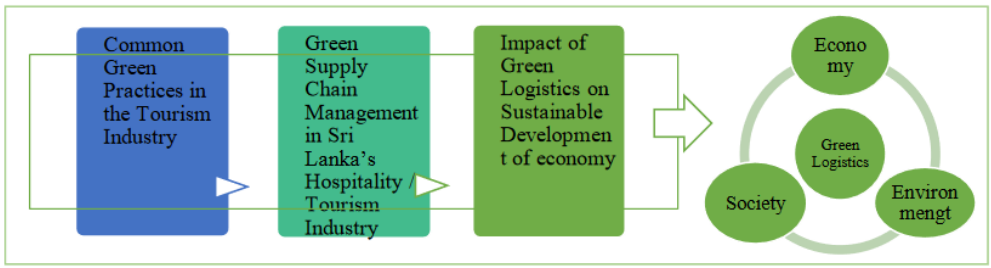


Figure 1: The core studies for Green Logistics Practice including sustainable development reflect
Source: Developed by Author

2. Literature Review

A. Green Supply Chain Management (GSCM) in Tourism Industry and focus on Sri Lanka

The tourism industry is an enormously influential element of the global economic machine in its entirety. Nonetheless, one cannot undermine the fact that the use of natural resources underlines the importance of sustainable consumption guidelines GSCM is now viewed as the appearance of one of the most fundamental principles, which helps in the maintenance of a balance between ecology and economic development in tourism There has been revelation through studies that green is highly embraced as a common practice globally in the service sector like the hospitality industry.

The tourism sector of Sri Lanka is immense due to its favourable conditions in terms of nature, culture and history, therefore, it gives big profit and noteworthy beneficiaries. The state authority acknowledges the tourism as a source which generates the highest percentage of the country's GDP and is stimulating the sector for more development. Nevertheless, sustainable activities are those accessible approaches to Sri Lanka in sustaining its competitiveness on the large-scale and specifically with regard to increasing demand for ecotourism.

B. Green Logistics and Sustainable Development

Green logistics practices are divided into transportation, warehousing, and packaging sections that help reduce the environmental impact. This study intends to explore and put forward relevant actions that should be applicable to Sri Lanka's tourism industry. The research significance lies in; Finding the eco-friendly logistics approaches that go with tourism industry in mind and improving their performance, and Betterment of GSCM position towards the country's economic growth by improving the sustainability of the tourism industry.

C. The Green SCOR Model

The Green Supply Chain Operations Reference (Green SCOR) template give a way which GSCM can be applied. This article will develop an assessment framework based on its literature review and the input from relevant industries. The framework proposed aims at linking green practices in the logistics and the performance of tourism industry in Sri Lanka.

3. Research Methodology

This research is using a mixed method approach. Firstly, an intensive literature

review will be carried out in order to identify prominent Green Logistics solutions utilized within the service sector all over the world. Besides, the research is to be made on the hospitality / tourism sector in Sri Lanka mainly. Further, I discovered industry experts' articles to clarify how today's green practices are implemented by tourism industry. Taking the findings into account, a framework for assessment will be created that encompasses the identification and prioritization of the green practices probably fit for the Sri Lankan reality.

4. Case Study

Through the analysis of Sri Lanka case study, the government addresses tourism industry as the key pillar of the economic growth, so it aims to enhance performance in other sectors as well, for example, employment, infrastructure, and manufacturing along with hospitality. In addition public awareness and the demand of sustainable tourism, those countries must carry the sustainability policies that can make them more preferable comparing with others. In the same token, though, Sri Lanka has the capacity of growing its tourism industry just like other neighboring countries within Asia.

Further, The Forbes magazine in a freshly published report has ranked Sri Lanka as the 4th place for solo travelers in 2024 before Jordan, Thailand and Indonesia and the Sri Lanka Tourism Development Authority Monthly Tourist Arrivals Report for Dec 2023. Statistics on tourism are;

Table 1: Criteria

Month	2022	2023	% change 2023/22
January	82,327	102,545	24.5
February	96,507	107,639	11.5
March	106,500	125,495	17.8
April	62,980	105,498	67.5
May	30,207	83,309	175.8
June	32,856	100,388	205.5
July	47,293	143,039	202.4
August	37,760	136,405	261.2
September	29,802	111,938	275.6
October	42,026	109,199	159.8
November	59,759	151,496	153.51
December	91,961	210,352	128.7
Total	**719,978**	**1,487,303**	**106.6**

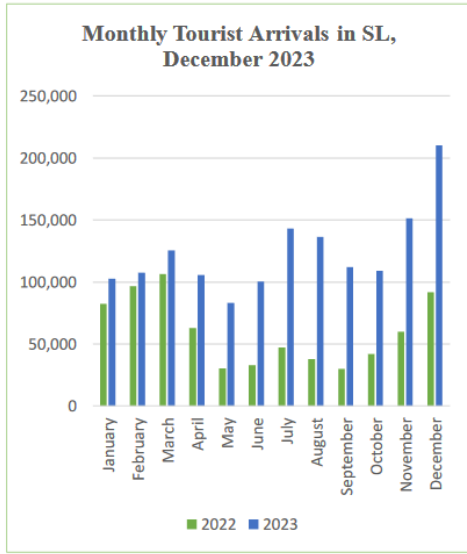


Figure 1: Monthly tourist arrivals, December 2023
Source: Monthly Tourist Arrivals Report of Sri Lanka Tourism Development Authority – Dec 2023. Developed by Author

Accordingly, the tourism sector and migrant workers' remittances have driven USD 5.16 billion into the economy as revealed by the numbers that came from the Central Bank of Sri Lanka in the last 8 months of the year 2023. During the period from January to August, 2023 the amounts of USD 1,304.5 million were achieved through tourism as earnings, while remittance of workers totaled at USD 3,862.7 million. In addition, tourism activities and others generated an aggregate USD 609.7 million in the month of August alone, which resulted in USD 210.5 million earnings from tourism and workers' remittances (inflows) worth USD 499.2 million. These figures are indicators of substantial effect that these sectors are having on the Sri Lankan economy.

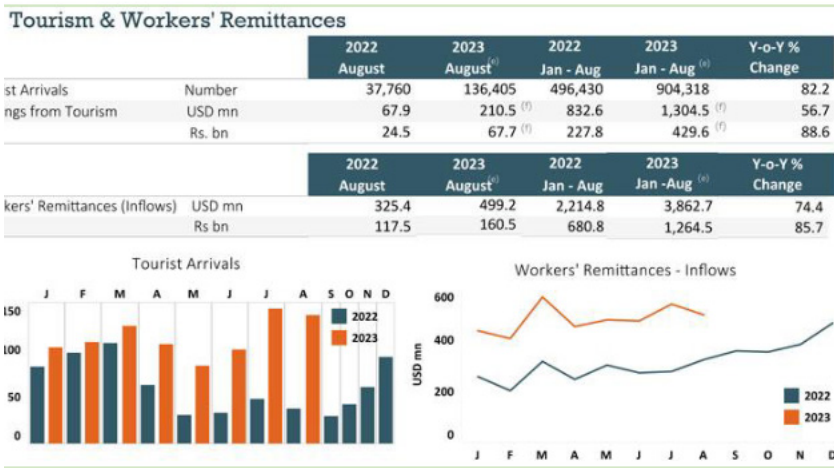


Figure 2: Tourism and Workers' Remittances compression 2022/Jan-Aug 2023

Source: Monthly Tourist Arrivals Report of Sri Lanka Tourism Development Authority – Dec 2023

The paper aimed at the way a green logistic can be introduced to help the development of Sri Lanka tourism industry efficiently and environmentally friendly. The eco-logistics comprehend an assembly of methods that are being implemented all along the supply chain of the tourism sector, meaning to not only reduce but also conserve natural resources. These three critical areas of study would be broadly investigated to reach a holistic understanding, which are as follow;

A. Common Green Logistics Practices on the Tourism Industry in Sri Lanka

Sri Lanka's tourism way is based on the country's scenic landscape and the cultural heritage, but the habitual doing of things now is in the danger of losing them. A green logistics environments should be an important part to achieve sustainable development. It is an approach that provides tours with eco-friendly content; green transportation is used and waste is managed in an environmentally friendly way. Through this theory so many eco-tourists can be attracted, which has very positive consequences for economy, at the same time ensuring the protection of the environment for a great result. The main five sustainable green logistics practices which can be the foundation in

the quest of giving a green future to the Sri Lanka's tourism industry;

1. Eco-Tourism Packages: Creating nature based tourism experience that interfuses with nature instead of destroying the environment. The types of activities involved in the ecosystem tourism range between wildlife safaris, hiking and cultural explorations.

