

**DEVELOPMENT OF SUPPLY CHAIN MODEL FOR CKD
(COMPLETELY KNOCKED DOWN) OPERATION IN LIGHT
OF BANGLADESH AUTOMOBILE DEVELOPMENT POLICY**

By

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DECLARATION

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at BRAC University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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ETHICAL STATEMENT

This thesis is grounded in a commitment to upholding the highest ethical standards throughout the research process. The study recognizes the importance of respecting the rights, dignity, and autonomy of all individuals involved, including participants, stakeholders, and the broader community. Informed consent will be obtained from participants, ensuring their voluntary participation and the protection of their privacy and confidentiality. The research will be conducted with transparency, integrity, and fairness, striving to minimize any potential harm or adverse effects on individuals or groups. Any potential conflicts of interest will be disclosed and managed appropriately. Ethical guidelines provided by BIGD will be strictly followed to ensure the responsible and ethical conduct of this research. The findings and outcomes of this thesis aim to contribute positively to knowledge, promote understanding, and uphold the principles of justice and social responsibility.

DEDICATION

This thesis is dedicated to my loving parents and my beautiful life partner whose unwavering support, encouragement, and belief in my abilities have been instrumental in the completion of this work. Your constant guidance, love, and inspiration have been the driving force behind my journey, and I am forever grateful for your presence in my life. This achievement would not have been possible without your unwavering faith in me.

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List of Acronyms

AI	Artificial Intelligence
CKD	Completely knock down
CPFR	Collaborative Planning, Forecasting, and Replenishment
DMAIC	Define- Measure- Analyse- Improve-Control
EOQ	Economic Order Quantity
ERP	Enterprise Resource Planning
IMS	Inventory Management Systems
IoT	Internet of Things
JIT	Just-in-Time
KPI	Key Performance Indicators
ML	Machine Learning
OEM	Original Equipment Manufacturers
PDCA	Plan-Do-Check-Act
QC	Quality Control
R&D	Research and Development
RFP	Request For Proposal
ROP	Reorder Point
SKD	Semi knock down
TMS	Transportation Management System
TQM	Total Quality Management
VMI	Vendor-Managed Inventory
WMS	Warehouse Management System

ABSTRACT

Complete Knock Down operation in Bangladesh automobile industries is so far was limited to the producing three wheelers and assembling trucks, motor cycles and cars. Assembling bikes attained the economy of the scale due to tax cuts and large size of the local market. As long as imported reconditioned cars were allowed locally assembled cars would be costlier. It is apprehended that the people of Bangladesh desiring buy cars would not be able even to afford locally assembled car unless a comprehensive supply chain is established.

The study was mainly a descriptive research. Data were collected from both primary and secondary sources using field methods and document analysis respectively. Primary sources of data were the key personnel responsible for policy making, procurement, training and operational support management of automobile industries. Secondary sources of data were published books and unpublished materials relevant to the study. The collected data were analysed qualitatively and quantitatively, as applicable, using descriptive analytical tools and was presented in descriptive forms.

The identified challenges include Lack of skilled manpower, Inadequate Resources, Improper Inventory Control, Poor Planning and lack of Research and Development. Growing automobile markets, favourable government policies, cost advantage, increasing localisation efforts, rising export potential and infrastructure development were some of the prospects of CKD operations in the automobile industries of Bangladesh. The study proffered some strategies which include development of Skilled Manpower, promulgation of local content policy, Improvisation of Inventory Control, Efficient Planning and institutionalisation of R & D efforts.

The study recommended among others that the automobile industries of Bangladesh may implement a comprehensive plan to develop skilled manpower, National Assembly may enact local content policy, Stakeholders may establish data centre, full pledged planning and dedicated R&D department.

Keywords: Supply Chain, Automobile, CKD, Local Contents

CHAPTER 1

INTRODUCTION

1. Background of the Study

Development of automobile started in 1672 with the invention of first steam powered vehicle. Invention led to the creation of first steam powered automobile capable of human transportation in 1769. The practical marketable automobile for everyday use appeared in 1886. Since then, the automotive industries have been playing vital role in the economic development of different countries. (Erik, 2001).

An automobile industry designs, develops, manufactures and markets motor vehicles. Manufacturing process includes assembling the components, testing the vehicle and delivering it to the customer. Different approaches are in practice for assembling automobiles. Complete Knocked Down (CKD) approach is being encouraged now a days. The CKD operations involve the importation of partially assembled vehicles, which are then assembled locally using domestically sourced components. Thus CKD promotes local industry, generates employment and ensure technology transfer. (Miller and Russell , 2000).

The successful implementation of CKD operations demands an effective supply chain. Supply chain encompasses the flow of raw materials, components and finished goods from suppliers to manufacturers and ultimately to customers. A well-designed supply chain model ensures efficient and timely delivery of components, minimises production costs and maximises overall operational effectiveness. (Inspection, 2021)

Despite the small size of local market, New Zealand developed a car assembly industry as import substitution and to provide local employment. But following economic reforms in the 1980s many car companies ended assembly because of, the lowering of import tariffs by the Government, and the ability to import Australian-built vehicles duty-free. They switched to importing completely built-up vehicles from Japan, Australia, or Europe. (Webster Mark, 20012)

In 2009, Mahindra & Mahindra Limited announced that it would export pickup trucks powered by diesel engines from India to the United States in CKD kit form. Mahindra planned to export CKD kits as complete vehicles that would be assembled in the United States. However, Mahindra's United States CKD and export plans never materialised and were subjected to several lawsuits. (Kong Benson,2009)

In 2013, Tesla started operating an assembly plant in Tilburg, the Netherlands for the assembly of their Model S sedan and Model X Sports Utility Vehicle (SUV) for the European Union (EU). For the most part, the car was manufactured in the Tesla Factory in Fremont, California. During the final assembly in the Netherlands, various parts were added to the car, most notably the rear subframe with the drive train as well as the battery pack. (tesla.com, 2013), (carfax.eu. 2017), (*GoPress Mobility* ,2017)

The transport sector in Bangladesh is dominated by road transport. In FY 2017, the transport sector accounted for 10 per cent of Gross Domestic Product (GDP). (BBS,2018) This sector is an integral part of the national and international value chain contributing to sustain the production and distribution network both nationally and internationally.

In terms of numbers, cars dominate the total number of vehicles in any country, and Bangladesh is of no exception. The car market in Bangladesh is comprised of three types: imported brand-new cars; imported reconditioned cars and cars manufactured in Bangladesh.

Imported reconditioned cars dominate passenger vehicle sales. In 2020, out of 377,660 registered vehicles, only 20,093 belonged to the passenger vehicle segment, covering a mere 5.3% of the automobile industry volume. Sedans accounted for approximately 55 %, while SUVs and minibuses made up the rest of the segment (LightCastle Analytic Wing, 2021)

Domestic manufacturing of cars in Bangladesh has been primarily limited to assembling of CKD components. Only one public sector company has been assembling limited number of old or discontinued model cars since 1960s with very limited success. Very recently, a number of private entrepreneurs have launched assembling plants using the cover of protective tariff structure.

The CKD operation in Bangladesh automobile industries is so far is limited to the producing three wheelers and assembling trucks, motor cycles and cars. Companies however prefer assembling bikes because they can attain the economy of the scale due to tax cuts and large size of the local market. As long as imported reconditioned cars are allowed locally assembled cars will remain costlier. It is apprehended that people of Bangladesh will not able to afford one even they are locally assembled cars unless a comprehensive supply chain is established.

With this background, the purpose of this study is to develop a comprehensive supply chain model for CKD operations in Bangladesh's automotive industry, taking into consideration the requirements and objectives outlined in the Bangladesh Automobile Development Policy.

1.2. Statement of the Research Problems

Bangladesh is one of the most populous countries in the world. She has already graduated from least developed country and expected to enter into middle income countries by 2041. She has potential enormous market for both passenger and commercial vehicles. Proposed Bangladesh Automobile Development Policy welcomes vehicle assembly in either Semi Knock Down (SKD) or CKD forms. But the present size of the market, forward and backward linkage among others poses daunting challenges. Thus the study seeks to analysis the impediments of CKD operation in the automobile industries of Bangladesh through probing the following research questions:

- a. What are the issues involved in supply chain of CKD operation in automobile industries of Bangladesh?
- b. What are the effects of supply chain on CKD operation in automobile industries of Bangladesh?
- c. What are the challenges militating against supply chain for effective CKD Operation in automobile industries of Bangladesh?
- d. What are the prospects of the CKD operation in automobile industries of Bangladesh?
- e. What are the strategies to mitigate the challenges militating against supply chain for effective CKD Operation in automobile industries of Bangladesh?

1.3. Objective of the Study

The main objective of this study is to identify the impediments to the development of supply chain model in automobile industries of Bangladesh for effective CKD operation and proffer strategies to mitigate such impediments. The specific objectives of the study are to:

- a. Identify the issues involved in supply chain of CKD operation in automobile industries of Bangladesh.
- b. Highlight the effects of supply chain on CKD operation in automobile industries of Bangladesh.
- c. Examine the challenges militating against supply chain for effective CKD Operation in automobile industries of Bangladesh.
- d. Discuss the prospects of the CKD operation in automobile industries of Bangladesh.
- e. Proffer the strategies to mitigate the challenges militating against supply chain for effective CKD operation in automobile industries of Bangladesh.

The expected outcome of this study would be a supply chain model for effective CKD operation in automobile industries of Bangladesh.

1.4. Scope of the Study

The scope of this study covered time, space and content boundaries of the research with rational justification. This study covered the period from 2015 to 2023. The period chosen marked the substantial growth of automobile market and drawn attention of the government. Besides, this period is considered ideal for an objective assessment of the supply chain trends of CKD operation in the current democratic dispensation.

The study is limited to the supply chain model for the CKD operation in the automobile industries of Bangladesh. Supply chain of CKD operation involves several activities from planning to execution. For this study, the attention is on supply chain optimisation, localisation of components, policy alignment, stakeholder collaboration and technological integration.

1.5 Significance of the Study

The significance of this study bears from its potential to improve policy, performance improvements, further research and advance the frontier of knowledge. This study is significant as it would be beneficial to the Government of People's Republic of Bangladesh (GPRB) and Road Transport & Highways Division for the formulation of necessary policy guidelines in order to ensure the economic interest of Bangladesh. The developed supply chain model would provide valuable insights and guidelines for the stakeholders to optimise their operations, enhance efficiency, reduce costs, and promote sustainable growth in the sector.

Furthermore, the study would be relevant to researchers who might wish to embark on further studies into this and/or related subjects. Finally, the study would be useful to readers and would provide the knowledge base of Supply Chain Model in the context of CKD operations in automobile industries of Bangladesh.

1.6 Limitation of the Study

Access to classified document presented some challenges especially in the face of poor and inaccurate record keeping. Efforts were however made to overcome these limitations through interviews, discussions and consultations. Furthermore,

data obtained from the primary and secondary sources were used to fill gaps due to dearth of official records.

1.7. Structure of the Thesis

This study is organised in eight chapters. Chapter 1 presents background to the study, statement of the research problem, objectives of the study, significance of the study, scope of the study and limitations of the study.

In Chapter 2, the two key variables, supply chain and CKD operations are conceptualised using relevant literature. Some literatures relevant to the research are reviewed and the Indian models of CKD operation is highlighted. Chapter 3 presents methodology of the study.

Chapter 4 presents an overview of supply chain of CKD operation and focuses its effects on automobile industries of Bangladesh. It also discusses the issues, effects and challenges for automobile industries to develop supply chain model for CKD operations. It thereafter highlights the prospects for mitigating the challenges against supply chain for effective CKD operations of automobile industries of Bangladesh.

Chapter 5 proffers strategies to mitigating the challenges against Supply Chain for effective CKD operations of automobile industries of Bangladesh. It also provides an action plan for the implementation of the strategies.

Chapter 6 presents background, key objectives of automobile development policy on CKD operation and its implications for the automobile industries of Bangladesh. Chapter 7 presents a supply chain model for effective CKD operations of automobile industries of Bangladesh.

Chapter 8 focuses on the main findings and deductions made by the study that lead to recommendations for effective CKD operations of automobile industries of Bangladesh.

CHAPTER 2

LITERATURE REVIEW

This chapter conceptualises the key variables in this study. Thereafter, a review of some existing relevant literatures and a theoretical framework are undertaken. Finally, examples of how adoption supply chain model of CKD operation has affected automobile industries of India are presented to draw lessons for the study.

2.1. Conceptual Discourse

The key variables in this study are: supply chain and CKD Operation. The variables are conceptualised.

2.1.1 Supply Chain

Supply chain is a complex logistics system that consists of facilities that convert raw materials into finished products and distribute them to end consumers or end customers (Ganeshan and Harrison, 2005) (Ghianz, et al; 2004). Hayes views a supply chain as a network of individuals and companies who are involved in creating a product and delivering it to the consumer. Links on the chain begin with the producers of the raw materials and end when the van delivers the finished product to the end user. (Hyes, 2024)

In broader sense, supply chain refers to the entire process of handling and moving goods from the supplier to the customer. It encompasses the flow of materials, information, and resources across different stages, from the sourcing of raw materials to the delivery of the final product to the end-user. Conceptually, the supply chain can be visualised as a network of interconnected entities and activities involved in creating and delivering a product or service. It includes

various components such as suppliers, manufacturers, distributors, retailers, and customers.

Throughout the supply chain, there is a continuous flow of information and coordination between different stakeholders. This includes demand forecasting, inventory management, order processing, logistics planning, and customer service. Technologies like transportation management systems, inventory management software, and Enterprise Resource Planning (ERP) systems play a crucial role in facilitating this information flow and optimising supply chain operations.

2.1.2 Completely Knock Down Operation

The CKD operations, refer to the process of dismantling, packaging, and shipping vehicle components or sub-assemblies to a destination country, where they are further assembled into complete vehicles. It is a widely adopted practice in the automobile industry to optimise production costs and enhance local manufacturing capabilities. (Iqbal, 2024)

The CKD process starts with the disassembly of vehicles into individual components or sub-assemblies at the manufacturing plant. These components, such as engine parts, chassis, body parts, electrical systems, and interior fittings, are carefully packaged and labeled for efficient transportation. The process ensures that the components are compact, secure, and easily identifiable to facilitate streamlined assembly at the destination. (Asyraf, 2023)

CKD operations in the automobile industry offer significant advantages in terms of cost optimisation and local manufacturing capabilities. Effective supply chain model, collaboration among stakeholders and the implementation of innovative

strategies are key to overcoming the challenges associated with CKD operations. With continuous improvement and sustainability initiatives, CKD operations can contribute to the growth and competitiveness of the automotive industry while minimising environmental impact. (Asyraf, 2023)

2.2. Review of the Existing Literature

Erfurt, in his work, “Integration of knockdown supply chains and global manufacturing networks” viewed knock down supply as solution to the unsatisfactory qualification of local forces and insufficient supply bases. (Erfurt, 2021). He emphasised on integration of knockdown supply chain and presented in integrated framework that matched knock down supply chain with global manufacturing networks. He explained the types of knockdown supply chain and their limitations. His work did not consider local operation of the supply chain in automobile industries of any particular country.

