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ANALYZING THE BARRIERS TO THE ADOPTION OF A LOW CARBON LOGISTICS IN INDIAN SMES, WITH SPECIAL ATTENTION TO RISK AND SUSTAINABILITY: AN EMPIRICAL STUDY

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Abstract
There is immense pressure on Indian small-medium enterprises (SMEs) to fight against global climate change while also being the logistics service providers. A low-carbon logistics (LCL) system combines operations with a low carbon footprint and supply chain processes to reduce the amount of carbon dioxide emitted in the logistics value chain. Therefore, the logistics industry must release lower emissions of carbon dioxide, and the implementation of LCL requires adequate analysis of further opportunities as well as barriers in consideration of the aspects of associated risk and sustainability for Indian SMEs. In this context, this study attempts to understand the barriers that pose issues in the effective implementation of the LCL network in Indian small and medium-scale enterprises with a considerate perspective of risk and sustainability factors. A quantitative study was performed based on the research objectives and hypotheses formulated. A questionnaire was designed and used as a research tool for data collection from the identified respondents. Based on the empirical results obtained by data collection, it is evident that lack of organisational encouragement, lack of information technology application, lack of collaboration among supply chain(SC) partners, lack of government support, lack of a sustainable transport system, and high costs has been identified as the barriers to implementing the LCL system. The study thus highlights that a substantial amount of research is required to focus on functional & operational aspects of the LCL system as a scope for future research.

Keywords: Low Carbon Logistics Network, Barriers, Transport sector, Indian SMEs, sustainability, organization encouragement, supply chain

1.0 Introduction

Due to the fast progression and development in the logistics sector lately, its fundamental and strategic role in national economic development has become increasingly significant, but issues lie in the associated energy and environmental concerns it brings. Due to the fast progression and development in the logistics sector lately, its strategic and fundamental role in the economic development of the country has grown to be increasingly significant, but the issues lie in the associated environmental and energy concerns it brings. As the logistics sector is anticipated to grow, this will lead to an increase in its energy consumption and GHG emissions unless adequate measures are initiated. This requires the sector to improve its energy efficiency (Cheng & Zhang, 2017). With an emphasis on long- term sustainability in the logistics industry, low-carbon logistics systems assure the long-term survival and continuity of a business while also contributing to the future well-being of the community. The three aspects that are essential in consideration of low-carbon logistics are environmental, economic, and social (Christopher,

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2017). However, there are a few barriers that pose issues in the adoption and implementation of low carbon logistics, leading to green supply chains in practice (Brockhaus et al., 2013). To address these challenges and barriers, performance measurement of organisations with a focus on sustainability and low-carbon logistics assists in finding trade-offs between the ecological implications of dioxide impacts (Lubin & Esty, 2010). Through the identification and evaluation of long-term performance in sustainability for low-carbon logistics, accounting for the aspects of sustainability and risk can provide avenues to address environmental and economic activities (Christ & Burritt, 2013). With the growing amount of attention and study being paid to LCL in recent years, LCL has developed a more organised and systematic theory. The main objective of this paper is to analyse in detail the specific factors obstructing the implementation of the LCL system in Indian SMEs. This detailed knowledge will assist the low carbon logistics providers to understand the challenges in a better way and accordingly identify the opportunities for eventually setting up the network effectively. In context of this empirical study, firstly, after specifying the objectives of the study, a review of the literature relevant to the study is presented. Further, hypotheses are proposed to assess the role of identified factors and variables, and then the results of hypothesis testing as well as data analysis are discussed. Lastly, implications for Indian SMEs with directions for future research are also provided.

1.1 Research Purpose and objectives

The primary goal of this study is to investigate those influences that hinder the effective implementation of the LCL system in Indian SMEs in consideration of factors related to risk and sustainability. The further objectives of the study are:

- To comprehend the concept of a LCL network.
- To identify barriers influencing the implementation of LCL networks among SMEs
- To analyse risk and sustainability aspects that affect the implementation of LCL networks.