2. Electric or Hybrid Vehicles: Communicate with the hotels and other providers operating in that region and require them to use electric or hybrid vehicles for airport transfers, sightseeing tours, and local passenger transportation within the destination. This can be considered as an important part of the measures to cut down carbon emissions and air pollution.

3. Waste Management Programs: By involving proper waste management systems all across the tourist destinations. Empowering local cultures through tourism: implications for social, economic, and environmental sustainability. This includes composting organic wastes, sanitize metals, and to minimize one-time plastic product.

4. Sustainable Accommodation: We have partnered with the hotels and resorts that have greened their operations and practices through use of energy-saving appliances, water-conservation measures and employing of the local produce and food products. (E.g:- Jetwing Vil Uyana, Sigiriya, Tri Lanka, Koggala Lake and Ulagalla by Uga Escapes, Anuradhapura).

5. Digital Marketing and Communication: A DMC must take advantage of digital platforms for marketing and communication. These might include emails or social media posts instead of paper brochures, for example.

Figure 3: Green Logistics Practices on the Tourism Industry in Sri Lanka
Source: Developed by Author

B. Green Supply Chain Management in Sri Lanka's Hospitality / Tourism Industry

The Sri Lankan Tourism industry, the major lift support for the economy, approaches a crucial challenge of balancing the high rate of growth with the responsibility for environment protection. By using tour the changing sceneries and the old cultural inheritance that is what attracts the tourist but the traditional way of tourism follows

heavily green supply chains. Green Supply Chain Management (GSCM) is one of those solutions that acts on all the stages of tourism through practices that aim mainly exploiting the least resources and at the same time, keeping the last atoms limited.

This section of the study analyze the existing state of GSCM in Sri Lanka by the hospitality and tourism sector at the present time. Disclosing the acquired strategies and specifying the areas for the growth and development are indispensable for the establishing of sustainable goals' roadmap. In this section, will introduce the three integral components which are;

1. Identify Existing Practices

As tourism in Sri Lanka is still growing, attention is being given to sustainability and encouraging the stakeholders to include GSCM practices in their area. Below is a glimpse of a few existing initiatives that cover various aspects of the industry;

In Hospitality Sector; Energy Efficiency: High-end hotels and resorts are changing their way of operation by using less power. These measures include changing various forms of bulbs to LED, employing energy-efficient appliances, and using occupancy sensors to reduce electricity to the minimum, Water Conservation: The water-saving faucets and urinals that today are the standard in most bathrooms, rainwater harvesting for landscaping, and even guest awareness about water conservation are becoming popular water conservation practices, Sustainable Procurement: By now, the items from local producers, non-toxic and eco-friendly cleaners, and pieces of furniture from reclaimed wood were among the top choice of customers, Waste Management: Composting, recycling papers, plastics, and glasses, and reducing single-use plastics are the main traceable objects in hotels to manage the waste appropriately, and Sustainable Linen and Laundry Services: Although some hotels are transitioning to eco-friendly linen practices and using biodegradable detergents provided to the guests so that they can reuse the towels and linens.

Second, Transportation Providers; Modernization of Fleets: Gradually, aircraft will be equipped with engines that reduce fuel consumption and emissions to the minimum, Eco-Friendly Tours: Car rentals companies are adapting and providing electric or hybrid cars for city tour or in certain destinations visited by most travelers, and Responsible Waste Management: Airports and transport centers are such entities that create initiatives on recovery and segregation of garbage to reduce environmental impact. And

Travel Agencies and Activity Providers; Promotion of Eco-Tours: As a result, several travel agencies are generating more and more ecotourism which gives natural praises care and ecological factor consideration. They may be about

wildlife safaris through eco - tourism or participation in adventurous trekking or other programs which support the local communities, Carbon Offsetting Options: One of the ways is to let travellers contribute to carbon offsetting projects that support emissions reduction, so that to compensate for their travel greenhouse gas footprints, and Partnerships with Local Communities: Travel companies together with local activity providers put forward communities that emphasize responsible tourism practices.

2. Evaluate Effectiveness

Analyze if the existing green practices in the Sri Lankan tourism industry are effective on the environmental sustainability and resources use or not. Green practices are embraced by Sri Lanka's tourism sector as it has realized the importance of sustainability. The results of environmental practices are ambiguous and do not clearly show that the goals for environment would be achieved. Include the discussion on the analysis;

Positive aspects; Policy and Initiatives: In a move forward, Sri Lanka Tourism Development Authority (SLTDA) enrolls in the National Sustainable Tourism Certification (NSTC) program. On this basis, engaged hotels together with some tourism businesses which are associated with the green practices. The GBCSL of Sri Lanka (GBCSL) has many tools in its toolbox, one of which is the Green SL rating system that is used to score and evaluate the environmental performance of a building, Focus areas: Sri Lankan environmental practices are in the favorites for crucial Eco- issues, Energy conservation: Initiatives are to employ energy savvy appliances, exploit sustainable energy resources such as solar power and educating guest about acceptable environmental behavior (e.g., switching off unnecessary lights), Water conservation: Write down the rainwater harvesting, low-flow showerheads, and educating guests on water usage which could be the first steps that hotels take to find solutions for their own water use, and Waste management: Composting food waste, phasing out the usage of plastics, and appropriate waste management at different levels are one of the approaches.

C. Impact of Green Logistics on Sustainable Development of economy

Sri Lanka tourism sector has developed a reputation of being a haven of environmental resources and architectural landmarks. But being successful at this is mostly a matter of making a balance between economics and the environment. The commitment to sustainable transportation called green logistics is the most excellent solution. Through the optimum use of transport, storage and packaging processes, which are devised in a way so that they do not harm the environment, the industry has quite a

number of economic and environmental perks.

Instead, the Sri Lankan tourism industry can make the best of the situation if it adopts a green logistics model. Businesses enjoy lowering costs and increased exposure in the market, while the country protects the environment and educates its people for long-term economic prosperity. This moving toward green tourism places Sri Lanka among the forerunners responsible tourism ensuring a flourishing future to both the two pillars of the industry - the people and the island nation's ecological wonders. For the Sri Lanka's tourism industry this would be create a lot of economic benefits and also the environment friendly;

Economic Benefits; Enhanced Brand Image: An environmental conscious among travelers is rising. Integrating green logistics can symbolize one's commitment to sustainability. With that in mind, it can bring in eco-tourists and raise the reputation of a brand, which, in essence, can provide the competitive advantage, Increased Efficiency: The simplification of logistics means fewer repetitions and faster delivery times, resulting in better service for customers and perhaps, in turn, raising the level of tourist satisfaction, Government Incentives: Sri Lanka's government can provide tax cuts or other advantages to companies that do this by practicing the green way, Increased Tourist Arrivals: As eco-tourism is becoming more popular, tourists starting leaning in favor of destinations that are in line with sustainable practices. It is likely that the total number of tourists and revenues will rise, Improved Tourist Experience: Sustainable tourism in Sri Lanka promotes the idea of environmental friendliness, as well as it gives tourists an opportunity to reconnect with the beauties of Sri Lanka's natural reserves, Waste Management Efficiency: Check how well the waste management programs which have been put into use by hotels, resorts and other tourism service providers have carried out their roles. It could be, for example, a study of diversion rate data from composting and recycling as compared to landfill, and Other Economic Benefits: Less fuel, waste disposal and resources used for businesses lead to operational cost savings in tourism.