Klug in his article, “Logistic implications of global production networks in car manufacturing” highlighted that the automobile industries tended to form flexible production networks with external and domestic suppliers. (Klug, 2010) He explained theoretical perspectives of logistic implications of production network. He perceived knock down operations as a transition phenotype between single central manufacturing and multisite production. However he failed to explain how resources and other parameters affects the choice of CKD operation.

Abate and Negussie in their works, “Identifying standard SKD/CKD and automobile manufacturing development stage in Ethiopia” posited that the countries where complete build up (CBU) are not preferred technically and economically opt for CKD. They explained the basic standard of CKD and their benefits. Their findings has been very fruitful for Ethiopia but did mention

whether it would be equally applicable for other developing nations. (Abate and Negussie, 2023)

Malavolti in his paper , “Cost efficiency and waste reduction in completely knocked down production” stated that CKD operation could be beneficial depending on the market condition. He emphasised on the value creation of each step of CKD operation starting from design to final assembly. His paper focused on the cost efficiency and waste management. However he did not mention about the sourcing of the CKD kit and lead time. (Malavolti, 2019)

David and Isa in their paper, “ Impact of sales volume (SAV) and completely knocked down in automotive industry on economic growth in Nigeria” presented the impact of CKD in sales volume using sales data from 1987 to 2019. They have emphasised on the sales volume and the impact on the overall country’s economy, however they did not mention about the operational process of CKD and did not design any supply chain model to make the CKD operation more efficient. (David and Isa, 2021)

The literatures reviewed so far have no doubt made significant contributions to the field of study. However, none of them treated supply chain and CKD operation in the context of developing countries like Bangladesh. Therefore, this study seeks to bridge this gap by developing a supply chain model for CKD operations in the automobile industries of Bangladesh

2.3. Theoretical Framework

Theoretical framework for supply chain in CKD operations of automobile industries is be based on supply chain network design; selection and management

of supplier; inventory management; demand forecasting and planning; transportation and logistics; quality control and information technology.

Supply chain network design involves determining the optimal location and structure of the supply chain network. Factors include the number and location of suppliers, manufacturing facilities, distribution centres, and retail outlets. The goal is to minimise overall costs while ensuring efficient flow of CKD parts and components. (Reza et al, 2014)

Selection and management of supplier involves identifying and evaluating potential suppliers based on their capabilities, quality standards, pricing, and delivery performance. Proper supplier management is crucial to ensure a reliable and timely supply of CKD parts to the manufacturing facilities. (Iqbal, 2024)

Inventory management involves determining the appropriate level of inventory for CKD parts and components at each stage of the supply chain. Inventory needs to be balanced to avoid stock outs and excessive holding costs. Techniques such as JIT and Vendor-Managed Inventory (VMI) can be used to optimise inventory levels.

Accurate demand forecasting is crucial for effective supply chain management in CKD operations. This involves analysing historical data, market trends, and customer demand patterns to predict future demand. Planning involves developing production schedules and coordinating with suppliers to ensure timely delivery of CKD parts. (Iqbal, 2024)

Efficient transportation & logistics are vital in CKD operations. This involves selecting the appropriate transportation modes (e.g., road, rail, sea) and optimising routes to minimise transportation costs and lead times. Effective

logistics management ensures smooth movement of CKD parts from suppliers to manufacturing facilities and eventually to the dealers.

Quality Control (QC) processes need to be implemented at each stage of the supply chain to ensure that CKD parts meet the required quality standards. This involves setting up quality control checkpoints, conducting inspections, and implementing corrective actions when necessary. Supplier performance metrics can be used to monitor and improve the quality of CKD parts.

Utilising the right information technology systems is crucial for efficient management of the CKD supply chain. This includes implementing ERP systems, Supply Chain Management (SCM) software, and data analytics tools to automate processes, track inventory, monitor performance, and make informed decisions.

2.4. Examples of Other Countries

Many countries have grabbed the opportunities of supply chain for effective CKD operations in their automobile industries in order to achieve optimum performance. India was selected for this illustration. The choice of the India provided an opportunity for drawing lessons for this study.

2.4.1 Supply Chain Model for CKD Operation in India

The Indian automotive industry has seen considerable growth in the last two decades mainly due to economic liberalisation. Global automobile and component manufacturing companies are motivated to establish manufacturing and R&D facilities in the country due to availability of large pool of skilled workers, low production costs, faster design and development process and emerging market status.

The industry comprises various groups: local assemblers, multinational assemblers, local component suppliers, multi-national component suppliers, each with specific strengths and weaknesses. Presently, there are more than 30 OEMs offering more than 75 options in all categories of vehicles. Overall domestic sales are led by two-wheelers, followed by passenger vehicle and commercial vehicles (Ray, 2012)

India has the best-in-class fuel economy rates as well as affordable total cost of ownership (KPMG, 2006). Realising the importance of the auto industry, grown in seven clusters the Indian government laid out the goals of the industry in two documents ' –Auto Policy 2002 'and 'Auto Mission Plan 2006-16.

The setting up of manufacturing facilities in India by large automakers such as Hyundai, Ford, Toyota etc has also ensured rapid establishment and growth of a robust auto ancillary/component sector. Research and Development (R&D) have increased substantially (Joshi et al , 2013).

The multi-tiered auto component industry presently contributes significantly to the overall growth of the automobile industry and major part of exports go to the Original Equipment Manufacturers (OEMs) and Tier I suppliers. Automakers are increasingly looking towards rural markets and the youth segment in India due to enhanced buying capacity of this segment.

2.4.2 Lessons Learnt for the Study

The aforesaid study of the supply chain model in CKD operations presents some lessons to be learnt for this study. Lessons learnt for the study include global sourcing, supplier development, efficient logistics, government support, skill development and collaboration & cluster development. These are discussed in subsequent paragraphs.

2.4.2.1 **Global Sourcing**

India's automobile industry heavily relies on global sourcing of components and parts for CKD operations. It implies that Bangladesh automobile industries need establishing strong relationships with international suppliers to access high-quality components at competitive prices.

2.4.2.2 **Supplier Development**

To ensure a robust supply chain, automobile manufacturers in India invest in supplier development programs. Automobile industries of Bangladesh may take initiatives to enhance the capabilities of local suppliers through providing technical support, training, and encouraging collaboration between suppliers and manufacturers.

2.4.2.3 **Efficient Logistics**

India's automotive industry has established efficient logistics networks to transport components to their manufacturing plants. Bangladesh can focus on enhancing its logistics infrastructure, including transportation modes, customs processes, and warehousing facilities, to ensure timely and cost-effective movement of components for CKD operations.

2.4.2.4 **Government Support**

The Indian government has provided significant support to the automobile industry, including policies to attract foreign investment, infrastructure development, and tax incentives. Bangladesh can take these initiatives and create

an enabling environment for automobile manufacturers, including offering tax benefits, streamlining regulatory processes, and providing infrastructure support.

2.4.2.5 **Skill Development**

India's automobile industry emphasises skill development programs to ensure a skilled workforce capable of handling CKD operations. Bangladesh can invest in technical education and vocational training programs to build a skilled labor force that can contribute effectively to the automobile industry.

2.4.2.6 **Collaboration and Cluster Development**

In India, automobile manufacturers often collaborate with suppliers, industry associations, and academic institutions to develop supplier clusters and foster innovation. Bangladesh can learn from this approach and promote collaboration among manufacturers, suppliers, and academia to develop robust CKD supply chains and promote industry growth.

CHAPTER 3

METHODOLOGY OF THE STUDY

The study adopted document analysis and interview based field survey methods. This method involved the gathering of official documents and publications, as well as conducting unstructured interviews and administration of questionnaires to a sample of respondents who are involved in the policy making, training and acquisition process of the automobile and supply chain industries. The detailed procedures adopted are highlighted in the subsequent paragraphs.

3.1.1 Level of Research

The level of research embarked in this study was descriptive research. The descriptive research was adopted as it provided the researcher an opportunity to present his perspectives on the subject.

3.1.2. Nature of Data Collection

The researcher adopted applied research employing empirical approach to enable it established new factual information. The nature of data collected for this study was an integration of qualitative and quantitative data for an informed analysis.

3.1.3. Research Design

Survey research design was used for the study. It enabled the researcher obtain data from the field and existing literatures on the subject for an informed analysis.

3.2. Sources of Data

The study obtained data from both primary and secondary sources. The primary and secondary sources of data are discussed in the subsequent paragraphs.

3.2.1. Primary Sources

Primary sources of data were key personnel responsible for policy making, acquisition, training, maintenance and logistics management of the automobile and supply chain industries.

3.2.2. Secondary Sources

Secondary sources of data were books, journals, the Internet, newspapers, magazines and other relevant published and unpublished materials. In addition, official documents and publications were obtained from different automobile industries.

3.3 Methods of Data Collection

Primary data were obtained through interviews, discussions, participants' observation and the administration of questionnaires. The questionnaire, a sample copy of which is shown in Appendix 1, focused on how CKD was incorporated in organisation, training, logistics and maintenance system of the stakeholders to gather valid results on the subject of study.

In most cases the theme of the interview questions was sent to the personalities concerned prior to the interviews. This made it possible for the interviewees to prepare themselves for the questions. Most questionnaires were sent as attachments through e-mail and were retrieved through the same means. The interviews were unstructured in nature either telephonic or through e-mail.

Secondary data were gathered from annual reports of the automobile industries, published and unpublished materials, such as: books, journals and magazines, including extensive use of the Internet.

3.4. Sampling Techniques

Probabilistic sampling technique was adopted for this study. This technique uses randomisation sampling. The method involves; collection of lists of

population, numbering the list and selecting the sample. For this study, research population consisted of about 1500 stakeholders. The calculated sample size was 120. The sample size was determined using a web-based calculator. With the population, if Confidence Interval (CI) and Confidence Level (CL) are fed into the windows of the web calculator, the sample size automatically displays. Thus, for, CI of 8.58 and CL of 95 per cent, the sample size of 120 resulted. However, allowing 10 per cent for poor/non-response, questionnaires were drawn up for 132 stakeholders. Only 120 respondents returned the questionnaires. Simple random sampling technique was used in selecting research sample for the survey. Inherent shortcoming of this technique is that it always does not equally represent all groups (sex, age, etc) of the sampled population.

3.5. Methods of Data Analysis

The data collected for the study was analysed using both qualitative and quantitative methods. Qualitative analysis used logical reasoning to arrive at cogent deductions.

Data generated from administered questionnaires were analysed quantitatively by adopting descriptive analytical tools. The analyses were used to draw conclusions and make recommendations towards the application of Supply Chain Model for effective CKD operations of the automobile industries of Bangladesh.

3.6. Methods of Data Presentation

Analysed data were presented in a descriptive analytical form. In some cases, they were translated into tables, pie charts and bar charts for clarity.

CHAPTER 4

SUPPLY CHAIN IN CKD OPERATION IN AUTOMOBILE INDUSTRIES OF BANGLADESH: AN ANALYSIS

This chapter provides an overview of CKD operation in automobile industries of Bangladesh and discusses issues involved in supply chain for effective CKD operations. Thereafter, it examines the effects of supply chain on CKD operations and highlights the summary of research findings. Finally, the chapter discusses the challenges militating against supply chain for effective CKD operations as well as prospects of the CKD operations in the automobile industries of Bangladesh.

4.1. Overview of CKD Operation in Automobile Industries of Bangladesh

The automobile industry in Bangladesh has a relatively short history but has made significant progress in recent years. During the 1970s and 1980s, Bangladesh primarily relied on imports for its automobile market. Imported vehicles were expensive due to high import duties and limited availability, making car ownership largely limited to a small affluent segment of the population.

In the early 2000s, the government of Bangladesh initiated policies to promote local automobile assembly and manufacturing. This led to the establishment of several automobile assembly plants with the aim of reducing dependency on imports and creating job opportunities.

The CKD assembly plants started appearing in Bangladesh during the 2010s. Various international automobile manufacturers, such as Mitsubishi, Toyota, Honda, Suzuki, and Mahindra, established CKD assembly plants in the country.

This development contributed to the growth of the domestic automobile industry and increased access to affordable vehicles for the local market.

The government of Bangladesh has undertaken various initiatives to support the growth of the automobile industry. These include reducing import duties on CKD kits and providing tax incentives for automobile manufacturers. The government has also encouraged the use of locally assembled vehicles by offering subsidies and preferential policies for public procurement.

Over the years, the presence of automobile manufacturers in Bangladesh has expanded, and many manufacturers have started to localise production by sourcing components from local suppliers. This has encouraged the growth of ancillary industries and created a more comprehensive supply chain within the country.

In recent years, there has been an increasing focus on promoting the adoption of Electric Vehicles (EVs) in Bangladesh. The government has introduced policies to incentivise the import and manufacturing of EVs, aiming to reduce pollution and dependency on fossil fuels.

Over the past two decades (2000-2020), the utilisation of motorised vehicles in Bangladesh has seen a substantial increase. The number of registered motorised vehicles in the country was a mere 303,215 units in 2003 (The Daily Star, Dhaka, 2023). However, as of May 2021 data from the Bangladesh Road Transport Authority (BRTA) reveals a significant surge, with a total of 4,729,393 registered vehicles in Bangladesh. Out of these, 544,616 are passenger cars, and sedans dominate the automobile market, constituting approximately 68% of the passenger car segment. SUVs account for 12.40%, while minibuses cover 19.27%. (Nazrul, 2021). Figure 1 shows the share of market of different vehicles.

This increase in vehicle ownership can be attributed to the rise in purchasing power, as more individuals from various segments of society are now able to afford and purchase vehicles.