2.0 Literature review

2.1 Concept of Low Carbon Logistic Network and its implementation

The LCL is explained as the set-up of a network that deals with the distribution of materials and production on the premise with a perspective of sustainability in consideration of environmental and social aspects (Sbihi & Eglese, 2010). According to Cheng and Zhang (2017), low-carbon logistics is based on a supply chain management procedure that aims to reduce the ecological risk of logistics and delivery activities. As per Liying (2010), a Low Carbon Logistics Network (LCLN) utilises the concepts and techniques of scientific management, which in combination with advanced logistical and informational systems, realises the consolidated communion of environmental advantages and financial benefits. As explained by Viswanadham & Kameshwaran (2009), a Low Carbon Logistic Network is set up by low carbon logistics providers which create value through a union of supply chain capabilities by utilising information flows and goods flows within the supply chain for effective optimization of costs and carbon emissions. The implementation of LCLN leads to mainly two aspects, i.e., one that addresses the operational and functional aspects of supply chain management, which includes procurement, production, planning, distribution, system design, and SC coordination. The additional aspect addresses the accounting and conceptualisation of

carbon footprints (Shaw et al., 2012). From a theoretical model perspective, the core activities of Low Carbon Logistic Network based supply chain management are selection of suppliers, inventory planning, logistics management, system design, and coordination strategy. The main impartial of LCLN is to control and limit the overall supply chain carbon emissions with no compromise on the overall economic interests of the SMEs involved. Therefore, LCLN leads to trade-offs between financial and ecological goals in all the supply chain functions (Das & Jharkharia, 2018). The implementation of a LCL is based on the macro mechanism and small enterprise level. The macro mechanism level addresses the provision of relevant policy provisions for the firm's emission reduction and energy saving to further develop a long term mechanism for the growth of the low-
carbon logistics segment. The microenterprise level addresses the need to actively look for ways to reduce emissions and save energy from all aspects of logistics and assists in the realisation of maximum financial benefits and communal benefits of the enterprises working as low-carbon logistics providers (Zheng et al., 2017).

2.2 Strategies and barriers of Low Carbon Logistics

An efficient LCL SCM can be described as an integrated environmental strategies that is aimed at such a supply chain management network that caters to product design, raw material sourcing and selection, manufacturing processes, distribution of the final product to the consumers, and well-to-wheel product management with in-depth understanding of industrial coaction (Chaabane et al., 2011; Srivastava, 2007). McKinnon & Piecyk (2012) stated that, in consideration of sustainability, various corporate organisations have developed and are constantly developing specific carbon reduction strategies. A study performed by McKinnon (2011) developed a seven-stage process that can be applied by organisations as a decarbonisation strategy for logistics. Gruchmann (2019) mentioned that the accumulation of environmentally pertinent information on proceedings in the separate processes (visibility) is basic for the creation and application of a complete LCL system. The use of information technology in combination with purchase, production, supply, and waste disposal logistics leads to strategies for green logistics. The strategies relevant to Low Carbon Logistics Supply Chain Management involve ecological purchasing, ecological transportation, ecological packaging, and ecological reverse logistics. Moreover, using Green Decision Support Systems (GDSS) for the ecological optimization of logistics organisations facilitates decision-makers in the logistics sector to perform assessments for dissimilar logistics policies. Olatunji et al. (2019) explained that forecasting future demand for products and services, as well as sustainable development and carbon footprint reduction, are becoming increasingly important. The drivers of Low Carbon Logistics comprise risk, customer awareness, supply chain association, rising energy prices, climate change, power position, cost reduction, social responsibility, and the cost of late adoption. In spite of the drivers identified for the implementation of LCL, there are still various barriers identified. These barriers include lack of association between the supply chain associates, lack of a consistent approach to carbon review, deficiency in installation of related systems and data inaccuracy. Pannirselvan et al. (2016) stated that in the technological-oriented era, environmental issues related to logistics are being resolved based on green logistics strategies. However, there are barriers preventing the implementation of LCL. The different barriers highlighted are categorised as inner obstructions and outer obstructions. The aspects of monetary, specialized, data, administrative, and authoritative are inner obstructions, and outer obstructions include applied approach and market issues. Monetary and business sector aspects are observed as the significant obstructions to low carbon logistics implementation. A study was performed by Pannirselvan et al. (2016) to determine the barriers to implementing low-carbon logistics in manufacturing industries. They identified 12 barriers in 2 major groups, i.e., internal and external. Inner barriers included lack of fiscal resources, lack of IT implementation, lack of skills/knowledge in-house, lack of upper management commitment, lack of organisational reassurance, lack of training, and high investment costs. External barriers included lack of customer interest/awareness, lack of logistics/ transport suppliers, lack of economic incentives or partners interest, shortage of government support policies, and lack of clear regulations. The following figure 2.1 represents the stages in the process of development of a decarbonisation strategy for logistics.