Environmental Benefits; Carbon Footprint Reduction: Determine any less greenhouse gas emissions achieved from existing green practices via any means. The aim of such a research could be, for example, in studying the impact of promoting eco-friendly transport options such as bicycles and electric vehicles, or analysis of data, after adopting energy-efficient appliances in hotels, on their energy consumption, Conservation of Resources: The principles of waste reduction, as well as optimization of resources for shipment and storage additionally promote sustainable environmental impact, Protection of Biodiversity: Efficient logistics is an effective tool to resist pollution, which causes a lot of harm to living organisms but is on the opposite – the Sri Lankan nature's marvel, a serene place for tourists from most corners of the world, and Natural Resource Protection: Consider the current protectionism mechanisms in place for preservation of the natural resources in Sri Lanka. It can mean monitoring water consumption measures

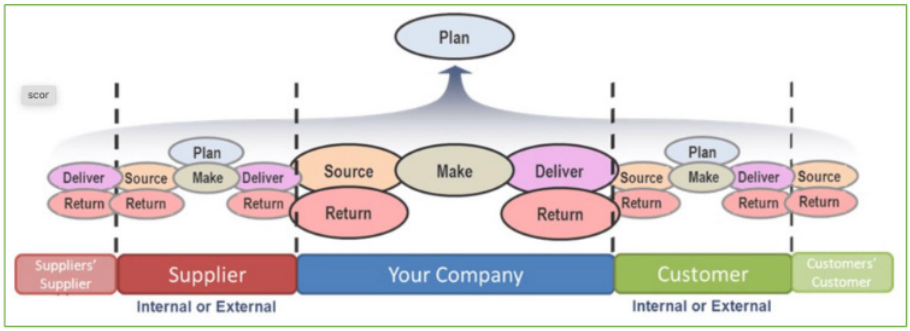
in hotels, waste responsible disposal systems around the destination cities or reveal the consequences of ecotourism on wildlife and their ecosystems.

D. Green Supply Chain Operations Reference (Green SCOR)

The Green Supply Chain Operations Reference (Green SCOR) model can be a valuable tool for optimizing Sri Lanka's tourism industry for sustainable economic development and contributing to the overall economy. The Green SCOR model builds upon the Supply Chain Operations Reference (SCOR) model, a widely used framework for supply chain management. Green SCOR adds environmental considerations to the core SCOR functionalities. It provides a structured approach to assess and improve practices across the entire supply chain.

1. Applying Green SCOR to Sri Lanka's Tourism Industry for the economic development

Identify Green Practices: Analyze the tourism industry in Sri Lanka and identify areas where green practices can be implemented. This includes aspects like; Procurement: Sourcing local, sustainable products for hotels and resorts, Transportation: Optimizing routes and fuel efficiency for transportation of goods and services, Packaging: Utilizing eco-friendly packaging materials for supplies and guest amenities. Operations: Implementing energy and water conservation measures in hotels and resorts, and Returns & Disposal: Establishing responsible waste management practices



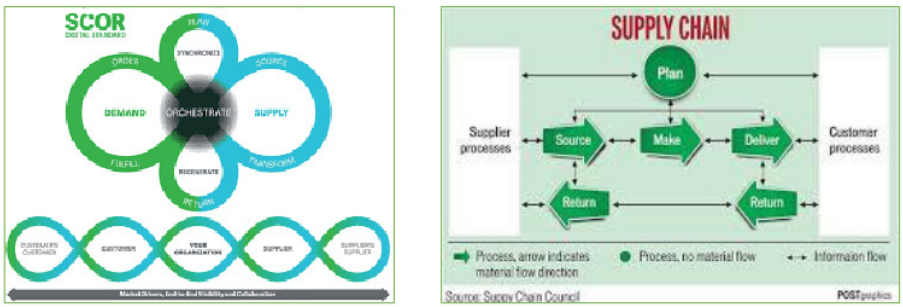
Traditional SCOR Model of Supply Chain Management
Source: https://majorsustainability.smeal.psu.edu/greenscor-model

2. Map Green Practices to SCOR Processes

Match the identified green practices to the relevant SCOR processes. SCOR categorizes supply chain activities into five core processes: Plan, Source, Make, Deliver, and Return.

3. Performance Measurement

Green SCOR offers metrics to evaluate the environmental impact alongside traditional performance measures like cost and delivery time. This allows you to track progress and identify areas for improvement.



SCOR Model of Supply Chain Management
Source: https://majorsustainability.smeal.psu.edu/greenscor-model

5. Benefits for Sri Lanka's Economy

By implementing Green SCOR in the tourism industry, Sri Lanka can achieve several benefits; Reduced Environmental Impact: Sustainable practices minimize resource consumption and pollution, contributing to a healthier environment, Enhanced Brand Image: Eco-conscious tourists are increasingly drawn to destinations with sustainable practices, Cost Savings: Green practices often lead to cost reductions in areas like energy and waste disposal, Improved Competitiveness: A focus on sustainability can differentiate Sri Lanka's tourism industry from competitors, and Economic Growth: A thriving, sustainable tourism industry generates jobs, investment, and revenue.

5. Conclusion

Green logistics in particular was analyzed in this research as a mean for the sustainable development of the Sri Lankan tourism industry. This research shows how the Sri Lankan hospitality sector can adopt green practices by analyzing existing practices that are implemented worldwide in the supply chain. An assessment framework developed in this research, which is based on the Green SCOR model and the opinions of manufacturing industry experts, gives a very useful tool to find out which green practices a company should implement first. Institution of these procedures can result in tangible economic and environmental advantages.

Green Logistics will give a boost to Sri Lanka's competitiveness in the global tourism market and enable it to welcome environmentally friendly tourists. On the other

hand, resource optimization becomes the root of cost savings for tourism businesses and ultimately leads to economic growth. In addition, through lessening environmental footprint, Green Logistics can contribute to Sri Lanka's ecological preservation and natural beauty – which is the base of its tourism industry – thereby, keeping the business sustainable.

Finally, this research underlines the essence of the green logistic for the achievement in sustainable development of Sri Lanka tourism industry. Through implementing eco-friendly methods throughout the supply chain, the country will be able to protect its natural resources, improve its economic competitiveness and will end up with constant development and coexistence with nature in the tourism sector.

REFERENCES

De Silva, Rukmal. "Green Competitiveness in the Logistics Industry: Analysis of Emerging Practices from Three Continents." (2023).

De Silva, R. (2023). Green Competitiveness in the Logistics Industry: Analysis of Emerging Practices from Three Continents.

Lenora, V. S., et al. "Green Logistics for Sri Lankan Business Organizations: A study of Attitudes of Managers and Staff Members, and the impact it has on productivity-A Research Proposal." USCMT 2014 (2014): 164.

Jayarathna, Chamari Pamoshika, et al. "Multi-objective optimization for sustainable supply chain and logistics: A review." Sustainability 13.24 (2021): 13617.

Sandhu, Sonia Chand, Vedanti Kelkar, and Vaideeswaran Sankaran. Resilient coastal cities for enhancing tourism economy: integrated planning approaches. No. 1043. ADBI Working Paper Series, 2019.

Perez Cuso, M., Zhao, Y., Bakeer-Markar, A., Peiris, S., & Rajapakse, V. (2024). Strategy to promote inclusive and sustainable businesses to achieve the Sustainable Development Goals in Sri Lanka: Background note.

Amjad, Ahmad, et al. "Effects of the green supply chain management practices on firm performance and sustainable development." Environmental Science and Pollution Research 29.44 (2022): 66622-66639.

Akkucuk, Ulas. "SCOR model and the green supply chain." Handbook of research on waste management techniques for sustainability. IGI Global, 2016. 108-124.
Schrödl, Holger, and Paulina Simkin. "A SCOR perspective on green SCM." (2013), and Chat GPT.

PUBLIC-PRIVATE SECTOR SYNERGY: DRIVING ECONOMIC PROSPERITY THROUGH LOGISTICS

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Abstract

In today's globalized economy, the collaboration between the public and private sectors is crucial for ensuring efficient and sustainable logistics management, which in turn drives economic prosperity and resilience. This paper delves into the multifaceted relationship between the public and private sectors in the realm of logistics, examining how their synergy contributes to economic growth, stability, and adaptability. Through a comprehensive review of literature, case studies, and empirical evidence, this paper elucidates the mechanisms, challenges, and opportunities associated with public-private sector collaboration in logistics management. By highlighting successful strategies and best practices, it offers insights for policymakers, practitioners, and stakeholders to enhance cooperation and navigate sustainably in the face of evolving challenges and opportunities.

Keywords: *logistics management, public-private sector synergy, economic prosperity, sustainability, resilience*

1. Introduction

The intersection of globalization, rapid technological advancements, and dynamic shifts in consumer preferences has propelled logistics management into a pivotal role as a catalyst for fostering economic resilience and prosperity. As goods and services traverse borders with increasing frequency and complexity, the efficiency and effectiveness of logistics operations become paramount in ensuring the smooth flow of trade and commerce.