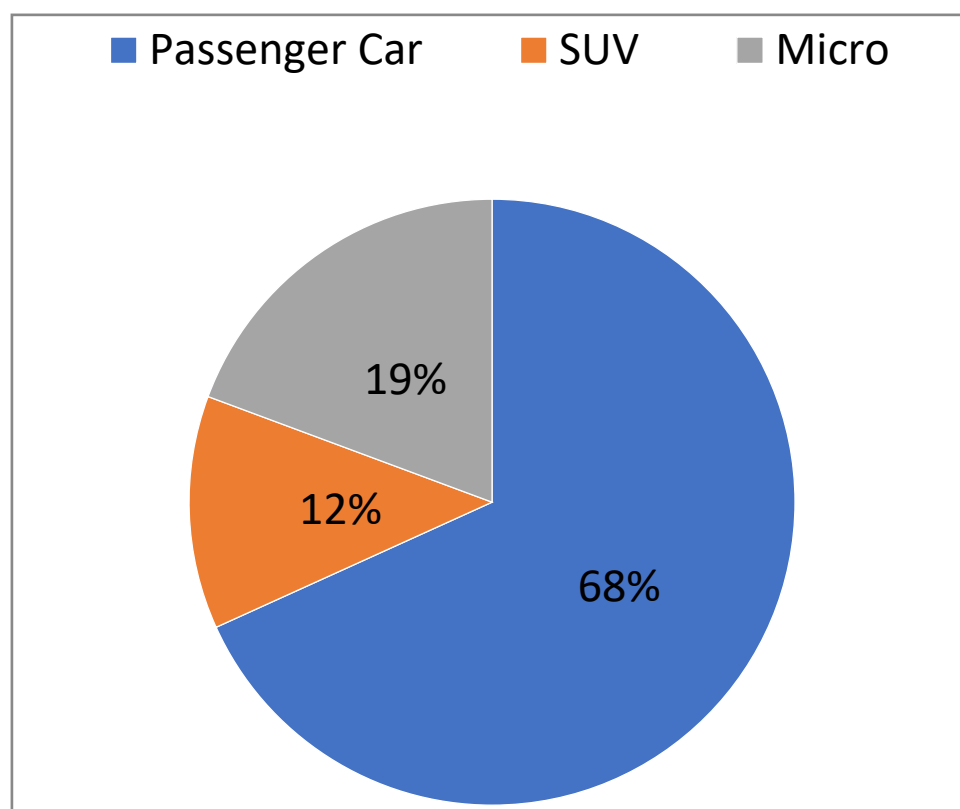


Figure 1: Share of Market of Different Vehicles , Nazrul 2021

The rate of car purchases in Bangladesh experienced a significant surge until 2017.

During that year, BRTA recorded a total of 32,942 registrations for private passenger cars, jeeps, and minibuses. However, in the subsequent years, the purchase of personal vehicles witnessed a decline. By 2020, the number had decreased to 20,093. Several factors contributed to this decline, including slower economic activity, adjustments in the financial market, higher tax rates, and the increasing popularity of ride-sharing companies. (Nazrul, 2021)

The COVID-19 pandemic further exacerbated the situation, negatively impacting the automobile market. Automobile market has significantly recovered after the pandemic. There is a substantial potential market of approximately 12 million middle-class individuals in Bangladesh who have the means and desire to own a car. (Nazrul, 2021)

Presently Bangladesh does not manufacture car domestically. There are several companies, both public and private, involved in automobile assembly. The first automobile assembly operation was initiated in 1966 by "Pragati Industries Limited" through a joint venture with the government. This plant primarily assembles Mitsubishi brand SUVs for government officials. Besides several local private automobile assembly companies operate in Bangladesh.

However, locally assembled cars have not gained significant attraction in the market so far. In 2020, among newly registered cars, 82% were reconditioned or imported from the grey market, 16% were brand new imported vehicles, and only 2% were locally assembled. (Iqbal, 2024) Figure 2 shows the share of locally assembled car in the market as of 2020.

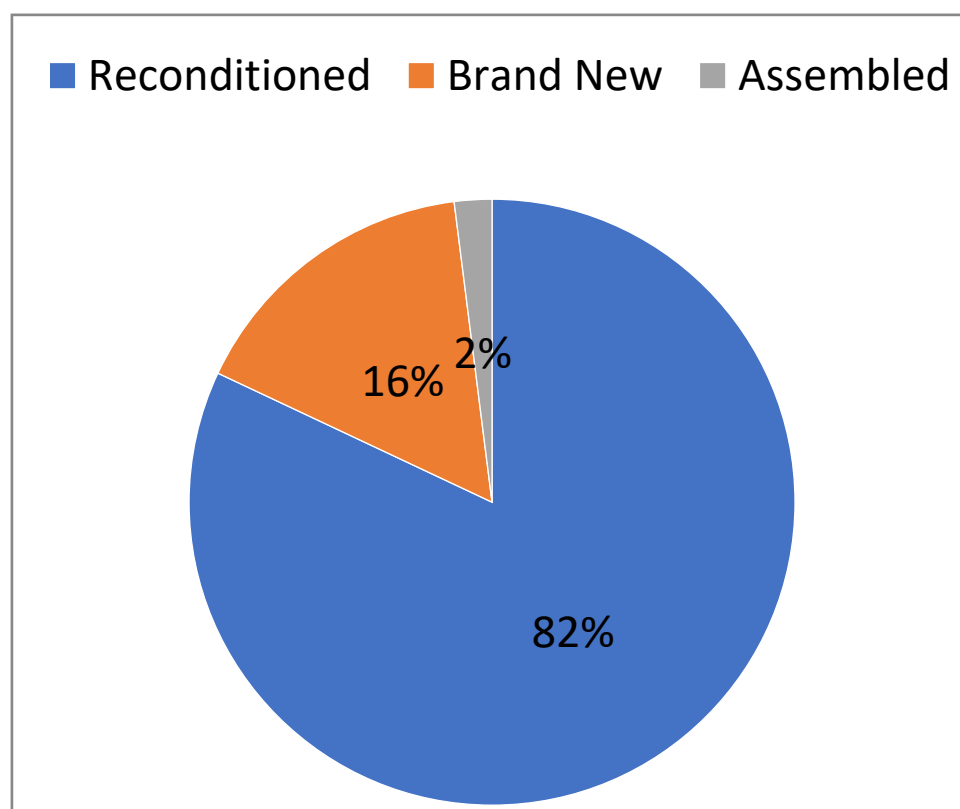


Figure 2: Share of Assembled Cars, Iqbal, 2024

Trend of vehicle market indicates increasing demand for brand new cars, SUV obtaining popularity and increasing demand for hybrid Vehicles. The demand for brand new cars in Bangladesh has been on the rise, leading to a decline in the dominance of Japanese reconditioned cars in the automobile market. One of the factors contributing to this shift is the minimal tax difference between reconditioned Japanese cars and brand new cars.

This changing trend indicates a growing preference among Bangladeshi consumers for brand new cars that offer the latest features. In 2016, brand new cars held a market share of 7%. However, after four years, in 2020, the market share had doubled to 16%. It is projected that the market share of brand new cars will continue to increase, potentially reaching 20% to 60% of the total market by 2025. (LightCastle Survey). Figure 3 shows the increasing demand of brand new cars.

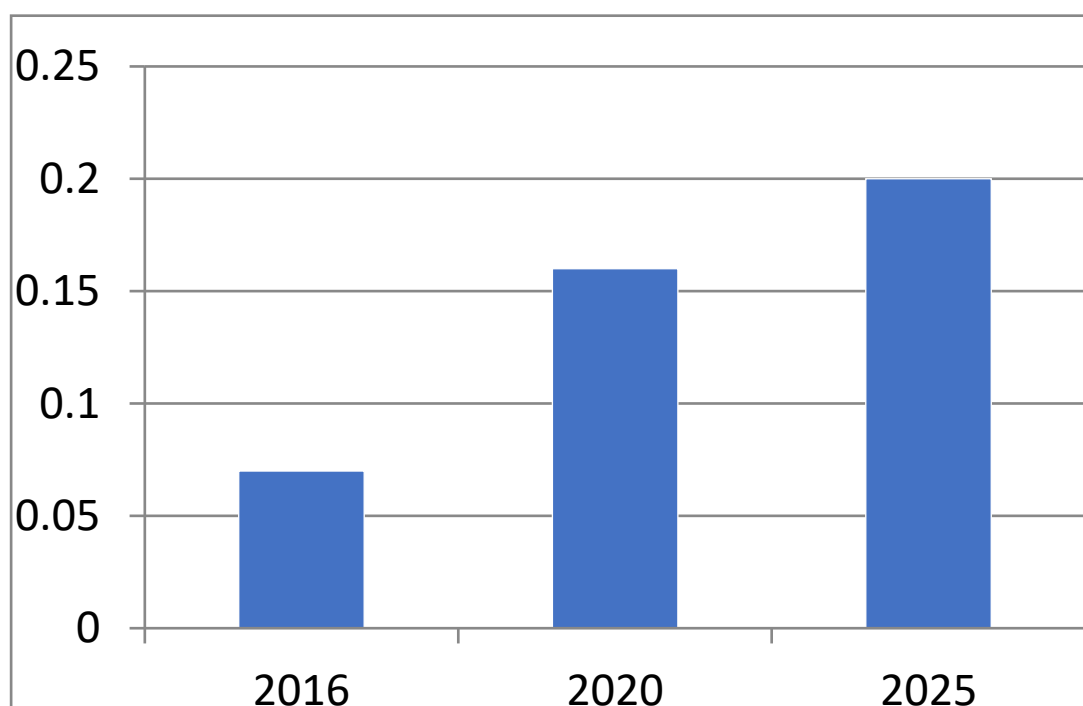


Figure 3: Trends of Increasing Demand of Brand New Car, LightCastle Survey

SUVs have historically been present in the Bangladeshi market, primarily used by government officials and important corporate personnel. However, in recent years, there has been a shift in their popularity, following a global trend. SUVs are now gaining popularity among family buyers as well. This can be attributed to their better driving comfort, suitability for Bangladeshi road conditions, and high ground clearance. The sporty look of SUVs also appeals to the younger generation.

According to a survey conducted by LightCastle, 28.1% of prospective buyers express their willingness to purchase an SUV in the future. In 2017, SUVs held a market share of only 16%, but by 2020, that figure had increased to 24%. Figure 4 shows the increased trends of popularity of SUVs.

The demand for hybrid vehicles in Bangladesh is experiencing significant growth.

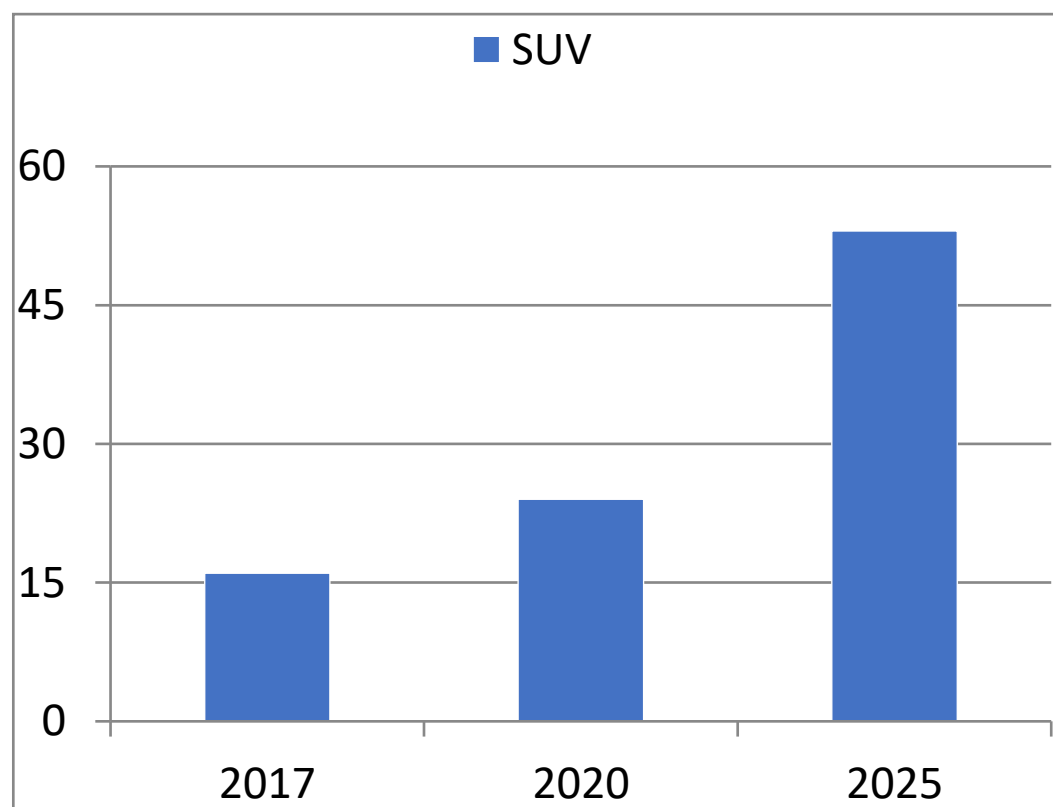


FIGURE 4: Trends of Increasing Demand of SUVs, LightCastle Survey

Popular brands such as Toyota Axio, Honda Grace, and Nissan X-Trail offer hybrid vehicle options that have gained traction in the market. (Iqbal, 2024) The lower tax rates on hybrid vehicles contribute to their increasing popularity among buyers.

In 2018, the hybrid four-wheeler market witnessed a remarkable 900% increase in sales. According to a leading importer and retailer in the Bangladeshi automobile industry, a basic 1500 cc hybrid car can achieve a fuel efficiency of 15-25 kilometres per litre (LightCastle Survey). Additionally, hybrid cars are equipped with motors that provide extra horsepower, resulting in additional power.

EVs are also entering the Bangladeshi market. The tax rates on EVs are currently much lower in Bangladesh compared to gasoline-fuelled Completely Built-Up (CBU) vehicles. However, challenges such as the lack of charging infrastructure on roads, limited technical expertise, and the road conditions in Bangladesh are currently constraining the widespread popularity of EVs in the market.

Despite the relatively young age of the automobile industry in Bangladesh, it has shown promising growth potential, with increasing investments and initiatives to develop a robust and sustainable automotive sector. The industry still faces challenges such as inadequate infrastructure, high import duties, and limited consumer purchasing power, but ongoing efforts are being made to overcome these obstacles and further expand the automobile sector in the country. The overview has brought out pertinent issues involved in supply chain of CKD operations of automobile industries.

4.2 Issues Involved in the Supply Chain of CKD Operation

The major issues involved in supply chain of CKD Operation include: skilled manpower, resources, inventory control, planning and Research and Development (R&D). These are subsequently discussed.

4.2.1 Skilled Manpower

A skilled worker may be defined as someone who holds the necessary qualifications to perform his role, and consistently goes above and beyond in the performance of his duties. From striving to provide an outstanding customer experience to ensuring that all work is carried out with care and attention to detail, they understand their roles and are fully committed to it. Skilled workforce maximises productivity, have problem solving abilities, save money, contribute to improved profitability and stronger growth. They improve workplace relations. This ensures a happier workplace, staff loyalty and reduced stress.

Bangladeshi Automotive Industry provides direct and indirect employment to over 3 million people. Direct employment includes personnel working with automobile OEMs and auto component manufacturers (about 30% to 40%). Indirect employment includes personnel working in the enabling industries, such as vehicle finance and insurance industry, vehicle repair, vehicle service stations, vehicle maintenance, vehicle and component dealers, drivers, cleaners etc (about 60% to 70%). (Fahim, 2023).

The success of the industry largely depends on the skilfulness of these workforces. Thus, skilled manpower is an issue of the supply chain for effective CKD operation.

4.2.2 Resources

The resources required for CKD operations in the automobile industry varies depending on the specific product and manufacturing process. However, commonly required resources are: manufacturing facilities; machinery and equipment; raw materials and components; and transportation and logistics.