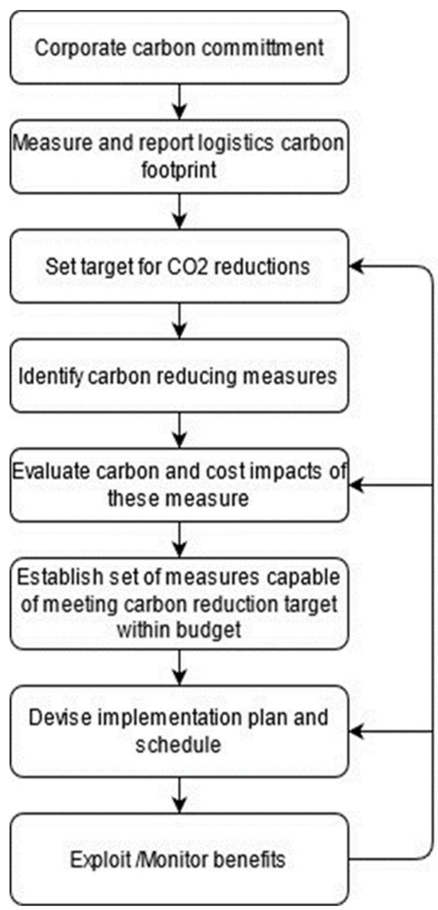

Figure 2.1 Stages in the process of development of a decarbonisation strategy for logistics (Source: McKinnon, 2011)

Based on the questionnaire data collected from 47 food manufacturing industries in Johor Darul Takzim, it was identified that the most vital barrier that prevents food manufacturing companies in Johor Darul Takzim from implementing LCL is the lack of organisational encouragement. The solution identified for such barriers that prevent the best methods to implement LCL is to put a limit on the number of distribution trips to reduce the carbon footprint. Tay et al. (2015) explain that organisations face obstruction in implementing low-carbon logistics that lead to a sustainable supply chain system. The internal barriers include deficiencies in organisational commitment, strategic issues comprising absence of resources, absence of the latest performance measurement systems, inadequate organisational size, and issues related to financial, technical, information, managerial, and organisational aspects, and lastly, functional issues. The external barriers include government regulations, competitive pressures, customer expectations, the media, less regulated sectors, organisational policy issues, and technology. Lah (2015) explains that there is an immediate requirement for policy intervention to overcome barriers associated with low-carbon transport systems. These barriers include initial-cost barriers resulting from the higher capital intensity of low-carbon fleet, rebound or take-back effects affecting energy efficiency, and barriers resulting from a lack of collective action due to a lack of a standard policy framework. Bongard et al. (2010) mentioned that implementation of low-carbon logistics systems is challenged by a large number of fences that need to be addressed by planned action. Such fences are time-lag between decisions and belongings (measures are based on long term approaches that are effective only after consistent political decision- making is attained), the cross-cutting nature of transport (other sectors decisions affect transport demand and require combined decision making), and the disjointed target group (sources of emissions are small and require bundled measures to address the mobility needs). Moktadir et al. (2018) explain that different obstacles are faced by organisations while implementing sustainable logistics practices. In developing countries like India, these barriers exist because supply chain associates lack attentiveness regarding sustainability and their role in its attainment. This leads to reluctance to emolument and a deficiency in demand for a sustainable value chain. Moreover, managerial barriers also pose challenges in implementing sustainable logistics, as organizations' top management commitment, readiness, and provision are the core features of the sustainability initiative. Manufacturing organisation providers consider sustainability as an additional burden while executing sustainable logistics practices. Baig et al. (2020) also explained that low adoption of ecological logistics performance is due to barriers classified as sectoral-economic, managerial, and supplier hindrance.