Against this backdrop, the collaboration between the public and private sectors emerges as a cornerstone for unlocking the full potential of logistics management. This synergy serves as a linchpin for streamlining supply chains, bolstering infrastructure, and establishing regulatory frameworks conducive to sustained economic growth. By harnessing the collective strengths and resources of both sectors, stakeholders can navigate the intricacies of modern logistics challenges with agility and innovation.

This paper delves into the dynamic interplay between the public and private sectors in the realm of logistics management, exploring how their collaboration influences the trajectory of sustainable economic development. Through a comprehensive examination

of collaborative initiatives, regulatory landscapes, and strategic partnerships, we seek to unravel the complexities and uncover the opportunities inherent in this synergistic relationship. By elucidating the synergies and potential pitfalls of public-private sector collaboration in logistics management, this study aims to provide insights and recommendations for driving forward sustainable economic development agendas in an increasingly interconnected and competitive global landscape.

Theoretical Framework

a. Transaction Cost Economics: Transaction Cost Economics (TCE), developed by Nobel laureate Oliver E. Williamson, provides a lens through which to understand the dynamics of transactions between economic agents, including firms and institutions. TCE posits that economic actors seek to minimize transaction costs, which encompass the costs of searching for information, negotiating contracts, and enforcing agreements. In the context of logistics management, TCE helps elucidate the decision-making processes involved in choosing between different governance structures for coordinating supply chain activities.

Within public-private sector synergy in logistics, TCE offers insights into the choice between hierarchical (e.g., government-led) and market-based (e.g., private sector-led) governance mechanisms. For instance, when designing and managing transportation infrastructure projects, policymakers must consider whether to engage in direct provision through government agencies or rely on private sector participation through public-private partnerships (PPPs). TCE highlights the trade-offs between transaction costs associated with bureaucratic inefficiencies and those stemming from market failures, guiding policymakers in selecting the most efficient governance structure.

b. Institutional Theory: Institutional Theory examines how institutions, including formal rules, norms, and cognitive scripts, shape the behavior and interactions of individuals and organizations within a socio-economic context. Institutions are the scaffolding upon which economic activities are structured, influencing the strategies, practices, and relationships within and between the public and private sectors.

In the context of logistics management, Institutional Theory sheds light on the role of regulatory frameworks, industry standards, and cultural norms in shaping public-private sector collaboration. For example, regulations governing trade facilitation and customs procedures can either facilitate or hinder cross-border logistics operations. Institutional pressures, such as legal requirements and societal expectations, also influence the adoption of sustainable logistics practices by both public and private actors.

Understanding institutional dynamics is crucial for navigating the complexities of public-private sector synergy in logistics, as it helps stakeholders anticipate and respond to regulatory changes, market trends, and stakeholder expectations. By aligning

their strategies with prevailing institutional logic, actors can enhance the legitimacy and effectiveness of collaborative initiatives, thereby fostering economic prosperity and resilience.

c. Resource Dependence Theory: Resource Dependence Theory (RDT), developed by Jeffrey Pfeffer and Gerald Salancik, examines how organizations strategically manage their dependence on external resources to achieve their goals and objectives. According to RDT, organizations are embedded within interdependent networks of resource exchange, wherein power dynamics and asymmetries shape their ability to access and control critical resources.

In the context of logistics management, RDT elucidates the interplay of power dynamics between the public and private sectors in shaping collaborative arrangements. For instance, private logistics firms may possess specialized expertise, technology, and capital, while public entities control regulatory frameworks, infrastructure assets, and policy levers. Effective collaboration requires navigating these power asymmetries through negotiation, coalition-building, and resource-sharing mechanisms.
Moreover, RDT highlights the role of inter-organizational networks and alliances in mitigating resource dependencies and enhancing organizational resilience. By forging strategic partnerships and alliances with complementary stakeholders, firms and governments can leverage their respective resources and capabilities to address shared challenges, such as climate change mitigation, supply chain disruptions, and infrastructure development. Public-private partnerships

The Role of Public-Private Sector Synergy in Driving Economic Prosperity

a. Infrastructure Development and Investment: Infrastructure serves as the foundation of logistics operations, comprising transportation networks, ports, warehouses, and ICT systems. Public-private sector synergy is vital for driving infrastructure development and investment, catalyzing economic prosperity. While public entities control planning and regulation, private firms bring expertise and financing. Collaboration accelerates critical infrastructure projects, facilitated by mechanisms like PPPs. These partnerships leverage private investment, streamline project delivery, and align investments with economic goals. Innovative financing mechanisms, such as toll roads, enhance project sustainability. Transparent governance optimizes resource allocation, maximizing socio-economic benefits.

b. Policy and Regulatory Alignment: Policy and regulatory frameworks are vital for shaping the logistics operating environment, covering trade facilitation, customs procedures, safety standards, and environmental regulations. Public-private sector synergy is crucial for aligning policies that support logistics activities and drive economic growth. Collaboration enables evidence-based policymaking, balancing stakeholder interests, promoting competition, and removing trade barriers. Engaging in dialogue

and consultation processes allows policymakers to understand industry needs and develop targeted interventions. Public-private partnerships facilitate regulatory reforms, capacity-building, and harmonization efforts to enhance institutional capabilities and compliance with standards. Collaboration promotes the adoption of best practices, enhancing transparency, accountability, and trust in logistics operations. This fosters fair competition, innovation, and continuous improvement in logistics management.

c. Innovation and Technology Adoption: Innovation and technology are reshaping logistics management, offering opportunities to boost efficiency, cut costs, and enhance sustainability. Public-private sector collaboration drives technology adoption across the logistics value chain. By facilitating knowledge exchange and research collaboration, stakeholders accelerate the development of innovative solutions. Public-private partnerships catalyze private investment in innovation ecosystems, nurturing startups and SMEs. Collaboration also promotes industry standards and data-sharing frameworks, fostering an open innovation culture that optimizes resource utilization and enhances operational efficiency in logistics operations.

Mechanisms of Collaboration

a. Public-Private Partnerships (PPPs): Public-private partnerships (PPPs) in logistics management are collaborative arrangements between government entities and private sector firms to jointly plan, finance, develop, and operate infrastructure projects and services. They offer a flexible mechanism to leverage the strengths of both sectors to address infrastructure deficits, promote innovation, and enhance service delivery. Various contractual models, such as concessions and build-operate-transfer agreements, are tailored to project needs. PPPs facilitate risk-sharing and incentivize private investment, with each party contributing expertise and resources. However, successful implementation requires robust governance, transparent procurement, and effective risk management to ensure value for money and public interests. Continuous monitoring and evaluation are essential for project performance optimization.

b. Collaborative Governance Structures: Collaborative governance structures in logistics management facilitate coordination and decision-making among diverse stakeholders, including government agencies, industry associations, and civil society organizations. These structures enable alignment of interests, information sharing, and collective problem-solving for complex challenges like trade facilitation and sustainability. Multi-stakeholder platforms serve as forums for dialogue and consensus-building, enhancing policy formulation and coordination. Inclusive decision-making processes promote transparency and accountability, overcoming barriers to collaborative action. Additionally, these structures foster innovation by harnessing stakeholders' collective intelligence to address emerging challenges. However, their effectiveness hinges on factors like institutional capacity and stakeholder engagement, necessitating investment in capacity-building and trust-building initiatives for sustainability.

c. Information Sharing Platforms: Information-sharing platforms are vital for transparency and collaboration among public and private stakeholders in logistics management. They facilitate real-time data exchange on supply chain performance, market trends, and regulatory requirements, enhancing decision-making and operational efficiency. Common platforms include EDI systems and supply chain visibility networks, enabling tracking across complex supply chains. They also aid regulatory compliance by automating documentation and streamlining customs processes, reducing delays and costs. Additionally, these platforms help anticipate and mitigate disruptions through early warning alerts and predictive analytics. Challenges like data governance and cybersecurity require clear rules and standards to build trust and ensure information integrity.