A dedicated production facility is required to carry out CKD operations. This facility should have sufficient space for assembling and manufacturing various components of the vehicles. The operations also require a range of machinery and equipment, such as assembly lines, welding machines, painting booths, and testing equipment. These tools are necessary for assembling the various components and manufacturing the vehicles. In addition, the CKD operations require the procurement and stocking of raw materials and components from suppliers. These can include engine parts, chassis, bodywork, electrical components, and other necessary components for vehicle assembly.

The transportation and logistics infrastructure is crucial for CKD operations, as components and vehicles need to be transported to and from the manufacturing facility. This may involve coordination with third-party logistics providers for efficient transportation and distribution.

The supply chain process begins with the sourcing of components and parts required for vehicle assembly. This involves identifying reliable suppliers, negotiating contracts, and ensuring the availability of quality components. Once the components are sourced, they are transported to the assembly plant. This

involves coordinating transportation logistics, including selecting the most efficient mode of transportation (road, rail, or sea) and managing customs clearance and import procedures.

4.2.3 Inventory Control

Inventory control is a crucial aspect of CKD operations in the automobile industry. Some common issues include: components availability, inventory holding cost, seasonal demand fluctuations, lead time, quality control, inventory tracking, regulatory compliance and risk of obsolescence.

Ensuring the availability of the required components is an important issue in CKD operations. Delayed or unreliable supply of components can disrupt the assembly process and lead to production delays. Holding inventory comes with costs such as storage space, insurance, and the risk of obsolescence or damage. Managing these costs is essential to maintain profitability in CKD operations.

The CKD operations may face seasonal demand fluctuations. Accurately predicting and adjusting inventory levels to match fluctuating demand can be challenging, as over or under stocking can result in financial losses. The lead time for procuring components can vary, especially if they are imported from different regions. Long lead times can impact the production schedule and the ability to fulfil customer orders on time.

Maintaining quality control of components is crucial to ensure a smooth assembly process. Identifying and managing defective or low-quality components is necessary to avoid production issues and customer dissatisfaction.

Accurate tracking and management of inventory plays vital roles in CKD operations, especially if there are numerous components and multiple suppliers involved. Implementing robust inventory tracking systems is essential to avoid stock outs and minimise inventory discrepancies.

The CKD operations must comply with various regulations, such as customs and import/export regulations. Managing inventory in compliance with these regulations can be complex, especially when dealing with cross-border operations.

The CKD operations involve many parts and components, and there is always a risk of certain components becoming obsolete due to changes in technology or product design. Managing obsolete inventory and minimising the risk of obsolescence is crucial for efficient inventory control in CKD operations.

4.2.4 Planning

Planning plays a critical role in the supply chain of CKD operations in the automobile industry. Planning involves production planning, supplier management, demand planning, logistic planning, risk management,

Effective production planning is essential to ensure the availability of required components and parts for assembly. This involves determining the production schedules, coordinating with suppliers to ensure timely delivery of parts, and

managing inventory levels. By accurately forecasting demand and coordinating production activities, planning helps avoid stock outs, reduce lead times, and minimise the risk of production disruptions.

Planning involves establishing strong relationships with suppliers and ensuring their capacities and capabilities align with production demands. This includes negotiating contracts, establishing quality standards, and communicating production requirements. Effective planning helps in assessing supplier capabilities, managing supplier performance, optimising supplier networks, and mitigating risks associated with quality, lead times, and disruptions.

Accurate demand forecasting is vital for CKD operations to optimise production schedules and inventory management. Planning helps gather and analyse historical sales data, market trends, customer demand patterns, and external factors to predict future demand. This enables companies to optimise production levels, minimise excess inventory, and meet customer demands more efficiently.

Planning helps in optimising logistics and transportation activities associated with CKD operations. This includes determining the most efficient routes, modes of transportation, and managing customs regulations for component import and finished vehicle export. Planning also considers factors like warehouse capacities, material handling, packaging requirements, and reverse logistics for parts returns. Effective logistics planning helps reduce costs, shorten lead times, and enhance overall supply chain efficiency.

Planning helps identify and mitigate risks that can impact CKD operations. These risks can include supplier disruptions, production delays, quality issues, inventory shortages, and fluctuations in demand. Planning involves developing contingency

plans, implementing risk mitigation strategies, and ensuring business continuity through effective supply chain resilience.

4.2.5 Research and Development

The R&D in the supply chain of CKD operations helps identify quality gaps and potential areas for improvement. This includes conducting quality control tests and inspections at different stages of the supply chain, from component sourcing to assembly. R&D teams can analyse data and feedback to identify root causes of quality issues and develop solutions to enhance product reliability and performance.

The efforts enable the localisation of various components needed for CKD operations. This involves identifying local suppliers for parts and collaborating with them to meet the required quality standards. The R&D teams can work with suppliers to develop localised alternatives for imported components, reducing reliance on foreign sources and enhancing the domestic value chain.

The R&D activities in CKD operations aim to streamline the production process and minimise costs. By studying and implementing efficient assembly techniques and using advanced manufacturing technologies, R&D teams can identify and eliminate bottlenecks, reduce waste, and improve overall productivity.

It facilitates the adoption of new technologies and innovation. This includes exploring alternative fuels, electric vehicles, autonomous driving systems, and other advancements in the automotive industry. By collaborating with research institutions and industry experts, R&D teams can stay updated on the latest trends

and incorporate them into CKD operations, making the industry more technologically advanced.

R&D teams are responsible for conducting rigorous testing and validation of the assembled vehicles. This involves various tests, such as durability, performance, safety, and emission tests, to ensure compliance with national and international standards. R&D efforts also involve the development of crash test facilities and other testing infrastructure to improve vehicle safety.

R&D in the supply chain of CKD operations in automobile industry is critical for enhancing product quality, localisation of components, optimising production processes, adopting new technologies, and ensuring regulatory compliance. By investing in R&D activities, the industry can achieve sustainable growth and compete effectively in the global market.

4.3. Effects of Supply Chain in CKD Operation

Effects of supply chain on CKD Operation of automobile industry include costs efficiency, Quality Control (QC), timely delivery, inventory management, supplier collaboration and localisation opportunities, These are subsequently discussed.

4.3.1 Cost Efficiency

CKD operations involve importing partially assembled vehicle parts and components from various suppliers. The supply chain directly impacts the cost of these parts and components. A well-managed supply chain ensures cost efficiency

by sourcing from reliable and cost-effective suppliers, optimising transportation routes, and minimising inventory costs.

4.3.2 Quality Control

The supply chain influences the quality of CKD operations. Effective supplier management and QC processes are essential to ensure that the imported parts meet the required standards and specifications. A robust supply chain enables effective quality control measures to be implemented at each stage.

4.3.3 Timely Delivery

Timely delivery of parts and components is critical to CKD operations. Delays in the supply chain can disrupt the assembly process, resulting in production setbacks and increased costs. An efficient and well-organised supply chain ensures that all components are delivered on time, minimising production delays and maintaining smooth operations.

4.3.4 Inventory Management

CKD operations require effective inventory management to ensure that the right parts are available at the right time. The supply chain helps in maintaining optimal inventory levels by tracking demand patterns, monitoring lead times, and collaborating with suppliers. This helps to avoid excess inventory costs while ensuring an uninterrupted production process.

4.3.5. Supplier Collaboration

The supply chain involves close collaboration with various suppliers. Effective communication, coordination, and collaboration with suppliers are essential for CKD operations. This includes sharing production plans, forecasting requirements, managing supplier relationships, and implementing performance metrics. A well-established supply chain fosters strong relationships with suppliers, leading to better cooperation and improved operational efficiency.

4.3.6. Localisation Opportunities

The supply chain also influences localisation opportunities in CKD operations. As the industry evolves, automobile manufacturers often seek to localise the sourcing of components and reduce reliance on imports. A well-designed supply chain facilitates the identification and development of local suppliers, helping to enhance local manufacturing capabilities and promote economic growth.

4.4. Summary of the Research Findings

The automobile industry in Bangladesh has a relatively short history but has made significant progress in recent years. During the 1970s and 1980s, Bangladesh primarily relied on imports for its automobile market. In the early 2000s, the government of Bangladesh initiated policies to promote local automobile assembly and manufacturing. This led to the establishment of several automobile assembly plants with the aim of reducing dependency on imports and creating job opportunities.

The CKD assembly plants started appearing in Bangladesh during the 2010s. Various international automobile manufacturers, such as Mitsubishi, Toyota, Honda, Suzuki, and Mahindra, established CKD assembly plants in the country.

This development contributed to the growth of the domestic automobile industry and increased access to affordable vehicles for the local market.

The government of Bangladesh has undertaken various initiatives to support the growth of the automobile industry. These include reducing import duties on CKD kits and providing tax incentives for automobile manufacturers. The government has also encouraged the use of locally assembled vehicles by offering subsidies and preferential policies for public procurement.

Over the years, the presence of automobile manufacturers in Bangladesh has expanded, and many manufacturers have started to localise production by sourcing components from local suppliers. This has encouraged the growth of ancillary industries and created a more comprehensive supply chain within the country.

In recent years, there has been an increasing focus on promoting the adoption of EVs in Bangladesh. The government has introduced policies to incentivise the import and manufacturing of EVs, aiming to reduce pollution and dependency on fossil fuels. Market trends indicated increasing demand for brand new cars, more popularity for SUV and increasing demand for Hybrid Vehicles.

Despite the relatively young age the automobile industry of Bangladesh has shown promising growth potential, with increasing investments and initiatives to develop a robust and sustainable automotive sector.

The major issues, involved in supply chain of CKD Operation included skilled manpower, resources, inventory control, planning and R&D. It was revealed that

skilled workforce could maximises productivity, save money thus contribute to improved profitability and stronger growth.

The resources required for CKD operations in the automobile industry include: manufacturing facilities; machinery and equipment; raw materials and components,; and transportation and logistics.

Inventory control is a crucial aspect of CKD operations in the automobile industry. Some common issues include: components availability, inventory holding cost, seasonal demand fluctuations, lead time, quality control, inventory tracking, regulatory compliance and risk of obsolescence.

Planning plays a critical role in the supply chain of CKD operations in the automobile industry. Planning involves production planning, supplier management, demand planning, logistic planning, risk management. Effective planning helps in assessing supplier capabilities, managing supplier performance, optimising supplier networks, and mitigating risks associated with quality, lead times, and disruptions.

Planning helps in optimising logistics and transportation activities associated with CKD operations. Planning also considers factors like warehouse capacities, material handling, packaging requirements, and reverse logistics for parts returns. Effective logistics planning helps reduce costs, shorten lead times, and enhance overall supply chain efficiency.

Planning helps identify and mitigate risks that can impact CKD operations. These risks can include supplier disruptions, production delays, quality issues, inventory shortages, and fluctuations in demand. Planning involves developing contingency

plans, implementing risk mitigation strategies, and ensuring business continuity through effective supply chain resilience.

R&D efforts enable the localisation of various components needed for CKD operations. This involves identifying local suppliers for parts and collaborating with them to meet the required quality standards. The R&D teams can work with suppliers to develop localised alternatives for imported components, reducing reliance on foreign sources and enhancing the domestic value chain.

A well-managed supply chain ensures cost efficiency by sourcing from reliable and cost-effective suppliers, optimising transportation routes, and minimising inventory costs. The supply chain influences the quality of CKD operations. An efficient and well-organised supply chain ensures that all components are delivered on time, minimising production delays and maintaining smooth operations.

The supply chain helps in maintaining optimal inventory levels by tracking demand patterns, monitoring lead times, and collaborating with suppliers. This helps to avoid excess inventory costs while ensuring an uninterrupted production process. Effective communication, coordination, and collaboration with suppliers are essential for CKD operations. The supply chain also influences localisation opportunities in CKD operations. As the industry evolves, automobile manufacturers often seek to localise the sourcing of components and reduce reliance on imports. A well-designed supply chain facilitates the identification and development of local suppliers, helping to enhance local manufacturing capabilities and promote economic growth.

The summary of research findings presented some challenges militating against Supply Chain for effective CKD operation in automobile industries of Bangladesh.

4.5. Challenges Militating against Supply Chain for Effective CKD Operation

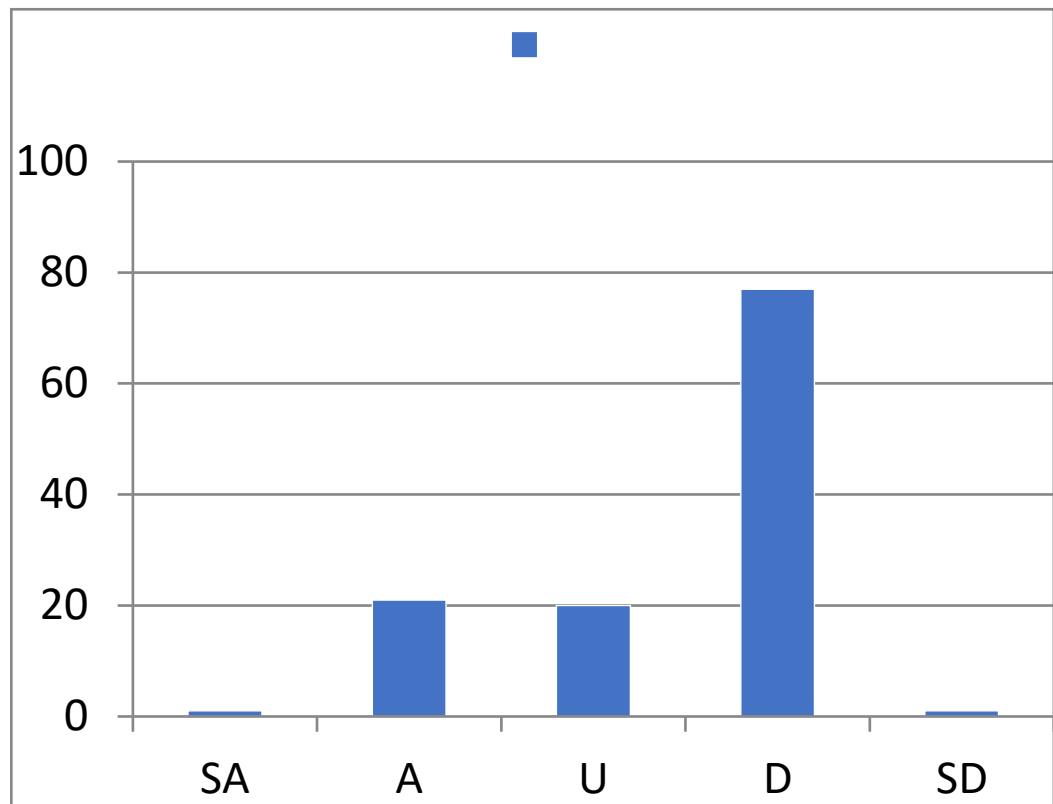
Challenges militating against supply chain for effective CKD operation in automobile industries of Bangladesh: lack of skilled manpower, inadequate resources, improper inventory control, poor planning and lack of R &D. These are subsequently discussed.