2.3 Performance measure system of Low carbon Logistics

He et al. (2017) explain that due to universal warming and environmental deprivation, green and low-carbon expansion modes are being followed by logistics providers. The lack of a performance measurement system obstructs the development of an LCL system. Logistics performance is normally assessed from both external and internal perspectives. The interior presentation indicators generally involve customer service, cost, productivity indicators, quality, and asset evaluation, whereas exterior performance indicators typically involve customer intelligence evaluation and the finest practise benchmarks. He et al. (2017) performed a study and a performance measure system with 42 signs from 12 magnitudes was established for evaluating the LCL by using the method of various case studies and literature examinations. Based on the study, it was found that most respondents understood that developing LCL is beneficial but highlighted barriers such as low carbon awareness, lack of strategies and regulation, deficiency of qualified logistics professionals, lack of organisation and facilities, low efficiency in logistics process management, and chaotic transport modes lead to low competence. The study concluded and proposed three dimensions of a performance measure system for low-carbon logistics. These dimensions include ecological performance, financial performance, and social performance, and hurdles are to be considered for an effective performance measure system. Lee & Wu (2014) mentioned that the economic and environmental performance of low-carbon logistics can be quantified by utilising a variety of methods. It is observed that LCL and SC measurement of performance mainly focuses on time, accuracy, and cost. The study performed based on a multi-methodological approach revealed that in order to determine and improve performance in terms of sustainability in SC and logistics, it is essential to relate performance in terms of sustainability in SC and logistics. On the basis of process mapping and mathematical modelling that provided a complete analysis of ecological and financial performance, it is suggested that it is vital to consider the performance factor in terms of physical (CO_2 emissions) as well as monetary presentation factors (cost) in ecological corporate assessment making in the area of LCL.

2.4 Risk aspects of LCL system

Herold & Lee (2017) explain that the rise in requirements for carbon management in logistics is mainly accredited to ecological issues, such as climate change or global warming, increasing levels of pollution, stakeholder awareness, and rising societal pressure. Carbon risk assessment is the formal process that is followed to identify and evaluate carbon-related risks that align with the prospects and the importance of their effects on products, operations,

and financial results. The risk aspects of the LCL system are classified as policy risks, regulatory, supply chain and product risks. Variations in the government's climate policies are considered the major source of carbon risk. Diverse challenges appear while implementing these strategies as a result of logistics providers' tolerant carbon taxes, and this leads to difficulty in reaching an agreement on carbon caps between logistics providers and policymakers. The pricing scheme also leads to an increase, even though it is a minor increase in overall logistics costs. Lieu et al. (2020) mentioned that in the context of low- carbon logistics pathways, two perspectives on risk are viewed. Application risk is the probable negative effect on the employment of a LCL system, and consequential risk refers to the possibility of negative consequences arising from the application of a potential pathway. The different risks identified with respect to LCL systems are factors related to ecological, communal, financial, civil, strategy, and technical aspects. Damert et al. (2018) explain that organisations' perceptions of risks are a critical factor in the effectiveness of motivating suppliers to use LCL practises. Based on a study performed on the perception of risks of an organisation to execute low carbon logistics, the findings established that executive decision-making is prejudiced by the perception of an ecological concern as either a risk or an opportunity. Also, production-related risks were positively correlated with environmental technology adoption, and the opposite relationship was observed for product-related risks. Thaller et al. (2012) mentioned that risk-related aspects are eminent in the supply chain and even human risks are a major concern in India in comparison to European countries. Storage and warehouse-related risks exist as the fragmented private logistics firms do not cooperate well along the logistic chains. Risk management in global supply chains also includes financial risks. Climatic risks also have a contributing role in affecting the perception of organizations' willingness to implement low-carbon logistics systems.

2.5 Sustainability aspects of LCL system

Santhoshkumar & Revathi (2014) explain that with the culture of the low-carbon concept, sustainable development is possible. Logistics activities are not only high energy- consumption