Challenges and Barriers

a. Misaligned Incentives and Objectives: Misaligned incentives and objectives pose a significant challenge to public-private sector synergy in logistics management. The public sector prioritizes societal goals, while the private sector focuses on profit. This misalignment can lead to conflicts and coordination challenges in collaborative initiatives. For example, stringent regulations may burden private firms, affecting competitiveness. Differences in time horizons and risk preferences exacerbate alignment issues. Addressing this challenge requires dialogue and compromise to find common ground. Incentive mechanisms like performance-based contracts can foster cooperation toward shared goals.

b. Regulatory Complexity and Compliance Burdens: Regulatory complexity and compliance burdens present significant obstacles to public-private sector synergy in logistics management. The industry faces diverse regulations imposed by various entities, leading to challenges in navigating this landscape. Compliance entails costs and risks, particularly for SMEs. Regulatory uncertainty undermines investment confidence and hampers innovation, hindering economic growth. To address these challenges, stakeholders must engage in regulatory reform efforts to simplify procedures and harmonize standards. Governments should promote coherence, transparency, and predictability in regulations to foster investment and competitiveness. Capacity-building initiatives and training programs are essential to enhance compliance capabilities among logistics operators. By providing support and incentives for compliance, governments can help businesses navigate regulatory challenges and improve logistics management practices.

c. Trust Deficits and Communication Gaps: Trust deficits and communication gaps pose significant barriers to public-private sector synergy in logistics management. Building trust is crucial for collaboration and achieving shared objectives. However, historical grievances and perceived conflicts of interest may hinder trust between sectors. Communication gaps impede collaboration by hindering information flow,

leading to misunderstandings and suboptimal decision-making. Addressing these challenges requires relationship-building, transparency measures, and conflict-resolution mechanisms. Open dialogue helps identify common interests and establish clear communication channels. Leveraging technology enables efficient information sharing and stakeholder engagement. Fostering a culture of transparency, accountability, and integrity is vital for building trust and credibility in collaborative governance structures. Adhering to ethical standards and honoring commitments demonstrate commitment to shared values, fostering trust in collaborative initiatives.

Case Studies

a. Port of Rotterdam: Public-Private Collaboration for Sustainable Port Operations: The Port of Rotterdam exemplifies successful public-private collaboration for sustainable port operations. Collaborative efforts between the Port Authority of Rotterdam (PoR) and private stakeholders optimize port operations and promote sustainability. The Rotterdam Green Port Program reduces environmental impact through initiatives like shore power facilities and emission reduction targets. Collaborative platforms like PortXL and RMSC foster innovation and knowledge exchange, enhancing efficiency and sustainability. Rotterdam sets benchmarks for environmental performance and stakeholder engagement, driving economic prosperity and resilience globally.

b. The ASEAN Single Window Initiative: The ASEAN Single Window (ASW) Initiative showcases the power of public-private collaboration in promoting cross-border trade and regional economic integration within the Association of Southeast Asian Nations (ASEAN). The initiative aims to streamline customs procedures and digitize clearance processes, facilitating the electronic exchange of trade documents among member states. Public-private collaboration between government agencies and private sector stakeholders has harmonized customs procedures and developed interoperable IT systems, resulting in faster clearance times and reduced trade costs for businesses. These efforts have enhanced ASEAN's competitiveness, attracted investment, and stimulated intra-regional trade, driving economic prosperity and resilience. Furthermore, the ASW Initiative promotes cooperation among member states and supports broader regional integration efforts, such as the ASEAN Economic Community (AEC), demonstrating ASEAN's commitment to fostering a conducive business environment and facilitating trade facilitation.

Strategies for Enhancing Collaboration

a. Establishing Clear Goals and Objectives: Establishing clear goals and objectives is fundamental for enhancing collaboration between the public and private sectors in logistics management. Clear goals provide a common vision and roadmap, guiding stakeholders toward shared outcomes. Stakeholders should engage in

participatory goal-setting processes involving diverse stakeholders to ensure inclusivity and relevance. Goals should be SMART to provide clarity and accountability. Regular communication and coordination mechanisms are crucial for ensuring alignment with evolving priorities and market conditions. Fostering transparency and accountability builds trust and enhances the effectiveness of public-private sector synergy in logistics management.

b. Building Trust and Mutual Understanding: Building trust and mutual understanding is essential for effective collaboration between the public and private sectors in logistics management. Trust enables stakeholders to overcome barriers and achieve common goals with confidence and integrity. To build trust, stakeholders should invest in relationship-building, communication, and conflict-resolution mechanisms. Active listening and empathy help bridge differences and build rapport. Demonstrating commitment through actions reinforces trust. Cultivating a collaborative culture encourages innovation and problem-solving, enhancing the resilience of collaborative initiatives in logistics management.

c. Leveraging Technology and Data Analytics: Leveraging technology and data analytics is crucial for enhancing collaboration between the public and private sectors in logistics management. Investing in digital platforms enables real-time data exchange, empowering stakeholders to make informed decisions and respond to market changes. Embracing emerging technologies like blockchain and IoT enhances transparency and efficiency in operations. Moreover, investing in data analytics capabilities allows stakeholders to extract insights from big data, optimizing supply chain performance. Overall, these strategies help overcome challenges and achieve shared goals for economic prosperity and resilience.

Policy Implications and Recommendations

a. Streamlining Regulatory Frameworks: Streamlining regulatory frameworks is crucial for fostering an enabling environment that promotes public-private sector synergy in logistics management. Complex and fragmented regulations can impede trade flows, increase compliance costs, and hinder the efficiency of logistics operations. To streamline regulatory frameworks, policymakers should:

Conduct regulatory impact assessments to identify redundant regulations, streamline administrative procedures, and remove barriers to trade and investment.

Harmonize customs procedures, documentation requirements, and technical standards across jurisdictions to facilitate cross-border trade and reduce compliance burdens for logistics operators.

Implement single window systems and electronic customs platforms that enable stakeholders to submit trade-related documents and declarations electronically, thereby

expediting customs clearance processes and reducing paperwork.

Establish regulatory sandboxes and pilot projects to test innovative regulatory approaches, such as risk-based inspections, self-certification schemes, and trusted trader programs, that enhance efficiency and compliance in logistics operations.

By streamlining regulatory frameworks, policymakers can create a more predictable, transparent, and business-friendly environment that encourages investment, innovation, and competitiveness in the logistics sector, thereby driving economic prosperity and resilience.

b. Investing in Infrastructure and Digitalization: Investing in infrastructure and digitalization is essential for enhancing the efficiency, reliability, and sustainability of logistics operations and promoting public-private sector synergy. Infrastructure deficits, inadequate connectivity, and outdated technology infrastructure can constrain supply chain performance and impede economic growth. To invest in infrastructure and digitalization, policymakers should:

Allocate adequate funding for the development and maintenance of transportation infrastructure, including roads, railways, ports, and airports, to support seamless connectivity and efficient freight movement.

Promote public-private partnerships (PPPs) and private sector investment in infrastructure projects through incentives, tax breaks, and risk-sharing mechanisms that mobilize private capital and expertise.

Embrace digitalization initiatives, such as digital supply chain platforms, IoT-enabled logistics networks, and blockchain-based traceability systems, that enhance visibility, transparency, and efficiency in logistics operations.

Invest in digital skills training, capacity-building programs, and technology adoption incentives to empower logistics operators and workers to harness the benefits of digitalization and innovation.

By investing in infrastructure and digitalization, policymakers can modernize logistics ecosystems, improve supply chain resilience, and unlock new opportunities for economic growth and development in an increasingly digital and interconnected world.

c. Promoting Capacity Building and Knowledge Transfer: Promoting capacity building and knowledge transfer is essential for enhancing the capabilities, competencies, and collaboration among public and private sector stakeholders in logistics management. Capacity constraints, skills shortages, and knowledge gaps can impede the effectiveness of collaborative initiatives and hinder progress toward shared goals. To promote capacity

building and knowledge transfer, policymakers should:

Invest in vocational training, skills development programs, and professional certifications for logistics professionals, government officials, and industry practitioners to enhance technical expertise, managerial skills, and regulatory compliance capabilities. Facilitate knowledge exchange, best practice sharing, and peer learning through training workshops, seminars, and industry conferences that bring together public and private sector stakeholders to discuss emerging trends, challenges, and opportunities in logistics management.

Establish partnerships with academic institutions, research organizations, and industry associations to conduct research, pilot projects, and technology demonstrations that generate new knowledge, insights, and solutions for logistics challenges.

Foster cross-sectoral collaboration and multi-stakeholder engagement through public-private dialogue platforms, advisory committees, and task forces that enable stakeholders to co-create policies, strategies, and initiatives that address shared challenges and priorities.

By promoting capacity building and knowledge transfer, policymakers can strengthen the resilience, agility, and competitiveness of logistics ecosystems, enabling stakeholders to navigate global uncertainties and seize new opportunities for sustainable economic growth and development.