4.5.1 Lack of Skilled Manpower

The quality of the personnel employed, both in terms of knowledge and skills is not appropriately matched to the requirements of the automobile industry in Bangladesh. Hence the significant gaps exist is the non-availability of skilled manpower. The problem is not so much in terms of quantity, but more in terms of quality of manpower available. This leads to lower productivity of the automobile sector in Bangladesh as compared to other nations producing automobiles.

As the industry progresses along its growth path, in order to provide for comprehensive growth, it is imperative to track the enablers of market and industry and at the same time capture and react to the changing skill requirements in each of these areas along with the skill requirements of the mainstream industry. The existing jobs will tend to change in terms of the skills and competences required and the relative importance attached to these. An increase in the numbers employed with these skills is likely to be a necessary condition for the optimistic scenario to become a reality. But this requires the industry to

be sufficiently attractive to enable companies to recruit people with the relevant skills, which depend in turn on the prospects for growth in the industry.



Administer Proposition: Automobile industries of Bangladesh has adequate skilled manpower for effective CKD operations.

Figure 5: Graph Showing Respondents' Responses On Skilled Manpower

Source: Respondents' responses, 2023. [Data at Appendix 2, serial 1]

Respondents' responses on administrative questionnaires revealed that the automobile industry of Bangladesh lacked skilled manpower mainly due to changing scenarios of skill required for CKD operation. The responses, as depicted at figure 5, showed that the automobile industries has failed to achieve the required level of efficiency for effective CKD operations. About 65 per cent respondents are in the opinion that the automobile industries of Bangladesh has not yet achieve required level of skilled manpower to maximise cost efficiency of CKD operations.

Thus the availability of skilled labour is a significant constraint for the automobile industries of Bangladesh. The country lacks specialised training institutes and programmes that can adequately train workers in automobile manufacturing, engineering and maintenance. As a result, the industry faces challenges in finding skilled professionals and technicians.

4.5.2 Inadequate Resources

Bangladesh relies heavily on import for automobiles due to lack of strong domestic manufacturing base. This has led to a higher dependency on foreign manufacturers, resulting in increased cost and reduced competitiveness in the market. Insufficient infrastructure including road networks, electric supply and logistics poses significant challenge for the automobile industries. Poor road conditions, traffic congestion and limited storage facilities hinders smooth operations of the industry causing delay, increasing cost and reducing efficiency.

Local availability of raw materials and components is limited forcing industry to heavily rely on imports. This dependencies on foreign source increases cost and exposes supply chain vulnerability. The problem is augmented due to fluctuating exchange rate and geopolitical factors. Limited access to financing and credit facilities is a major hurdle for the automobile industries of Bangladesh. Higher interest rates, stringent lending policies and lack of long term financing options hinders manufacturing and consumers' ability to invest in production and purchase.

One of the major challenges in implementing the automobile development policy in Bangladesh is the inadequate infrastructure. Insufficient road networks, lack of efficient transport systems, and limited charging stations for electric vehicles pose hurdles for the growth of the automobile industry.

Respondents' responses on administrative questionnaires revealed that the automobile industry of Bangladesh lacked resources mainly in terms of infrastructure, access to finance etc. The responses, as depicted at figure 6, showed that the automobile industries has failed to achieve the required level of efficiency for effective CKD operations. About 67 per cent respondents are in the opinion that the automobile industries of Bangladesh has not yet achieve required level of resources to maximise cost efficiency of CKD operations.

Administer Proposition: Automobile industries of Bangladesh has adequate resources for effective CKD operations.

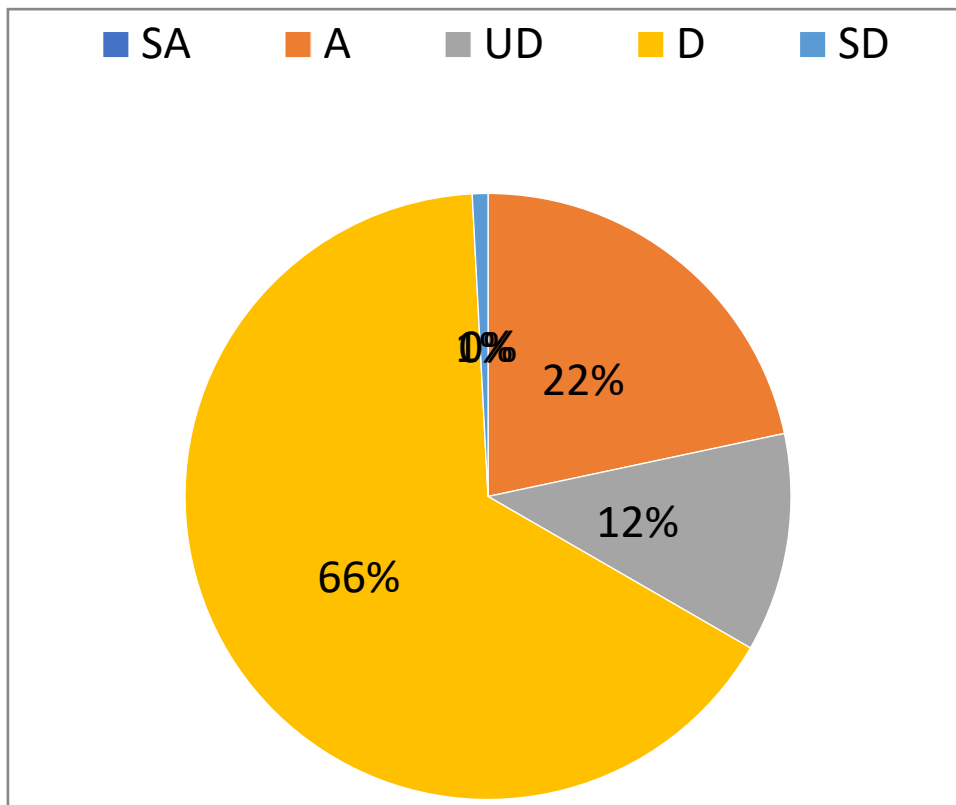


Figure 6: Pie Chart Showing Respondents' Responses on Resources

Source: Respondents' responses, 2023. [Data at Appendix 2, serial 2]

4.5.3 Improper Inventory Control

One of the major challenges in improper inventory control of CKD operations in Bangladesh's automobile industry is the lack of visibility across the entire supply chain. Often, suppliers, manufacturers, and distributors operate in silos, making it difficult to track inventory levels and demand accurately. This lack of visibility

can lead to overstocking or stock outs, resulting in financial losses or customer dissatisfaction.

The CKD supply chain in Bangladesh's automobile industry involves numerous suppliers, manufacturers, and distributors, often located in different regions or even countries. Managing inventory in such a fragmented network becomes complex, as multiple stakeholders need to coordinate their efforts to ensure timely delivery and avoid excess inventory.

The demand for CKD components in the automobile industry can be highly variable due to factors such as seasonality, market trends, and economic conditions. Managing inventory levels becomes challenging as manufacturers need to balance supply and demand to maintain optimal stock levels without incurring excessive costs or delays.

Accurate demand forecasting is crucial for effective inventory control. However, the lack of sophisticated forecasting techniques and data analysis capabilities in some CKD operations in Bangladesh can lead to inaccurate predictions. Poor forecasting can result in overstocking or stock outs, leading to increased holding costs and potential production delays.

Many automobile manufacturers and suppliers in Bangladesh still rely on manual inventory control processes, including spreadsheets and paperwork. This manual approach is prone to errors, delays, and challenges in data consolidation, making it difficult to achieve efficient inventory management. The lack of technological adoption hinders real-time tracking, automated replenishment, and seamless information sharing across the supply chain.

Adequate warehousing and storage facilities are essential for effective inventory control. However, in Bangladesh's automobile industry, there may be limitations in terms of available warehouse space, infrastructure, and handling capabilities. Insufficient or poorly managed warehousing can lead to inefficiencies, increased lead times, and difficulty in accurate stock counting.

CKD operations rely on a smooth flow of materials and components from suppliers to manufacturers. However, supply chain disruptions like natural disasters, political instability, or transportation issues can severely impact inventory control. These disruptions can lead to delays in material deliveries, production interruptions, and excess or shortage of inventory.

Bangladesh's automobile industry may face challenges related to trade regulations and customs clearance procedures, especially if there are import or export restrictions. Delays in customs clearance can obstruct the smooth flow of CKD components, leading to disruptions in inventory control and potential production delays.

Respondents' responses on administrative questionnaires revealed that the automobile industry of Bangladesh lacked proper inventory control mainly due to the lack of visibility across the entire supply chain. The responses, as depicted at figure 7, showed that the automobile industries has failed to achieve the required level of efficiency for effective CKD operations due to improper inventory control. About 63 per cent respondents are in the opinion that the automobile industries of Bangladesh has not yet achieve appropriate inventory management level to maximise cost efficiency of CKD operations.

Administer Proposition: Inventory Control of Automobile industries of Bangladesh is suitable for effective CKD operations.

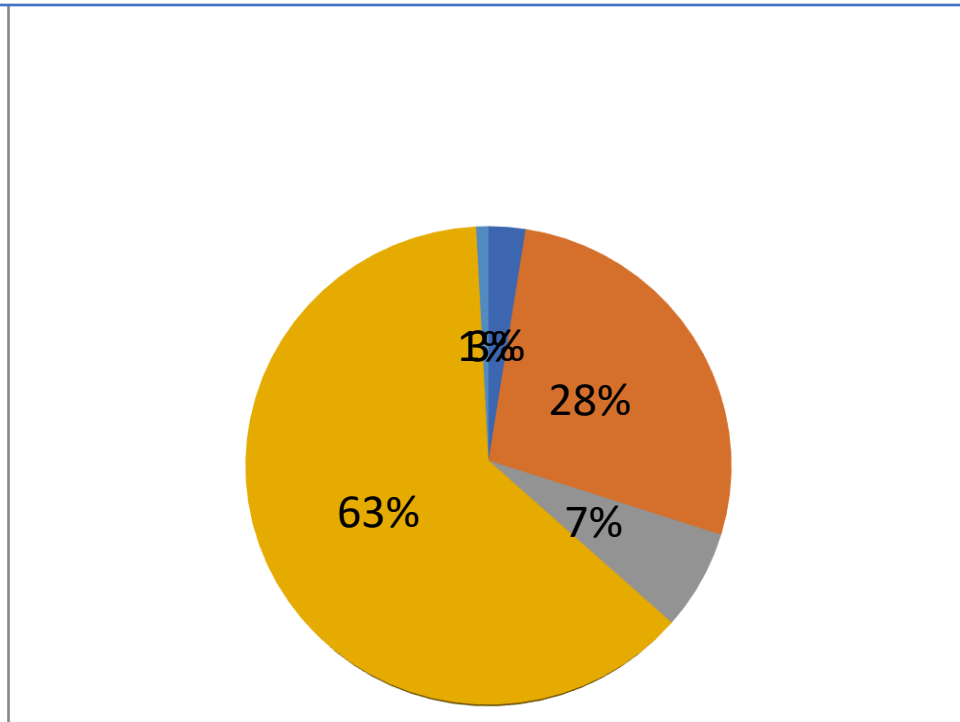


Figure 7: Pie Chart Showing Respondents' Responses On Inventory Control

Source: Respondents' responses, 2023. [Data at Appendix 2, serial 3]

4.5.4 Poor Planning

Several challenges arise from poor planning of the supply chain in CKD operations of the automobile industry of Bangladesh. These challenges include: inventory management issues, production delay, increased costs, quality issues,

lack of supplier visibility, insufficient logistics and limited stability and flexibility.

Poor planning can lead to inaccurate demand forecasting, which can result in excessive or inadequate stock levels. Excessive inventory levels tie up working capital and increase storage costs, while inadequate inventory levels can disrupt production and lead to missed sales opportunities.

Inadequate planning can result in delays in the procurement of necessary components and parts. This can disrupt the production process, causing delays in the assembly of CKD units, and potentially leading to missed delivery deadlines.

Inefficient supply chain planning can lead to higher costs due to expedited shipping, last-minute purchases, and production disruptions. This can erode profit margins and make the final product more expensive for customers. Poor planning can also lead to the use of substitutable or lower-quality components due to limited availability. This can negatively impact the quality and reliability of the finished automobile, potentially leading to customer complaints and brand reputation damage.

Insufficient supply chain planning can result in a lack of transparency and visibility into supplier performance and capability. This can make it difficult to identify potential issues or bottlenecks in the supply chain, hampering effective decision-making and problem-solving. It can lead to inefficient transportation and logistics operations, including suboptimal route optimisation and scheduling. This can result in increased lead times, higher transportation costs, and reduced overall efficiency within the supply chain.

Poor planning may not take into account future growth or market changes, limiting the scalability and adaptability of the supply chain. This can make it challenging to quickly adjust to changing customer demands or market conditions, inhibiting the industry's overall competitiveness.

Respondents' responses on administrative questionnaires revealed that the automobile industry of Bangladesh lacked effective planning mainly due to inventory management issues. The responses, as depicted at figure 8, showed that due to poor planning the automobile industries has failed to achieve the required level of efficiency for effective CKD operations. About 67 per cent respondents are in the opinion that the automobile industries of Bangladesh has not yet achieve maximum cost efficiency of CKD operations due to poor planning.

Administer Proposition: Planning of Automobile industries of Bangladesh is suitable for effective CKD operations.

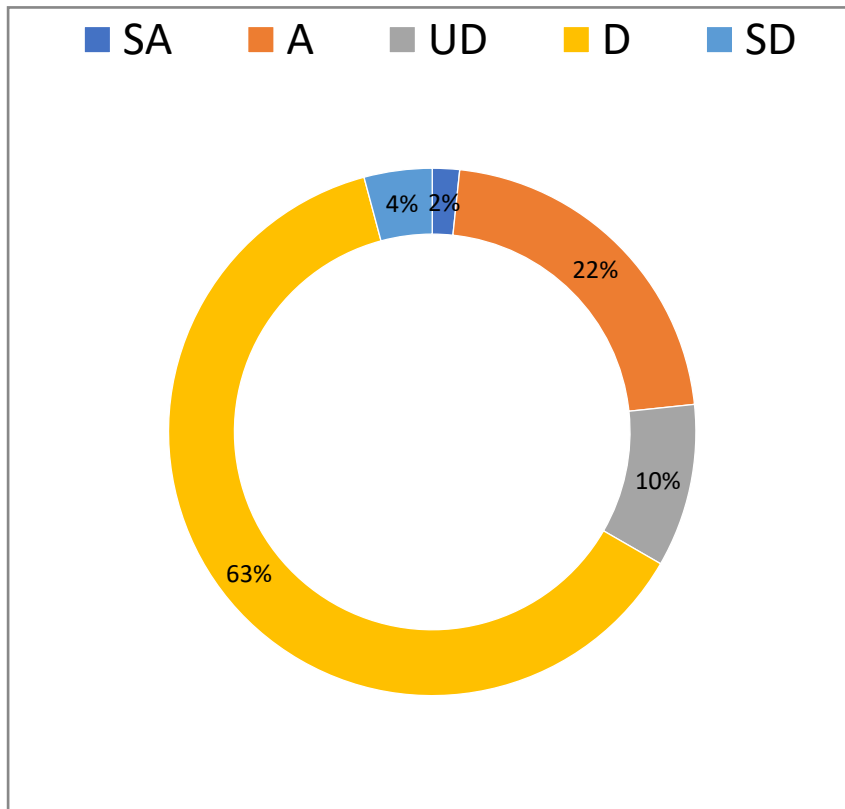


Figure 8: Doughnut Chart Showing Respondents' Responses On Planning

Source: Respondents' responses, 2023. [Data at Appendix 2, serial 4]

4.5.6 Lack of Research and Development

Lack of R&D in the supply chain of CKD operations in the automobile industry of Bangladesh can pose several challenges: such as product quality and reliability, limited localisation, lack of innovation and technology adoption, inefficient production process, compliance with regulation, limited competitiveness and market growth and talent retention and skill development,

Insufficient R&D investment can lead to lower product quality and reliability. Without proper R&D, manufacturers may struggle to identify and rectify quality issues, resulting in vehicles with substandard performance, safety concerns, and lower customer satisfaction. It may may discourage the development of local talent and limit skill enhancement in the industry which in turn may lead to a shortage of skilled professionals and hinder the growth of a strong R&D workforce in Bangladesh's automobile industry.