but also carbon emitters. Therefore, reduction in energy consumption, reduced carbon emissions, and carbon logistics has become the inevitable choice. By blending carbon cultural functions and logistics cultural elements, sustainable social development logistics can be accomplished. Low-carbon behaviour patterns of action, which involve low-carbon life, low-carbon consumption, and low-carbon production, lead to supportable growth of the economy and humanity. Mulugetta & Urban (2010) specify that the stress on ecological energy has led to an outlay on low carbon technologies and there is a rapid increment in low
carbon technologies. With creativity in mobilising human and financial resources and the building of the institutions that can support and promote meaningful citizen participation, local innovation, and raise finance, they can certify the framing of low carbon initiatives within the wider principles of ecological development. Purohit & Fischer (2014) mentioned that there are technical and financial barriers to following sustainability aspects while implementing low-carbon logistics systems in India. These barriers exist due to a lack of collaboration between the private sector and private-public partnerships, in addition to social, economic, and environmental challenges. Developing a strong biofuel industry can be a solution to addressing the sustainability aspect while implementing a low-carbon logistics system. According to Bakker et al. (2019), improving availability, mobbing, energy security and air quality are the main drivers of transportation policy to support LCL, with falling conservatory gas discharges having lower primacy. Avoiding and minimising journeys, switching to environmentally friendly modes of transportation, and improving vehicle energy efficiency are all part of the ecological transportation strategy outline. These framework elements also aid in overcoming implementation hurdles. Odero (2015) stated that challenges to sustainability in low-carbon transport span a broad range of issues and that a new sustainability strategy will assist in addressing sustainability challenges. Financing transport infrastructure is a major challenge and is dependent on policy.

3.0 Conceptual Framework

A conceptual framework has been developed based on the influences that have an impact on the implementation of the LCL system is shown in figure 3.1.

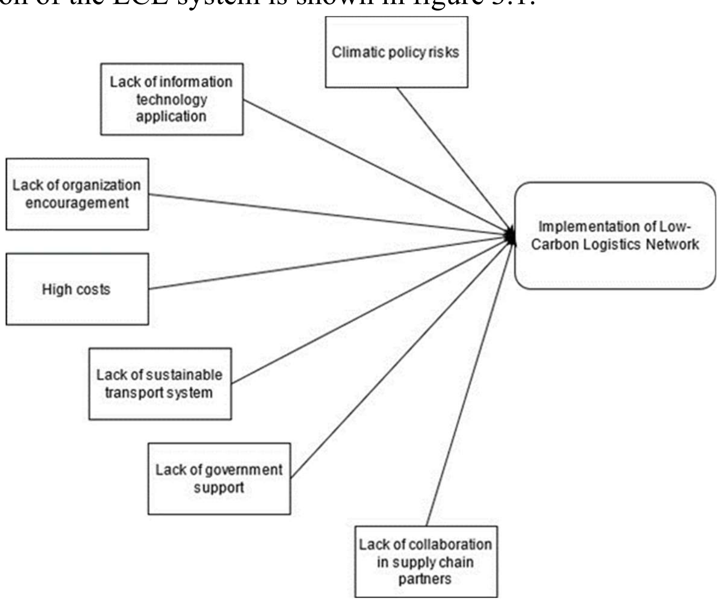

Figure 3.1 illustrates the conceptual framework of LCL

4.0 Development of Hypotheses

Based on the conceptual framework, the following assumptions are proposed.

H1: Lack of information technology application does not have a major outcome on the execution of LCL system.

H01: Lack of information technology application does have a major outcome on the execution of LCL system.

H2: Lack of organization encouragement does not have a major outcome on the execution of LCL system.

H02: Lack of organization encouragement does have a major outcome on the execution of LCL system.

H3: High Costs does not have a major outcome on the execution of LCL system H03: High Costs does have a major outcome on the execution of LCL system.

H4: Lack of collaboration in supply chain partners does not have a major outcome on the execution of LCL system.

H04: Lack of collaboration in supply chain partners does have a major outcome on the execution of LCL system.

H5: Lack of government support does not have a major outcome on the execution of LCL system.

H05: Lack of government support does have a major outcome on the execution of LCL system.

H6: Lack of sustainable transport system does not have a major outcome on the execution of LCL system.

H06: Lack of sustainable transport system does have a major outcome on the execution of LCL system.

H7: Climatic policy risk does not have a major outcome on the execution of LCL system.

H07: Climatic policy risks do have a major outcome on the execution of LCL system.