Conclusion

As logistics management continues to evolve in response to shifting global dynamics, the collaboration between the public and private sectors will remain pivotal for driving economic prosperity and resilience. The intricate interplay between government agencies, industry players, and other stakeholders shapes the efficiency, sustainability, and competitiveness of logistics ecosystems worldwide. By addressing challenges, embracing innovation, and fostering trust-based partnerships, stakeholders can unlock the full potential of synergistic collaboration and navigate sustainably toward a prosperous future.

The importance of collaboration between the public and private sectors in logistics management cannot be overstated. From infrastructure development and policy alignment to innovation adoption and capacity building, collaborative efforts enable stakeholders to pool resources, share expertise, and address complex challenges that transcend organizational boundaries. By leveraging the complementary strengths of both sectors, stakeholders can enhance the efficiency, reliability, and sustainability of logistics operations, driving economic growth and development.

However, collaboration is not without its challenges. Misaligned incentives, regulatory complexity, and trust deficits can impede collaboration and hinder progress toward shared goals. Overcoming these challenges requires proactive engagement, transparent communication, and mutual understanding among stakeholders. By building trust-based partnerships, stakeholders can navigate challenges, overcome obstacles, and achieve collective impact in logistics management.

Moreover, embracing innovation and digitalization is essential for enhancing the resilience and competitiveness of logistics ecosystems. Technologies such as blockchain, IoT, and data analytics offer opportunities to optimize supply chain operations, improve decision-making, and enhance transparency and traceability. By investing in infrastructure and digitalization, stakeholders can modernize logistics systems, unlock new opportunities, and adapt to evolving market dynamics

Collaboration between the public and private sectors is indispensable for driving economic prosperity and resilience in logistics management. By addressing challenges, embracing innovation, and fostering trust-based partnerships, stakeholders can unlock the full potential of synergistic collaboration and navigate sustainably toward a prosperous future. Together, we can build resilient and inclusive logistics ecosystems that support sustainable development and create shared value for society.

REFERENCES

Association of Southeast Asian Nations (ASEAN). (2021). ASEAN Single Window: Key Documents. Retrieved from https://asean.org/asean-economic-community/asean-single-window/asean-single-window-key-documents/

European Commission. (2021). Public-Private Partnerships in European Structural and Investment Funds: Guidance Document. Retrieved from https://ec.europa.eu/regional_policy/sources/docgener/informat/2014/ppp_guidance.pdf

Port of Rotterdam Authority. (2021). Sustainability Report 2021. Retrieved from https://www.portofrotterdam.com/en/sustainability-report-2021

United Nations Conference on Trade and Development (UNCTAD). (2020). Public-Private Partnerships for Sustainable Development: A Handbook. Retrieved from https://unctad.org/system/files/official-document/diaepcb2020d4_en.pdf

World Economic Forum (WEF). (2021). Accelerating Sustainable Public-Private Partnerships: Global Infrastructure Initiative. Retrieved from https://www.weforum.org/reports/accelerating-sustainable-public-private-partnerships-global-infrastructure-initiative

GREEN HORIZONS: STEERING SUSTAINABLE LOGISTICS FOR THE ECONOMIC RESILIENCE

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Abstract

This article investigates the basic connection between maintainable strategies and financial strength, underlining the significance of ecologically dependable practices across the inventory network. Economical coordinated factors includes streamlining transportation strategies, warehousing, and store network the board to lessen natural effect and work on functional proficiency. The monetary advantages of taking on feasible coordinated factors incorporate expense reserve funds, risk moderation, and upgraded intensity.

Key methodologies for maintainable operations incorporate carrying out eco-friendly transportation, advancing courses, putting resources into energy-proficient warehousing, embracing roundabout economy rehearses, and advancing cooperation across the store network. Contextual analyses of driving organizations like DHL, UPS, Maersk, Amazon, and Ikea show how manageable coordinated factors systems have prompted substantial financial and natural advantages.

Peaceful accords like the Paris Understanding and different country-explicit strategies give a structure to advancing economical planned operations internationally. Arising patterns and advancements, like independent vehicles, jolt, IoT, blockchain, and simulated intelligence, are molding the eventual fate of manageable strategies, offering the two difficulties and open doors.

Keywords: *Maintainable coordinated operations, Monetary strength, Green practices, Eco-friendly transportation, Elective fills, Course streamlining, Energy-productive warehousing, Round economy, Electric vehicles, Independent vehicles, IoT (Web of Things), Blockchain, Multimodal transport, Arising advances, Paris Understanding, Discharge decrease.*

1. Introduction

As the world wrestles with the difficulties of environmental change and natural corruption, the planned operations industry ends up at a basic intersection. The requirement for manageable coordinated factors has never been seriously squeezing. Economical operations allude to the practices and strategies utilized to limit the ecological

effect of getting products and materials across the inventory network. This incorporates improving transportation courses, decreasing outflows, using eco-accommodating bundling, and embracing energy-productive advances away and conveyance.

Financial strength, then again, is the capacity of an economy to retain and recuperate from shocks while keeping up with fundamental capabilities and advancing long haul manageability. With regards to strategies, monetary strength includes making vigorous, versatile frameworks that can endure disturbances and keep on working productively.

The connection between supportable planned operations and financial versatility is interlaced. By embracing supportable coordinated factors rehearse, organizations can improve their financial flexibility through cost reserve funds, functional efficiencies, and chance relief. Economical operations helps the climate as well as fortifies supply chains, making them more powerful and less defenseless against unanticipated interruptions like cataclysmic events, international strains, or market variances.

Besides, supportable strategies encourage a positive corporate standing and assists organizations with meeting administrative necessities and shopper assumptions for eco-accommodating practices. As organizations and states focus on maintainability, the job of reasonable coordinated operations in accomplishing monetary strength turns out to be progressively focal. In this article, we will investigate how maintainable planned operations can prompt a stronger economy and the methodologies organizations can take on to understand this objective.

The Current Landscape Of Logistics And Sustainability

Coordinated factors assume a vital part in the worldwide economy by working with the development of labor and products across locales and markets. Notwithstanding, conventional operations rehearses have for quite some time been related with a critical natural effect. Transportation is one of the biggest wellsprings of ozone harming substance discharges, especially carbon dioxide (CO2), which adds to a worldwide temperature alteration and air contamination. Moreover, the utilization of non-sustainable energizes in cargo transportation and warehousing tasks fuels asset consumption.

Besides, coordinated factors include critical energy utilization across various methods of transport, including street, rail, air, and ocean cargo. Warehousing and circulation focuses likewise consume significant energy for lighting, warming, cooling, and refrigeration. Bundling and material taking care of add to squander age, with single-use plastics and non-biodegradable materials representing a danger to biological systems.

Despite these challenges, the logistics industry faces obstacles in transitioning to sustainable practices. Key challenges include.

Cost of Green Technologies: Carrying out supportable arrangements, like electric vehicles or energy-productive offices, frequently requires significant forthright speculation, which can be restrictive for certain organizations.

Infrastructure Limitations: The current foundation, for example, charging stations for electric vehicles, might be inadequate or not generally accessible, making the reception of reasonable advancements troublesome.

Complex Supply Chains: The unpredictable idea of supply chains, which frequently range various nations and include various partners, can make it trying to reliably arrange and execute maintainable practices.

Regulatory Uncertainty: Conflicting or indistinct guidelines across locales might make vulnerability for planned operations organizations attempting to explore economical practices.

Despite these hurdles, the industry is making strides in advancing sustainable logistics. Notable advancements and innovations include:

Electric and Hybrid Vehicles: Planned operations organizations are progressively putting resources into electric and mixture vehicles, which decrease outflows and dependence on petroleum derivatives.

Route Optimization and Fleet Management: Innovative arrangements, for example, GPS following and artificial intelligence controlled course streamlining assist organizations with limiting mileage and fuel utilization, prompting lower outflows.

Green Warehousing: Maintainable highlights like sun powered chargers, energy-proficient lighting, and further developed protection are being integrated into distribution centers to lessen energy utilization.

Alternative Fuels: Biofuels and hydrogen power devices are being investigated as cleaner options in contrast to conventional fills for cargo transport.

Collaborative Logistics: Organizations are teaming up with one another to share assets and data, enhancing courses and decreasing void miles.

These progressions, joined with developing shopper interest for naturally cognizant practices, are pushing the strategies business toward a more maintainable future. As innovation keeps on advancing, the potential for additional enhancements in manageable operations stays promising.