Inadequate R&D efforts can hinder the localisation of components in the supply chain. Without a strong emphasis on R&D, manufacturers may rely heavily on imported parts, increasing costs and reducing the competitiveness of locally assembled vehicles.

In the absence of R&D, innovations and new technologies may be overlooked or delayed. This can impede the industry's ability to adopt advancements such as alternative fuels, electric vehicles, and autonomous driving systems, limiting its competitiveness compared to global counterparts.

Insufficient R&D may lead to inefficient production processes, resulting in higher costs and longer lead times. Without continuous research and optimisation, manufacturers may struggle to identify process bottlenecks, reduce waste, and improve productivity.

Without adequate R&D, ensuring compliance with national and international regulations becomes challenging. Manufacturers may struggle to conduct the required tests and validation, leading to potential legal and regulatory issues.

Inadequate R&D can hinder the industry's competitiveness and its ability to expand market share. Without continuous innovation and improvement, manufacturers may find it difficult to compete with global players offering technologically advanced and higher-quality vehicles.

Respondents' responses on administrative questionnaires revealed that the automobile industry of Bangladesh lacked effective R &D mainly due to proper academia industry collaborations. The responses, as depicted at figure 9, showed that due to lack of R &D efforts the automobile industries has failed to achieve the required level of efficiency for effective CKD operations. About 78 per cent respondents are in the opinion that the automobile industries of Bangladesh has not yet achieve maximum cost efficiency of CKD operations due non-coordinated R&D effort.

Administer Proposition: R &D of Automobile industries of Bangladesh is well coordinated for effective CKD operations.

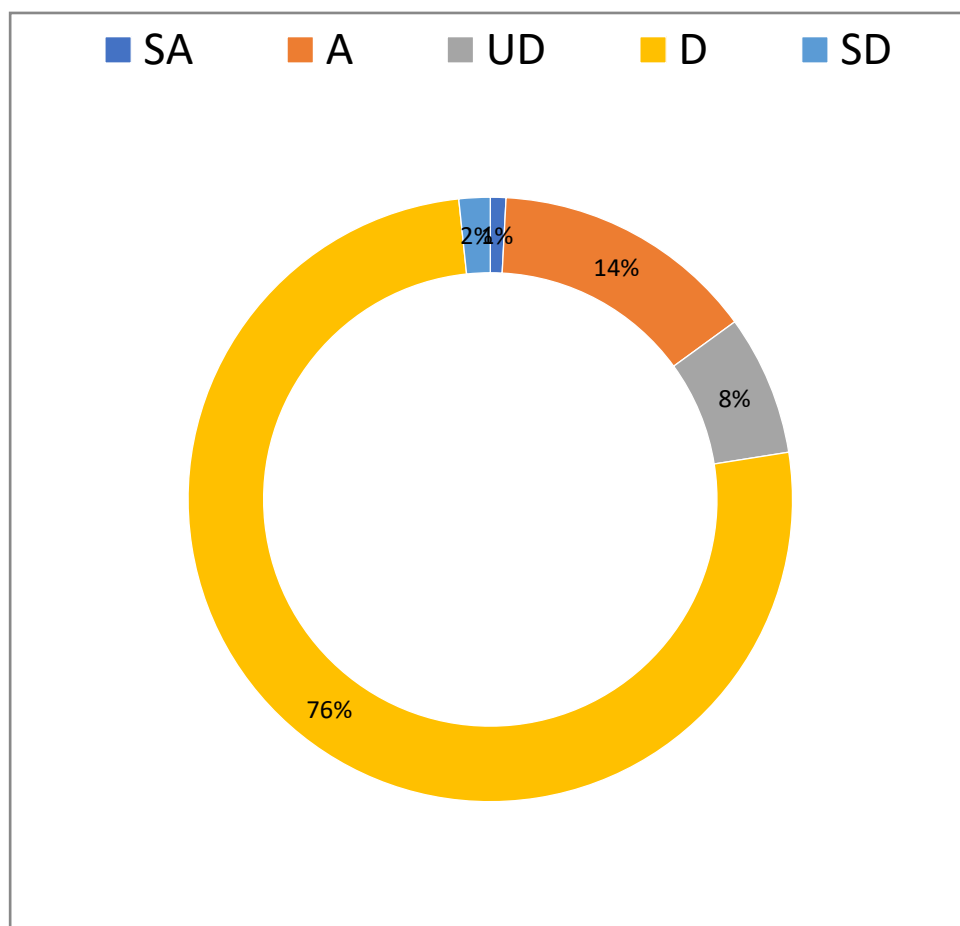


Figure 9: Doughnut Chart Showing Respondents' Responses On R &D

Source: Respondents' responses, 2023. [Data at Appendix 2, serial 5]

4.6. Prospects of CKD Operation in Automobile Industries of Bangladesh

Prospects of CKD operations in the automobile industries of Bangladesh include: growing automobile markets, favourable government policies, cost advantage,

increasing localisation efforts and rising export potential. These are discussed in subsequent paragraphs.

4.6.1. Growing Automobile Market

The automobile market in Bangladesh has been showing significant growth in recent years. The demand for vehicles, both private and commercial, has been increasing due to various factors such as economic development, government initiatives, improved road infrastructure, and the rise of ride-hailing services. With continued efforts and investments, the market is expected to continue expanding in the coming years.

One of the main factors driving the growth of the automobile market in Bangladesh is the country's strong economic growth. The increase in disposable income of the middle-class population has led to a rise in vehicle ownership. With more people having the purchasing power to buy cars and motorcycles, the demand for vehicles has skyrocketed. Additionally, the government of Bangladesh has taken several initiatives to promote the growth of the automobile sector. They have reduced import duties on vehicles and implemented policies that encourage local manufacturing of automobiles and auto parts. These measures have made vehicles more affordable and accessible to the general population.

Another contributing factor to the growing automobile market in Bangladesh is the improvement in road infrastructure. Over the years, the government has been investing heavily in the construction and maintenance of roads, highways, and bridges. This has not only made transportation easier but has also encouraged people to own vehicles for commuting purposes. Moreover, the growth of app-based ride-hailing services, such as Uber and Pathao, has increased the demand

for vehicles in the country. Many individuals are now opting to become ride-share drivers, leading to an increase in vehicle sales.

This growing automobile market shows prospects for CKD operations as manufacturers can meet the rising demand by assembling vehicles locally.

4.6.2. Favourable Government Policies

The government of Bangladesh has implemented various policies to support and regulate the automobile industry in the country as well as to encourage foreign and local investment in the automobile industry. These policies aim to promote the growth and development of the sector while ensuring environmental sustainability and consumer safety. These policies include tax benefits, duty reduction on CKD imports, and the establishment of special economic zones for automobile manufacturing. Such incentives attract automobile companies to set up CKD operations in the country.

The government has continuously reduced import duties on vehicles to make them more affordable for the general population. This has encouraged vehicle ownership and increased demand in the market. The government has introduced policies to encourage the local manufacturing of automobiles and auto parts. These policies aim to reduce dependency on imports, create job opportunities, and stimulate local industries.

Favourable government policies are aimed at promoting the growth and sustainability of the automobile sector in Bangladesh. They play a crucial role in creating a favourable environment for manufacturers, importers, and consumers,

while also addressing environmental and safety concerns and as such bear good prospects for CKD operations..

4.6.3. Cost Advantage

Manufacturing automobiles in Bangladesh offers several cost advantages compared to other countries. These advantages contribute to the growth of the automobile industry in the country. Some key cost advantages of manufacturing automobiles in Bangladesh low labour cost, affordable land and infrastructure, competitive components sourcing, access to raw materials, government incentive, growing domestic market and strategic location.

Bangladesh has one of the lowest labor costs in the world, making it an attractive destination for manufacturing. The availability of a large labor force at competitive wages significantly reduces production costs for automobile manufacturers. The cost of acquiring land and setting up manufacturing facilities in Bangladesh is relatively lower compared to other countries. The government has developed industrial zones and export processing zones with well-developed infrastructure, providing investors with cost-effective options for establishing manufacturing plants.

Bangladesh has a growing ecosystem of local suppliers and manufacturers of automobile components. This proximity to local vendors reduces transportation costs and lead times for sourcing various parts, contributing to overall cost savings in the manufacturing process.

The government of Bangladesh offers various incentives and tax benefits to attract investment in the automobile industry. These incentives include tax

holidays, duty exemptions on import of machinery and raw materials, and subsidised utility rates, which help reduce production costs for manufacturers.

Bangladesh has a significant domestic market for automobiles, with a large population and a rising middle class. This provides manufacturers with the opportunity to achieve economies of scale and cost efficiencies through bulk production and sales.

These cost advantages make Bangladesh an attractive destination for automobile manufacturing, attracting both local and foreign investment. The offered cost advantage in terms of labor and production costs is a great prospect for the supply chain of CKD operations.

4.6.4. Increasing Localisation Efforts

Bangladesh has been focusing on increasing local component manufacturing and reducing dependence on imports. This supports CKD operations by encouraging local suppliers to set up production facilities, thereby reducing costs and promoting the growth of a local supply chain.

In recent years, there have been efforts to localise the manufacturing of automobile components in Bangladesh. The government, along with various private sector companies, has been actively promoting and supporting the establishment of automobile component manufacturing facilities in the country.

As the economy grows and more people can afford cars and motorcycles, there is a need for a reliable and cost-effective local supply chain for automobile components.

To encourage localisation, the government has implemented various policies and incentives. These initiatives are aimed at attracting both domestic and foreign investment in the automotive component manufacturing industry. Private sector companies have also been actively involved in promoting localisation efforts. Some automotive manufacturers and distributors have set up component manufacturing units in Bangladesh to cater to their own production needs.

The localisation efforts of manufacturing automobile components in Bangladesh aim to reduce dependence on imports, increase self-sufficiency, and create a robust and sustainable automotive industry in the country.

5.6.5. Rising Export Potential

CKD operations in Bangladesh not only cater to the domestic market but also offer export potential. As the country's automobile industry develops, there is scope for exporting locally assembled vehicles and components to neighbouring countries.

Although the country currently imports a large share of its automobile demand, there has been a noticeable growth in the local automobile manufacturing sector, which indicates the potential for export opportunities. Here factors that contribute to the export potential of automobiles in Bangladesh are: cost competence, government support, strategic location, growing domestic market, regional integration and shift towards EVs.

Bangladesh's strategic location in South Asia provides it with access to major global markets such as India, China, and Southeast Asia. This geographical

advantage allows for shorter transportation distances and reduced logistics costs, making exports more viable.

Bangladesh is part of various regional trading arrangements and economic cooperation initiatives, such as the South Asian Free Trade Area (SAFTA) and the Bay of Bengal Initiative for Multi-Sectorial Technical and Economic Cooperation (BIMSTEC). These arrangements provide preferential trade agreements and market access opportunities, further enhancing the export potential of automobiles.

Bangladesh has already initiated efforts to promote the adoption of EVs, and the local manufacturing sector has started producing electric cars and motorcycles. This can open up export opportunities in the future as global demand for EVs continues to rise.

CHAPTER 5

STRATEGIES TO MITIGATE THE CHALLENGES MILITATING AGAINST SUPPLY CHAIN FOR EFFECTIVE CKD OPERATIONS

This chapter proffers strategies to mitigate the challenges militating against supply chain for effective CKD operations in automobile industries of Bangladesh. Thereafter it presents an action plan for implementation of the proffered strategies.

5.1. Proffered Strategies

The strategies include development of skilled manpower, promulgation of local content policy, automation of inventory control, strengthening the planning department and institutionalisation of R & D efforts. These are subsequently discussed.

5.1.1 Development of Skilled Manpower

To develop skilled manpower for the supply chain of CKD operations in the automobile industry of Bangladesh, needs education and training programme, the industry academia collaboration, certification and skill development programme, industry specific internship programme, continuous professional development and more importantly on job training and monitoring.

Collaboration with educational institutions, vocational training centres, and industry associations may aid to develop specialised education and training programs focused on supply chain management and CKD operations. These

programs should cover a range of topics such as inventory management, procurement, logistics, and quality control. Fostering partnerships between the automobile industry and academic institutions would ensure that the curriculum and training programs align with industry needs and encourage industry professionals to provide guest lectures.

Conduction of certification programs, workshops, and seminars specifically designed for supply chain professionals in the CKD operations can help enhance the skills and knowledge of employees, validating their expertise and providing opportunities for career advancement. Industry-specific internship programs for fresh graduates would allow them to gain practical experience and understand the complexities of CKD operations, nurturing a pipeline of skilled professionals for the industry.

Structured on-the-job training programs where new employees are paired with experienced mentors who can guide them through the intricacies of supply chain operations would help new hires gain practical knowledge, build relationships, and develop crucial problem-solving and decision-making skills. Establishing means of platforms or forums where professionals from various organisations and sectors can come together to discuss supply chain challenges and share best practices help foster knowledge exchange, networking, and collaboration, enabling the development of a skilled supply chain community.

Automobile industries of Bangladesh need a comprehensive plan to develop skilled manpower. A committee may be formed to make a draft plan. The draft plan may be vetted by academia and legal experts. Vetted plan may be implemented.

4.5.2 Promulgation of Local Content Policy

Formulating local content policies for the supply chain of CKD operations in the automobile industry of Bangladesh involves establishing guidelines and incentives to promote the use of locally sourced components and materials.

Market Assessment helps to assess the local capabilities and capacities in terms of component manufacturing and raw material availability for the automobile industry. It also identifies areas of strength and potential gaps that need to be addressed to increase local sourcing. On the basis of market assessment, minimum percentage of locally sourced components or materials that automobile manufacturers must incorporate in their CKD operations is determined.