5.0 Methods

The present study highlights the factors that lead to barriers in operation of LCL network in consideration to sustainability and risks. The study was performed with identified Indian SMEs for relevant data and further analysis. The affirmation of the research approach is supported by the objectives of study identified earlier in this study. This study follows a qualitative research approach for understanding the close association between the different variables under study and to structure the analysis. For data collection a quantitative approach
that includes the primary data collection was followed. A questionnaire as the primary data collection instrument was developed with the help of a 5-point Likert scale. The research paradigm adopted for this study is the positivist approach as the study involves development of assumptions on the basis of numeric data and testing the hypotheses. The research design shows the explicit procedure pursued for examining the determinants of the variables cited in the research problem. This study followed a design of descriptive research to investigate the effect of the variables identified. Based on the data collected through questionnaires with the representatives of India SMEs, statistical data analysis was performed to infer data results for deducing outcomes of the study. The results of the data analysis and consequent discussion is presented in the following section.

6.0 Results and Discussions

This section presents the results of statistical analysis performed to investigate the barriers that affect the enactment of LCL in Indian SMEs and the data analysis methods applied are based on statistical tests generally applied to quantitative data. At first the reliability of the questionnaire designed for this study was measured by using Cronbach's alpha.Cronbach Alpha is a reliability test used to assess the questionnaire's internal consistenc y, or dependability, as it is built using several likert scale statements. This test helps to determine if the scale is reliable or not and the alpha value above 0.7 means the data is reliable. The questionnaire designed for the study has 22 items and the applied Cronbach Alpha test reported the values for these items in the range of 0.899 to 0.915. The overall reliability of data based on the Cronbach alpha value is 0.908. This indicates that the data is reliable for the analysis and high level of internal consistency exists with respect to the variables for decision making, which is shown in table 6.1.

Table 6.1 Statistics on Reliability

Statistics on Reliability	
Cronbach's Alpha	No. of Items
0.908	22

After the reliability testing of questionnaire, further data analysis was performed for the results that were obtained from the selected 320 respondents representing their SME organizations on the basis of questionnaire shared. Based on the questions designed in the questionnaire for demographic variables such as Gender, Age, and Employment period, the data analysis results confirmed that out of 320 respondents, 210 respondents (around 65.6 percent) were male and 110 respondents (around 34.4 percent) were female. 126 respondents (39.4 percent) of the 320 students were in the age group of 36-45 yrs, 84 respondents (26.3 percent) of the 320 students were in the age group of 46-59 yrs, 62 respondents (19.4 percent) of the 320 students were in the age group of 26-35 yrs, and 48 respondents (15 percent) of the 320 students were below the age of 25 yrs. Regarding the data recorded for employment period of the respondents, the results indicated that the highest 179 respondents (around 55.9 percent) were having the employment period of 6-10 years, 84 respondents (around 26.3 percent) were having the employment period of 10 years+, 35 respondents (around 10.9 percent) were having the employment period of 2-5 years and 22 respondents (around 6.9 percent) were having the employment period under 2 years. Therefore, the data results based on the demographic variables showed that the sample of respondents representing the SMEs as part of this study are majorly male employees with most of them of the age above 36 years and majority of them having the employment period of at least 6 years. This reflects that sample respondents are experienced to provide detailed insights about their organization and the application of LCL system and associated barriers.

6.1 Testing of Hypotheses

Based on the study variables, the hypotheses were proposed and statistically tested. The main idea behind a statistical hypothesis assessment is to verify if the data sample is atypical or typical in comparison to the population assuming that the hypothesis expressed about the population is true (Emmert-Streib & Dehmer, 2019). For the current study, seven hypotheses