The Economic Case for Sustainable Logistics

Reasonable strategies hold incredible commitment for upgrading monetary flexibility across organizations and enterprises. As organizations face expanding compels from partners to work in a naturally capable way, embracing reasonable coordinated factors rehearses offers a way to more noteworthy strength through cost reserve funds, risk relief, and worked on functional proficiency.

Cost Savings and Improved Efficiency

One of the primary benefits of sustainable logistics is the potential for cost savings. By investing in green technologies and optimizing processes, companies can reduce expenses in key areas:

Fuel Efficiency: Changing to electric or elective fuel vehicles and streamlining conveyance courses can essentially reduce fuel expenses, which comprise a significant piece of coordinated factors costs.

Energy Conservation: Executing energy-productive practices in warehousing, like Drove lighting and sunlight based chargers, can bring down service charges and diminish fossil fuel byproducts.

Reduced Waste: Limiting bundling waste and taking on round economy rehearses, like reusing and reusing materials can prompt expense investment funds and a more maintainable inventory network.

Optimized Operations: Advancements like artificial intelligence driven course arranging and constant checking of shipments further develop conveyance times and decrease failures, adding to cost investment funds and improved efficiency.

Mitigating Risks and Ensuring Business Continuity

Sustainable logistics practices can help companies mitigate risks and maintain business continuity, contributing to greater economic resilience

Regulatory Compliance: As legislatures present stricter ecological guidelines, organizations that proactively take on supportable coordinated operations are more ready to follow these prerequisites, keeping away from expected fines and punishments.

Supply Chain Stability: Maintainable coordinated factors rehearses, for example, enhancing providers and improving courses, assist with making a more steady and tough store network that can endure disturbances.

Reputation Management: Organizations that focus on maintainability are seen all the more well by shoppers, financial backers, and accomplices. A solid standing for natural obligation can upgrade client reliability and give an upper hand on the lookout.

Adapting to Market Shifts: Supportable coordinated factors empower organizations to answer actually to changing business sector requests, including the developing inclination for eco-accommodating items and administrations.

Disaster Preparedness: Feasible coordinated factors can further develop readiness for catastrophic events and other unanticipated occasions by advancing versatile foundation and practices, for example, decentralized conveyance habitats.

Long-Term Economic Benefits

In the long run, the economic benefits of sustainable logistics extend beyond immediate cost savings and risk mitigation. By investing in sustainable practices, companies position themselves for sustained success and growth:

Innovation and New Opportunities: Sustainable logistics can lead to innovation and the development of new business models, products, and services, opening up new revenue streams.

Customer Loyalty and Market Share: A commitment to sustainability can boost brand loyalty and attract a growing segment of eco-conscious consumers, helping companies capture a larger market share.

Access to Capital: Numerous financial backers and monetary establishments focus on maintainability while settling on venture choices. Organizations with solid ecological qualifications might have better admittance to capital and financing amazing open doors.

As organizations endeavor to explore a quickly influencing world, manageable planned operations arises as a vital driver of monetary flexibility. By embracing green practices, organizations can upgrade their drawn out intensity and add to a more feasible and versatile economy for all partners.

Key Sustainable Logistics Strategies

Adopting sustainable logistics practices offers companies the opportunity to enhance efficiency, reduce environmental impact, and improve economic resilience. Here are specific strategies that companies can implement to make logistics more sustainable.

1. Implementing Fuel-Efficient Transportation Methods

Electric and Hybrid Vehicles: Progressing to electric and half breed vehicles can essentially decrease discharges and lower fuel utilization. These vehicles offer a cleaner option in contrast to conventional petroleum product controlled transportation.

Alternative Fuels: Investigating and using elective powers, for example, biodiesel, hydrogen, or gaseous petrol can assist with diminishing fossil fuel byproducts and dependence on non-inexhaustible assets.

Aerodynamic and Lightweight Design: Utilizing streamlined plans and involving lightweight materials in vehicles can further develop eco-friendliness and lower discharges.

2. Optimizing Routes and Reducing Empty Miles

Route Optimization Software: Using man-made intelligence controlled course advancement devices can assist organizations with distinguishing the most effective conveyance courses, limiting travel distances and fuel utilization.

Real-Time Monitoring: Utilizing continuous following and checking of shipments can permit organizations to make information driven acclimations to courses and timetables, decreasing postponements and further developing conveyance proficiency.

Backhauling: Coordinating return trips with additional cargo can reduce empty miles and optimize transportation resources.

3. Investing in Energy-Efficient Warehousing and Distribution Centers

Energy-Efficient Lighting and HVAC: Upgrading to LED lighting and energy-efficient heating, ventilation, and air conditioning (HVAC) systems can reduce energy consumption and operational costs.

Renewable Energy Sources: Installing solar panels or wind turbines on warehouse roofs can provide clean, renewable energy and reduce reliance on traditional power sources.

Green Building Design: Designing warehouses with sustainability in mind, such as using natural lighting, efficient insulation, and green

roofing, can lower energy usage.

Automated Systems: Implementing automated material handling and storage systems can improve efficiency and reduce the energy required for warehouse operations.

4. Adopting Circular Economy Practices in Supply Chain Management

Waste Reduction and Recycling: Underlining waste decrease, reusing, and reusing materials can limit natural effect and make cost investment funds.

Sustainable Packaging: Utilizing recyclable, biodegradable, or reusable bundling materials can diminish waste and outflows related with creation and removal.

Product Lifecycle Management: Planning items with end-of-life contemplations, for example, simpler dismantling and reusing, upholds a more roundabout production network.

5. Promoting Collaboration Across the Supply Chain

Shared Resources and Logistics: Teaming up with different organizations to share transportation assets, for example, loads and steel trailers, can further develop effectiveness and decrease costs.

Information Sharing: Open lines of correspondence and information sharing across the inventory network can assist all partners with upgrading tasks, lessen squander, and further develop supportability.

Collaborative Network Design: Planning coordinated factors networks that record for numerous partners' necessities can smooth out processes and limit by and large natural effect.

Case Studies and Best Practices

The fruitful execution of supportable coordinated factors techniques has permitted different organizations and ventures to accomplish unmistakable financial and natural advantages. How about we investigate a few instances of associations that have driven the manner in which in taking on maintainable strategies rehearses and the positive results they have encountered.

1. DHL: Green Logistics Initiatives

DHL, one of the world's driving operations organizations, has taken critical steps in reasonable coordinated factors through its "Practice environmental safety" system. The organization has put resources into electric vehicles for metropolitan conveyances and has an objective of zero-outflow planned operations by 2050. DHL has additionally enhanced its tasks by utilizing biofuels, half and half conveyance vehicles, and course improvement instruments. Subsequently, DHL has essentially diminished its carbon impression and functional expenses, adding to its standing as an industry chief in maintainability.

2. UPS: Embracing Alternative Fuel Fleets

UPS has been proactive in embracing elective fuel armadas, including electric, crossover, and gaseous petrol controlled vehicles. The organization utilizes progressed course streamlining programming to limit fuel utilization and discharges. UPS additionally puts resources into energy-effective advancements in its distribution centers, like sunlight powered chargers and proficient lighting. These reasonable practices have brought about cost investment funds and advanced effectiveness, while situating UPS as a ground breaking operations supplier.

3. Maersk: Pioneering Green Shipping

Maersk, a worldwide delivery and coordinated operations organization, has made critical interests in green transportation. The organization has presented vessels that sudden spike in demand for low-sulfur fuel and is investigating elective fills like methanol and smelling salts. Maersk additionally streamlines its transportation courses and timetables to decrease fuel utilization and outflows. These drives have permitted Maersk to reduce expenses, work on functional productivity, and improve its standing as a naturally dependable forerunner in the business.

4. Amazon: Sustainable Packaging and Delivery

Amazon, a significant online business and strategies player, has focused on manageability in its coordinated factors tasks. The organization involves electric conveyance vans for metropolitan conveyances and utilizes course improvement devices to limit discharges. Amazon's "Sans dissatisfaction Bundling" drive centers around lessening overabundance bundling and utilizing recyclable materials. These endeavors have brought about cost reserve funds, decreased squander, and further developed consumer loyalty.