Collaborations with relevant stakeholders such as automobile manufacturers, suppliers, government agencies, industry associations, and local content champions is vital to gather insights, foster dialogue, and ensure policy alignment with industry needs and capabilities. Financial incentives such as, tax breaks, or other benefits to automobile manufacturers who exceed the minimum local content requirements or invest in local component manufacturing facilities can help offset any additional costs associated with sourcing locally.

Support and incentives for local component manufacturers to enhance their capabilities and capacities includes access to financing, technology transfer, training programs, and assistance in meeting quality standards and certifications. Programs to support the development of local suppliers by providing training, technical assistance, and mentoring enhances the quality, reliability, and

competitiveness of local suppliers, making them more attractive to automobile manufacturers.

By formulating and implementing local content policies, Bangladesh can promote the development of a robust local supply chain for CKD operations in the automobile industry, leading to increased employment opportunities, technological advancement, and economic growth. Once the Policy is promulgated it needs to be regularly monitored and evaluated the implementation and effectiveness of local content policies to assess compliance by automobile manufacturers, track local content levels, and gather feedback from industry stakeholders to identify areas for improvement.

The automobile manufacturing association may form a committee to formulate local content policy. The draft policy may be vetted by experts and Ministry of Law and Parliamentary Affairs. Vetted policy may be enacted by the National Assembly.

4.5.3 Automation of Inventory Control

Automation of inventory control for the supply chain of CKD operations in the automobile industry of Bangladesh can help reduce costs, minimise stock outs, and optimise production. The improvisation process involves: demand forecasting, collaborative planning, standardisation, strategic sourcing, adoption of technology and so on.

The accuracy of demand forecasting may be improved by analysing historical data, market trends, and customer feedback. This allows for better anticipation of component requirements, reducing the risk of overstocking or stock outs. Information sharing among all stakeholders in the supply chain, including suppliers, manufacturers, and distributors needs to be strengthened by implementing systems like VMI or Collaborative Planning, Forecasting, and Replenishment (CPFR).

JIT approach reduces the need for excessive inventory, frees up working capital, and minimises the risk of obsolescence. Standardisation of components across different vehicle models aid to optimise inventory management and allows for economies of scale and simplifies stock control processes.

Strategic relationships with reliable suppliers ensure a steady and timely supply of components. Inventory Management Systems (IMS) or ERP software can provide real-time visibility, track stock levels, generate automated replenishment orders, and enable effective inventory planning.

It is very important to determine and monitor optimal inventory levels by analysing factors such as lead times, demand variability, and production cycle times. Techniques like Economic Order Quantity (EOQ) and Reorder Point (ROP) calculations helps to establish reorder triggers. Maintaining safety stock ensures a buffer against stock outs and minimises the risk of production interruptions.

It is also essential to review and analyse inventory data regularly to identify areas for improvement. Nevertheless, Training and Skill Development programs enhance the skills of inventory control personnel.

To improvise the inventory control of CKD operations in the automobile industry of Bangladesh the stakeholders may establish data centre, encourage automation, standardise components and form a monitoring cell.

4.5.4 Strengthening the Planning Department

Efficient planning is strongly linked with inventory control. However major considerations are: collaboration and communication, supplier's relationship management, production planning and scheduling, risk management among others.

Accurate demand forecasting is crucial for effective planning. Collaborative efforts with sales and marketing teams help to gather insights regarding upcoming promotions, product launches, or changes in customer preferences. Open lines of communication with suppliers, manufacturers, distributors, and retailers ensures a coordinated approach.

Strong relationships with suppliers may ensure reliable and timely component deliveries. Strategic partnerships and mutually beneficial contracts are essential to to assess performance, quality, and reliability. Alignment of production planning and scheduling with demand forecasts and customer requirements

optimises production cycles by minimising idle time and maximising capacity utilisation.

Streamlining warehouse operations is required for efficient material handling and inventory management. Optimum layout, storage systems, and picking processes is needed for faster order fulfilment. Efficient transportation and logistics are critical for CKD supply chain operations.

Contingency plans to mitigate supply chain risks is vital. It identifies potential disruptions such as supplier shortages, transportation delays, or natural disasters and establish alternative sourcing options.

The efficient planning of the supply chain for CKD operations in the automobile industry of Bangladesh leads to improved operational efficiency, cost savings, and better customer service. A strong planning team can contribute significantly. Manufacturing unit may establish a full pledged planning department. The team should include personnel from production, marketing as well as research and development.

4.5.6 Institutionalisation of Research and Development Efforts

To institutionalise R&D efforts for the supply chain of CKD operations of automobile industries in Bangladesh, the first and foremost requirement is to establish a dedicated R&D department. Partnerships and collaborations with local universities, research institutes, and technical colleges contributes to any R&D efforts.

Industry-led consortiums can bring together automobile manufacturers, suppliers, logistics providers, and other stakeholders with the goal of jointly investing in R&D activities. These consortiums can pool resources and expertise to tackle the complex challenges of the CKD supply chain.

The government in terms of policy incentives, grants, and funding for R&D may boost the automobile industry and enhancing the competitiveness of CKD operations.

Industry conferences, seminars, and workshops facilitate knowledge sharing and collaboration among different supply chain stakeholders and encourage the exchange of ideas, best practices, and research findings to drive innovation in CKD operations.

Partnerships and collaborations with international automobile manufacturers, suppliers, and research institutions leverage their expertise, technologies, and global best practices. This can help bring in advanced knowledge and accelerate the development of the CKD supply chain in Bangladesh.

Bangladesh Automobile industries may establish dedicated R&D department, establish a strong link with academia and collaborate each other on knowledge sharing and joint research.

5.2. Implementation Plan for Proffered Strategies

The strategies proffered to mitigate the challenges militating against supply chain for effective CKD operation in the automobile industries of Bangladesh require a synchronised action plan in order to achieve effective implementation. As such, a 3-phased implementation action plan is hereby proposed. The phases are subsequently discussed.

Phase 1 (0-12 months).

Phase 1 is the preliminary and preparatory phase of the duration of 12 months. The activities in this phase would entail the followings:

- a. The constitution of committee for the formulation of draft comprehensive plan for skilled manpower development, standardisation of the components, automation of inventory and local content policy.
- b. Submission of the Committee reports.
- c. Planning for Data centre
- d. Establishment of full pledged planning and R&D department.

Phase 2 (12-36 months).

Phase 2 is the implementation phase of the 24 months duration. It would entail the following activities:

- a. Vetting, approval and promulgation of the recommended draft comprehensive policy for skilled manpower development, standardisation of the components, automation of inventory and local content policy.
- b. Forming inventory monitoring cell.
- c. Establishment of with academia
- d. Carry out joint research.

- e. Establishment of protocol of knowledge sharing.
- f. Integration of R&D centre.

Phase 3 (36 months and beyond).

Phase 3 is the consolidation and evaluation phase. It would entail the full implementation of proffered strategies to mitigate the challenges militating against supply chain for effective CKD operations of automobile industries of Bangladesh. This phase would also entail:

- a. Continuous monitoring, evaluation and review (if needed) of the comprehensive policy for skilled manpower development, standardisation of the components, automation of inventory and local content policy.
- b. Full implementation of the proposed supply chain model for effective CKD operations of automobile industries of Bangladesh

CHAPTER 6

BANGLADESH AUTOMOBILE DEVELOPMENT POLICY

This chapter discusses the background and key objectives of Bangladesh Automobile Development Policy. It also highlights the implication of the policy on CKD operations.

6.1 The Background of the Automobile Development Policy

The Bangladesh Automobile Development Policy refers to a set of guidelines and initiatives implemented by the government of Bangladesh to promote the growth and development of the automobile industry in the country. The policy aims to attract investment, encourage local production, and enhance the overall competitiveness of the automotive sector.

The background of the Bangladesh Automobile Development Policy can be traced back to the early 2000s when the country's automobile market started witnessing significant growth. The increasing purchasing power of the middle class, along with a growing demand for vehicles, led to a surge in vehicle imports. However, the high dependency on imports resulted in a significant outflow of foreign currency and trade imbalances.

To address these challenges and stimulate domestic production, the government recognised the need for a comprehensive policy framework. In 2016, the Ministry of Industries, in collaboration with other relevant stakeholders, formulated the "Automobile Industry Development Policy 2016-2021." This policy aimed to

promote local manufacturing, attract foreign direct investment, and create employment opportunities within the automobile sector.

The Automobile Industry Development Policy introduced several measures to encourage investment in the sector. These included tax incentives for vehicle manufacturing plants, reduction of import duties on raw materials and components, and facilitation of technology transfer and skill development initiatives. The policy also emphasised the establishment of automotive industrial parks and special economic zones to provide a conducive environment for automobile manufacturing.

The government's efforts to promote the automobile sector gained further momentum with the subsequent formulation (Draft) of the "Automobile Industry Development Policy 2020-2025." This updated policy builds upon the previous framework and aims to attract more investment, promote electric vehicles, and develop a skilled workforce in the automotive sector.

Under the policy, the government has been actively engaged in creating an enabling environment for automobile manufacturers. This includes the development of infrastructure such as roads, highways, and ports, as well as the establishment of automotive testing and certification centres. The policy also encourages research and development activities and promotes collaboration between academia, industry, and research institutions.

By implementing these policies, the government of Bangladesh aims to reduce the dependency on vehicle imports, boost domestic manufacturing, create employment opportunities, and contribute to the overall economic growth of the

country. The focus on electric vehicles in the latest policy reflects the global trend towards sustainable transportation and aligns with Bangladesh's commitment to environmental sustainability.

6.2 Key Objectives of the Automobile Development Policy

The policy was formulated against the backdrop of a rapidly growing economy and increased demand for automobiles in Bangladesh. The government recognised the need to reduce the country's heavy reliance on imported vehicles and transition towards a more self-sufficient automotive industry. The key objectives of the Bangladesh Automobile Development Policy include: fostering a competitive automotive industry; promoting investment; developing skilled workforce; ensuring environmental sustainability and enhancing safety standards.

The policy aims to create a competitive environment for local automobile manufacturers, as well as attract renowned international automotive companies to establish production facilities in Bangladesh.

The policy offers various incentives and facilities to encourage foreign and domestic investments in the automobile sector. These incentives include tax benefits, duty exemptions on certain raw materials and components, and streamlined administrative processes for setting up manufacturing plants.

The policy emphasises the development of a skilled workforce to support the growing automobile industry. It aims to establish training centres and vocational

institutes to provide the necessary skills and knowledge for the sector's labor force.

The policy lays significant emphasis on promoting environmentally friendly practices within the automobile industry. It encourages the production and use of electric and hybrid vehicles, as well as the adoption of eco-friendly manufacturing processes.

The policy aims to improve vehicle safety standards within the country. It promotes the development and adoption of technologies that enhance road safety and reduce traffic accidents.

The Bangladesh Automobile Development Policy is considered a crucial step towards transforming Bangladesh into a regional hub for automobile manufacturing, promoting economic diversification, and reducing import dependency. It aligns with the country's overall industrial development plans and is expected to result in job creation, technology transfer, and increased exports of automotive products.

6.3 Implications of the Automobile Development Policy on CKD Operation

The automobile development policy have significant implications on the CKD operations. The key implications include: localisation requirement, tariff and duty, technology and skill, incentive and support; and environmental regulations. These are discussed subsequently.

6.3.1 Localisation Requirement

Many countries have localisation requirements as part of their automobile development policies in order to promote domestic manufacturing and job creation. These requirements may include a certain level of local content in the assembled vehicles, such as locally sourced parts. This can significantly impact CKD operations as manufacturers would need to establish local supply chains and partnerships with local suppliers to meet these requirements.

6.3.2 Tariff and Duties

The development policy may also have implications on the import duties and tariffs levied on CBU vehicles and CKD kits. Governments often impose higher duties on CBUs to encourage local assembly and manufacturing. This makes CKD operations more cost-effective and attractive for manufacturers, as they can avoid or minimise the duties by importing partially assembled kits. Any changes in the duties and tariffs structure can impact the viability of CKD operations.

6.3.3 Technology and Skill

Automobile development policies often focus on promoting advanced technologies and research and development in the automotive sector. This can result in manufacturers having to invest in new technologies and upgrading their assembly facilities to meet the policy requirements. This may require additional

skill development and training for the workforce involved in CKD operations to handle advanced technologies, which can have cost and resource implications.

6.3.4 Incentives and Support

Governments may provide incentives and support for manufacturers engaged in CKD operations as part of their development policies. These incentives can include tax rebates, grants, subsidies, and infrastructure support. The availability of such incentives can greatly impact the profitability and attractiveness of CKD operations for automobile manufacturers.

6.3.5 Environmental Regulation

Automobile development policies may also include stringent environmental regulations aimed at reducing carbon emissions and promoting sustainable transportation. Manufacturers engaged in CKD operations would need to ensure compliance with these regulations in terms of vehicle design, emissions standards, and use of eco-friendly materials. This may require additional investments and modifications in the CKD operations to meet the environmental requirements.

The automobile development policy can shape the regulatory environment, market conditions, and incentives for CKD operations. Manufacturers engaged in CKD operations would need to constantly monitor and adapt their operations to comply with the policy requirements and take advantage of the opportunities presented by the policy framework.

CHAPTER 7

SUGGESTED SUPPLY CHAIN MODEL

This chapter discusses steps of developing supply chain model and then suggest a suitable model for CKD operations in the automobile industry of Bangladesh

7.1 Steps of Developing Supply Chain Model

Developing a supply chain model for CKD operations in the automobile industry involves several key steps: identification of scopes and objectives, analysis of current operations, conduction of market research, identification of key stakeholders, optimising suppliers's relationship, streamlining transportation and logistics, leveraging technology and digitalisation and fostering collaboration and coordinations. These are subsequently discussed.

7.1.1 Identification of Scopes and Objectives

Identification of scopes include: evaluation of the current supply chain structure for identification of the areas for improvement in terms of efficiency, cost-effectiveness and responsiveness; identification of key stake holders and understanding their roles and interactions; analysis of the transportation and logistics network to identify bottlenecks and inefficiencies; assessing the current inventory management practices and identify opportunities for implementing JIT inventory systems; identification of technology solutions to enhance supply chain visibility and efficiency; evaluation of the regulatory environment and compliance requirements for CKD operations in Bangladesh; analysis of the market demand patterns, customer preferences and seasonality trends to develop a demand forecasting and planning system for CKD operations.

The objectives for developing a supply chain model for CKD operations of automobile industries in Bangladesh are to:

- a. Develop a streamlined supply chain model that reduces lead times, minimises inventory holding costs, and improves overall productivity
- b. Enhance collaboration and communication among stakeholders to ensure smooth flow of materials and minimise disruptions; optimise transportation routes, modal choices, and warehouse locations to reduce transportation costs and improve delivery times.
- c. Implement JIT principles to minimise inventory holding costs, reduce stock-outs, and improve overall supply chain agility
- d. Implement advanced technologies to track and trace CKD components, monitor production processes, and optimise overall supply chain performance.
- e. Ensure compliance with all regulatory requirements to avoid disruptions and penalties while maintaining high levels of product quality and safety.
- f. Develop accurate demand forecasts to optimise production schedules, minimise excess inventory, and respond effectively to changing market demands.