were proposed based on the study variables and were statistically tested by applying R-squared, ANOVA and F-test. The first hypothesis tested was to understand the effect of lack of information technology application variable on the operation of LCL system. Based on the R-squared statistical test, it was found that R square value is
0.321. This value indicates that the lack of information technology application variable has the 32.1% of the variability in the application of LCL system. Further, the data analysis based on ANOVA and F-test showed that for the first hypothesis, p-value is less than 0.05. The p-value is the measure for probability that the data could have occurred under the null hypothesis and has to be lower than 0.05 for null hypotheses to get rejected (Thiese et al., 2016). As the p-value is less than 0.05, it indicates that it is statistically significant so the null hypothesis is rejected. Therefore, this shows that lack of information technology application does influence the operation of LCL system and act as a barrier for establishing a LCL system due to associated costs. Hence, based on results it is found that awareness of right technological support and application of real-time applications in logistics networks can
assist in overcoming the barriers related to lack of information technology application and establishing a LCL system. The second hypothesis tested was to understand the effect of lack of organization encouragement variable on the implementation of LCL system. Based on the R-squared statistical test, it was found that R square value is 0.309. This value indicates that the lack of organization encouragement variable has the 30.9% of the variability in the implementation of LCL system. Further, the data analysis based on ANOVA and F-test showed that for the second hypothesis, p-value is less than 0.05. As the p-value is less than 0.05, it indicates that it is statistically significant so the null hypothesis is rejected. Therefore, this shows that lack of organization encouragement does influence the implementation of LCL system and act as a barrier for establishing a LCL system. Hence, based on results it is found that through initiatives at organizational level complying with environmental regulations and acceptable carbon compliance in transport logistics networks can assist in overcoming the barriers related to lack of organization encouragement and establishing a LCL system. The third hypothesis tested was to understand the effect of the high costs variable on the implementation of LCL system. Based on the R-squared statistical test, it was found that R square value is 0.805. This value indicates that the high costs variable has 80.5
% of the variability in the implementation of LCL system. This reflects that higher costs as variable indicates a better fit for the model. Further, the data analysis based on ANOVA and F-test showed that for the third hypothesis, p-value is less than 0.05. As the p-value is less than 0.05, it indicates that it is statistically significant so the null hypothesis is rejected. Therefore, this shows that high costs do influence the implementation of LCL system and act as a barrier for establishing a LCL system. Hence, based on results it is found that investment costs are involved in setting up a LCL system and further initiatives are required at organizational level to plan as well as compare the savings to be achieved due to LCL system in a longer run based on planned investment. These initiatives will assist in overcoming the barriers related to higher costs and establishing a LCL system. The fourth hypothesis tested was to understand the effect of lack of collaboration in supply chain partners variable on the implementation of LCL system. Based on the R-squared statistical test, it was found that R square value is 0.390. This value indicates that the lack of collaboration in supply chain partners variable has 39.0 % of the variability in the implementation of LCL system. Further, the data analysis based on ANOVA

and F-test showed that for the fourth hypothesis, p-value is less than 0.05. As the p-value is less than 0.05, it indicates that it is statistically significant so the null hypothesis is rejected. Therefore, this shows that lack of collaboration in supply chain partners does influence the implementation of LCL system and act as a barrier for establishing a LCL system. Hence, based on results it is found that through initiatives to collaborate with different partners involved in the supply chain has been considered as a better alternative in overcoming the barriers related to lack of collaboration in supply chain partners and establishing a LCL system. The fifth hypothesis tested was to understand the effect of lack of government support variable on the implementation of LCL system. Based on the R-squared statistical test, it was found that R square value is 0.123. This value indicates that the lack of government support variable has 12.3 % of the variability in the implementation of LCL system. Further, the data analysis based on ANOVA and F-test showed that for the fifth hypothesis, p-value is less than 0.05. As the p-value is less than 0.05, it indicates that it is statistically significant so the null hypothesis is rejected. Therefore, this shows that lack of government support does influence the implementation of LCL system and act as a barrier for establishing a LCL system. Hence, based on results it is found that through proper policy guidance and government support, organizations are able to initiate their activities for LCL system in a better way and this policy based support helps in overcoming the barriers related to lack of government support and establishing a LCL system, which is shown in table 6.2 and 6.3 respectively.

Table 6.2 Values of Model summary

MOD	R	Square of R	Adjus. Square of R	Std. Err. of the Esti.
1	0.897[a]	0.805	0.804	0.477

Table 6.3 Coefficients of model summary

MOD		Unstad. Coef.		Stad. Coef.	t	Sig.
		B	Stad. Error	Beta		
1	(Const.)	-0.087	0.116		-0.747	0.456
	Costs	0.341	0..009	0..897	36.238	0.000

The sixth hypothesis tested was to understand the effect of lack of sustainable transport system variable on the implementation of LCL system. Based on the R-squared statistical test, it was found that R square value is 0.324. This value indicates that the lack of sustainable transport system variable has 32.4 % of the variability in the implementation of