5. Ikea: Multimodal Transportation and Circular Supply Chains

Ikea, a worldwide furniture retailer, has carried out practical coordinated factors procedures, for example, utilizing multimodal transportation (rail, ocean, and street) to diminish its carbon impression. The organization additionally centers around about stock chains by planning items in view of reusing and reuse. Ikea's interests in supportable operations have prompted lower transportation costs and a decrease in outflows, adding to its general obligation to manageability.

Regulatory and Policy Landscape

Peaceful accords and public strategies assume a critical part in advancing feasible coordinated factors by laying out objectives, giving rules, and boosting organizations to embrace harmless to the ecosystem rehearses. One of the most eminent peaceful accords with a significant effect on practical operations is the Paris Understanding.

Paris Agreement

The Paris Understanding, embraced in 2015, is a worldwide accord that plans to restrict an Earth-wide temperature boost to well under 2 degrees Celsius above pre-modern levels, with endeavors to restrict the increment to 1.5 degrees Celsius. The understanding perceives the basic requirement for composed worldwide activity to battle environmental change and urges countries to go to lengths to decrease ozone depleting substance emanations across different areas, including transportation and coordinated factors.

Countries that have ratified the Paris Agreement are committed to developing national plans, known as Nationally Determined Contributions (NDCs), to achieve emissions reduction targets. These plans often include measures to promote sustainable logistics, such as:

Promoting Alternative Fuels: Numerous nations are empowering the reception of cleaner powers, like electric, hydrogen, and biofuels, for cargo transport.

Supporting Multimodal Transport: Countries are investing in infrastructure to facilitate the use of rail and sea transport as alternatives to road freight, thereby reducing emissions.

Setting Emission Standards: Governments are establishing stringent emission standards for vehicles and equipment used in logistics operations.

Country-Specific Policies

Different countries have developed specific policies to support sustainable logistics and achieve their climate goals.

European Union: The EU has set aggressive focuses for lessening discharges and expanding the utilization of sustainable power in transport. Drives, for example, the Green Arrangement and the EU Maintainable and Brilliant Versatility System frame measures to change to zero-out flow coordinated operations and advance elective fills and low-emanation zones.

United States: The US Environmental Protection Agency (EPA) runs the SmartWay program, which helps freight companies reduce fuel consumption and emissions through the use of cleaner technologies and practices. The US also provides tax credits and incentives for adopting alternative fuel vehicles and infrastructure.

China: China has set focuses for decreasing transportation emanations and is putting resources into electric and hydrogen power device vehicles. The nation is likewise advancing green coordinated operations in its Belt and Street Drive, empowering feasible practices in its global exchange passageways.

Japan: Japan has acquainted approaches with help the reception of electric and crossover vehicles and has set discharge decrease focuses for the coordinated factors industry. The nation additionally empowers the utilization of environmentally friendly power in stockrooms and dissemination focuses.

International Organizations

Global associations, like the Worldwide Oceanic Association (IMO) and the Global Common Aeronautics Association (ICAO), assume key parts in setting norms and guidelines for maintainable delivery and avionics. These associations pursue decreasing discharges and advancing energy proficiency in their separate areas.

The Future of Sustainable Logistics

The fate of supportable strategies is set apart by fast progressions in innovation and a rising accentuation on eco-accommodating practices. Arising patterns and developments can possibly reshape the operations business, preparing for an additional practical and proficient future. Be that as it may, the excursion towards manageable planned operations likewise accompanies its portion of difficulties and valuable open doors.

Emerging Trends and Technologies

Autonomous Vehicles and Drones: Autonomous vehicles and delivery drones have the potential to revolutionize logistics by reducing emissions and improving delivery efficiency. These technologies can optimize routes, reduce fuel consumption, and minimize human error.

Electrification of Transport: The shift towards electric vehicles (EVs) in logistics is accelerating, driven by advancements in battery technology and charging infrastructure. EVs offer a cleaner alternative to traditional fossil fuel-powered transport and contribute to reducing carbon emissions.

Internet of Things (IoT) and Connectivity: IoT technology enables real-time tracking and monitoring of goods and vehicles, allowing for greater transparency, efficiency, and sustainability in logistics operations.

Blockchain for Supply Chain Transparency: Blockchain technology provides secure and transparent tracking of goods across the supply chain, enhancing traceability and accountability in logistics. This technology can support sustainable practices by enabling better resource management and reducing waste.

Green Warehousing and Distribution: Innovations such as green roofing, energy-efficient designs, and smart technologies in warehousing and distribution centers can significantly reduce energy consumption and environmental impact.

Big Data and AI for Optimization: Big data analytics and artificial intelligence (AI) can optimize logistics processes, such as route planning and inventory management, leading to more efficient use of resources and reduced emissions.

Challenges and Opportunities

While emerging trends and technologies offer exciting opportunities for sustainable logistics, there are also potential challenges to consider

Infrastructure Development: The widespread adoption of electric and alternative fuel vehicles requires substantial investments in infrastructure, such as charging stations and fueling networks.

Regulatory Uncertainty: Inconsistent or evolving regulations across regions may pose challenges for businesses attempting to implement sustainable logistics practices.

High Initial Costs: Investing in emerging technologies and green infrastructure can require significant upfront capital, which may be a barrier for smaller businesses.

Technological Integration: Integrating new technologies into existing logistics systems can be complex and may require significant changes in operations and workforce training.

Despite these challenges, there are significant opportunities for businesses to leverage emerging trends and technologies to achieve sustainable logistics

Market Differentiation: Organizations that take on supportable operations practices can separate themselves on the lookout and draw in eco-cognizant clients.

I**mproved Operational Efficiency:** Arising advances can prompt more proficient and smoothed out operations processes, bringing about cost investment funds and diminished natural effect.

Innovation and New Business Models: The fate of reasonable strategies presents amazing open doors for organizations to improve and investigate new plans of action, for example, last-mile conveyance administrations utilizing drones or independent vehicles.

Partnerships and Collaboration: Collaborating with other businesses, governments, and international organizations can accelerate the adoption of sustainable logistics practices and foster shared resources and knowledge.

Conclusion

In this article, we have investigated the basic connection between reasonable coordinated operations and monetary flexibility. We started by characterizing supportable planned operations as the reception of harmless to the ecosystem rehearses across the store network, including the utilization of eco-friendly transportation, energy-proficient warehousing, and roundabout economy standards. Monetary strength, thusly, is the capacity of an economy to ingest and recuperate from shocks while keeping up with fundamental capabilities and cultivating long haul maintainability.

Current planned operations rehearses have been tested by their natural effect, with transportation being a critical supporter of worldwide emanations. Not with standing, progressions and developments like electric vehicles, elective powers, and proficient course improvement are making ready for a greener future in strategies.

The economic case for sustainable logistics is compelling, with companies benefiting from cost savings, improved operational efficiency, and risk mitigation. By adopting sustainable practices, businesses can position themselves as industry leaders, enhance customer loyalty, and access new market opportunities

Key sustainable logistics strategies include implementing fuel-efficient transportation methods, optimizing routes to reduce empty miles, investing in energy-efficient warehousing, adopting circular economy practices, and promoting collaboration across the supply chain

Contextual analyses of driving organizations like DHL, UPS, Maersk, Amazon, and Ikea exhibit how practical coordinated operations techniques have prompted substantial monetary and ecological advantages, including cost reserve funds, diminished outflows, and further developed brand notoriety.

International agreements such as the Paris Agreement and various country-specific policies provide a framework for promoting sustainable logistics globally. As governments and international organizations set targets and offer incentives, businesses are encouraged to adopt eco-friendly practices

The fate of practical strategies is splendid, with arising patterns and advancements like independent vehicles, zap, IoT, blockchain, and artificial intelligence driving change in the business. While challenges stay, for example, foundation advancement and administrative vulnerability, there are various open doors for organizations to enhance and separate themselves on the lookout.

All in all, controlling reasonable coordinated factors is fundamental for accomplishing monetary flexibility and getting long haul benefits for organizations and the climate. By embracing reasonable practices, organizations might not just diminish their carbon impression at any point yet additionally upgrade proficiency, benefit, and intensity. The source of inspiration is clear: organizations should focus on manageable coordinated factors practices to construct a versatile and reasonable future for all partners. Allow us to cooperate to make greener, more productive operations frameworks that help monetary development and natural stewardship.

REFERENCES

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9243999/

https://transportgeography.org/contents/chapter4/transportation-sustainability-decarbonization

https://www.iea.org/data-and-statistics

4. https://www.industryresearch.co/enquiry/request-sample/22378786

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