LCL system. Further, the data analysis based on ANOVA and F-test showed that for the sixth hypothesis, p-value is less than 0.05. As the p-value is less than 0.05, it indicates that it is statistically significant so the null hypothesis is rejected. Therefore, this shows that lack of a sustainable transport system does influence the implementation of LCL system and act as a barrier for establishing a LCL system. Hence, based on results it is found that through initiating adequate measures related to sustainability and access to a sustainable transport system as well as partners are helpful in overcoming the barriers related to lack of a sustainable transport system and establishing a LCL system. The seventh hypothesis tested was to understand the effect of the climatic policy risks variable on the implementation of LCL system. Based on the R-squared statistical test, it was found that R square value is 0. This value indicates that the climatic policy risks variable has 0 % of the variability in the implementation of LCL system. This reflects that higher costs as variable indicates a better fit for the model. Further, the data analysis based on ANOVA and F-test showed that for the seventh hypothesis, p-value is more than 0.05. As the p-value is more than 0.05, it indicates that it is not statistically significant and therefore, the null hypothesis is accepted. Hence, this shows that climatic policy risks do not influence the implementation of LCL system and does not act as a barrier for establishing a LCL system. Hence, based on results it is found that through initiating adequate measures related to sustainability and access to a sustainable transport system as well as partners are helpful in overcoming the barriers related to lack of a sustainable transport system and establishing a LCL system.

7.0 Conclusion

Transport systems and economic development are naturally related to each other, with the former empowering, facilitating and causing development. Economic development and rising gross domestic product are typically associated with an increase in transportation activities.. Transportation activities have become a crucial source of air pollution and greenhouse gas emissions, with the former known to have dangerous effects on human health and the latter being responsible for global warming. A sustainable future depends on a reconnection of economic growth and rising carbon emissions within the transport sector. True sustainability happens when all three factors namely environmental, social and economic are combined. Logistics has been a crucial part of the transport sector and has been often overlooked while analyzing the challenges for the transport sectors. The environmental impact of logistics activities has been considered of greater interest but is still considered as a minor criterion. Green or Carbon efficient logistics network has been recognized as a major contributor to ecological growth and decrease of carbon footprint. In spite of the benefits

outlined for carbon reduction practices through the LCL system, there are still many barriers. This study was focused on evaluating the barriers influencing the implementation of Low Carbon Logistics Network within Indian SMEs with specific to Risk and Sustainability aspects. Based on the study results analyzed and discussed, it is evident that there are many key barriers towards achieving a sustainable LCL system. It can be confirmed that among the factors considered as barriers and tested hypothetically for this study, only climatic policy risks variable do not affect the application of a LCL Network as a barrier. All other factors namely lack of organization encouragement, lack of information technology application, lack of collaboration in SC partners, lack of government support, lack of sustainable transport system, and high costs have been identified as the barriers in implementing LCL system. The main factor that reflects in these barriers is the perceived initial higher costs for implementing a LCL system but it is observed that efficiency is achieved with the reduction of the carbon emissions. Consequently, it can be concluded that there is a strong need for adequate collaboration at organization level, technological level, at logistics network level, at government policy level with a significant interest at environmental level in developing low carbon logistic solutions. In order to achieve a holistic LCL area, the entire process network must be designed and maintained in accordance with environmental regulations and long- term sustainability. The

current study has been significant in highlighting those barriers that can be transformed into opportunities based on some investment costs and approaches that make it possible for SMEs to minimize carbon emissions under different constraints. Even though this study can help many different SMEs to better understand the factors obstructing the adoption of a low carbon logistics network, this study could also help in understanding the need of required support from the government as well as partners in logistics network with assisting the decision makers of SME organizations to take better environmental actions and address issues that impacts the most. The current study has its limitations in that it focused on the barriers to establishing an LCL system. However, a substantial amount of research is required to be conducted on low-carbon logistics and SC network that focus on the operational and functional aspects of logistics network concerning emission issues and carbon performance, as well as the measurement issues of carbon footprint. By examining these aspects in detail, logistics networks can improve financial performance and environmental performance concurrently to achieve ecological development. Finally, it is critical to effectively promote the overall industry's and logistics system's sustainable development and energy savings, as well as reduce enterprise costs and optimise overall resources based on the initial investment for a LCL system.
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