7.1.2 Analysis of Current Operations

The analysis of the current operations provide insights into the strengths, weaknesses, and areas for improvement within the existing supply chain. Fields

of analysis include: supplier evaluation in terms of lead time, production capacity, and ability to meet demand fluctuations; inventory management in relation to the accuracy of demand forecasting, order quantities, and inventory turnover rates.; transportation and logistics to identify any bottlenecks, inefficiencies, or delays in logistics, including customs clearance and border crossings; current warehousing facilities; effectiveness of communication and collaboration among stakeholders; level of regulatory compliance and identify any potential risks or non-compliance issues; the use of technology and information systems in the supply chain; customer demands, preferences, and satisfaction levels in relation to CKD operations; Key Performance Indicators (KPIs) currently utilised to measure supply chain performance.

A detailed analysis of the current operations helps in developing an efficient and effective supply chain model for CKD operations in the automobile industry of Bangladesh.

7.1.3 Conduction of Market Research

Market research helps in understanding the market dynamics, customer preferences, and industry trends, which are crucial factors for designing an efficient and effective supply chain model. Steps to conduct market research for developing the supply chain model may include: defining research objectives, identification of target market, collection of primary and secondary data, analysing competitor strategies, assessing regulatory environment, identifying market trends, analysing customer preferences and demands, summarising findings & drawing conclusion and developing supply chain model based on the market research findings and analysis.

7.1.3 Identification of Key Stakeholders

When developing a supply chain model for CKD operations in the automobile industry, it is important to identify key stakeholders who play a crucial role in the functioning of the supply chain. Here are some key stakeholders to consider: Original Equipment Manufacturers (OEMs), Component Suppliers, Distributors/Wholesalers, Retailers/Dealerships, Logistics Providers, Government Agencies, Financial Institutions, Industry Associations, customers and academic & research institutes.

Identifying and engaging these key stakeholders help in developing a comprehensive and collaborative supply chain model for CKD operations in the automobile industry. Their involvement and contribution ensure a holistic approach and maximise the effectiveness of the supply chain.

7.1.4 Optimisation of Supplier Relationship

Optimisation of the supplier relationships for developing a successful supply chain model for CKD operations include: supplier selection, supplier collaboration, long-term partnerships, performance measurement, transparent communication, supplier development programs, risk management, encourage innovation, incentive programs, continuous evaluation and improvement etc.

By implementing these strategies, an optimum supplier relationships may be established that create a strong foundation for developing an efficient and effective supply chain model for CKD operations.

7.1.5 Streamlining Transportation and Logistics

Developing a supply chain model for the CKD operations of automobile industries requires a comprehensive analysis of the transportation and logistics process. This analysis aims to identify key areas for improvement and optimisation to ensure efficient and cost-effective operations. The aspects to consider are: supplier selection and management, transportation mode selection, route optimisation, warehouse management, packaging and containerisation, customs and regulatory compliance, information systems and communication, risk management and performance measurement and continuous improvement.

By analysing and addressing these aspects, automobile industries can develop a robust supply chain model for CKD operations. This model ensure the timely availability of high-quality CKD parts, reduce costs, and optimise the overall logistic process.

7.1.6 Leveraging Technology and Digitalisation

Integration of technology solutions plays a vital role in the development of a supply chain model for CKD operations in the automobile industry. It enables automation, real-time visibility, data analytics, and collaboration among various stakeholders. Some key technology solutions to consider are: ERP, Transportation Management System (TMS), Warehouse Management System (WMS), Track and Trace Technologies, Internet of Things (IoT) and Sensors, Data Analytics and Predictive Modelling, Collaborative Platforms, Blockchain Technology, Artificial Intelligence (AI) and Machine Learning (ML) and Mobile Applications.

By integrating these technology solutions, automobile industries can develop a robust supply chain model for CKD operations. It streamlines processes,

enhances visibility, optimises resources, and improves overall operational efficiency.

7.1.3 Fostering Collaboration and Coordination

Fostering collaboration and coordination among stakeholders is crucial for the development of a supply chain model for CKD operations in the automobile industry. CKD operations requires close coordination among various stakeholders such as suppliers, manufacturers, logistics providers, and government agencies.

A platform for communication in the form of a consortium, industry association, or regular meetings and workshops aid in sharing information and exchanging ideas. Engagement of key stakeholders in the supply chain model development process ensures that their perspectives and expertise are incorporated. Well defined common goals and objectives enhance collaborative efforts.

Governance framework ensures effective decision-making, accountability, and enforcement of agreed-upon guidelines. This framework should define roles, responsibilities, and mechanisms for conflict resolution. The exchange of information, best practices, and lessons learned among stakeholders is achieved through knowledge-sharing platforms, benchmarking exercises, and industry-wide reports. Building trust among stakeholders is crucial for effective collaboration. Transparency in sharing information, data, and performance metrics can help establish trust and facilitate decision-making. Joint initiatives and partnerships encourages stakeholders to collaborate on joint initiatives and partnerships for shared benefits.

By fostering collaboration and coordination among stakeholders, the development of a robust supply chain model for CKD operations in the automobile industry can be achieved.

7.2 Suggested Model

One suitable supply chain model for CKD operations in the automobile industry in Bangladesh is the "Local Sourcing Model." This model focuses on developing a strong local supplier base to support CKD operations. Figure 10 represents the complete suggested supply chain model. The model includes 6 modules. Modules are: identification and development of local suppliers; supplier capacity building; localisation of components; QC and certification; strategic inventory management and continuous improvement and innovation. For ease of understanding, each modules modules are further modelled as shown from figure 11 to 16.

SUGGESTED SUPPLY CHAIN MODEL

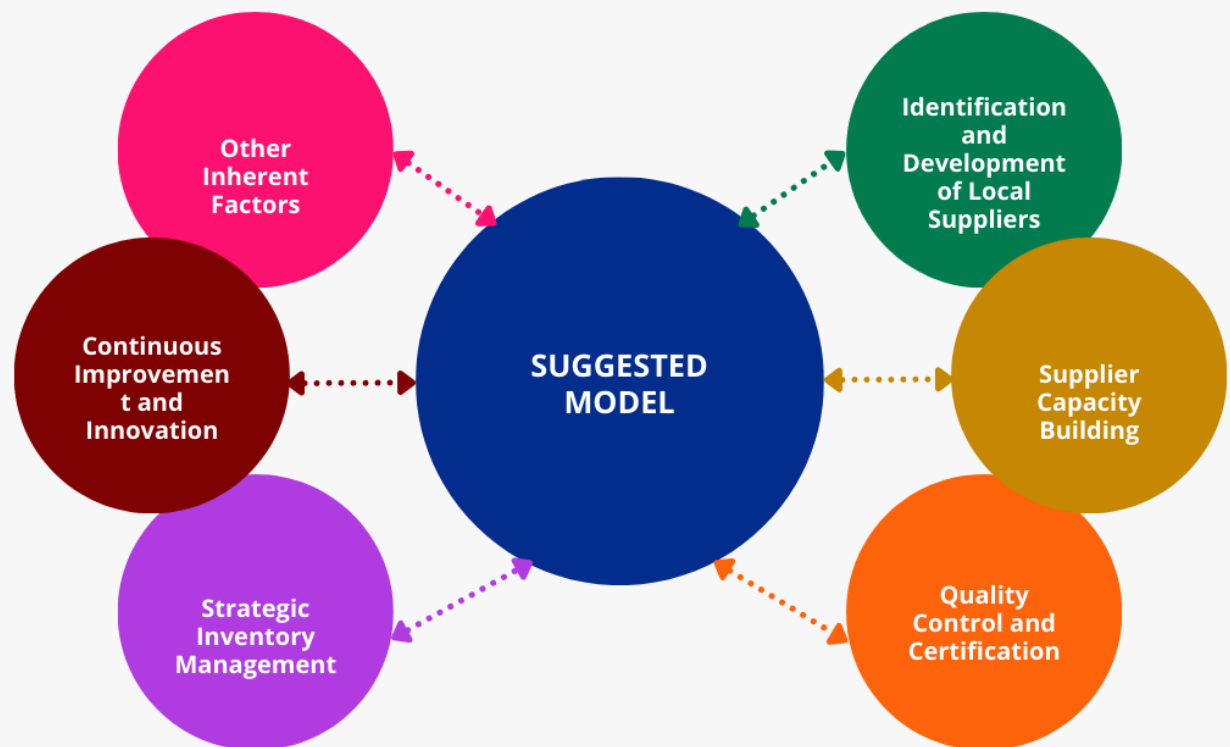


Figure 10: Suggested Complete Supply Chain Model, Proposed By The Researcher

7.2.1 Identification and Development of Local Suppliers

In this module, the steps include: identification of potential suppliers, determining pre-qualification, sending Request for Proposal (RFP), evaluation of the proposals, supplier's development and supplier's relationship management.

The first step is to identify potential suppliers who can provide the required goods or services. This can be done through various methods such as market research, referrals, trade directories, online platforms, and attending trade shows or

industry events. It is important to consider factors such as the supplier's expertise, capacity, reputation, location, and ability to meet the company's specific needs.

Once the potential suppliers have been identified, a pre-qualification process is usually conducted. This involves assessing their capabilities, financial stability, quality management systems, production processes, certifications, and compliance with legal and ethical standards. This step helps to shortlist suppliers who meet the company's requirements.

A RFP is sent to the shortlisted suppliers, outlining the company's specific requirements, expectations, terms, and conditions. The RFP may include details on pricing, delivery schedules, quality standards, performance requirements, and contractual terms. Suppliers are then invited to submit their proposals, including information on their capabilities, pricing, references, and any additional value-added services they can provide.

The received proposals are evaluated based on predefined criteria, including quality, cost, delivery, service, and overall value. The evaluation may involve site visits, product samples, reference checks, or negotiation of terms. It is important to consider not only the short-term benefits but also long-term viability and alignment with the company's strategic objectives.

Once the preferred suppliers have been selected, the company can start building a mutually beneficial relationship with them. This involves setting clear expectations, discussing performance metrics, negotiating contracts, and providing necessary training or support to help suppliers improve their processes, quality, and delivery capabilities. Regular communication, feedback, and monitoring supplier performance are essential to ensure continuous improvement and to address any issues or concerns that may arise.

After suppliers have been onboarded, it is crucial to maintain strong relationships and monitor their performance periodically. This includes regular communication, performance reviews, audits, and addressing any concerns or disputes. The company should also explore opportunities for collaboration, innovation, and joint problem-solving to enhance the value they receive from their suppliers.

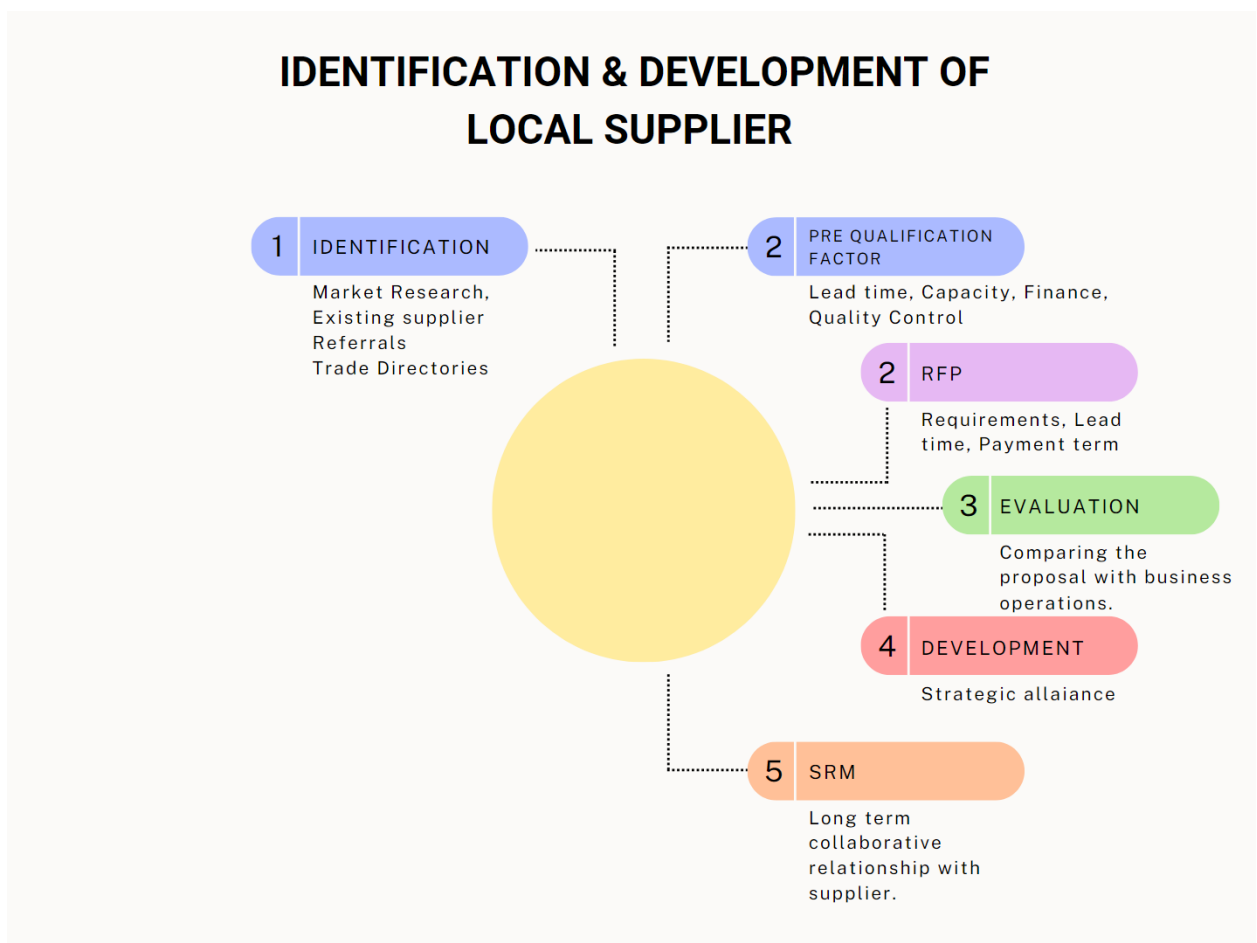


Figure 11: Supply Chain Model For Identification And Development Of Local Suppliers , Proposed By The Researcher

7.2.2 Supplier Capacity Building

Once potential suppliers are identified, capacity building programs can be implemented to enhance their technical and manufacturing capabilities. Supplier capacity building refers to the process of enhancing the capabilities and resources of suppliers to meet the requirements and demands of a company. This includes providing training, financial support, and technical assistance to local suppliers to meet quality standards and production requirements.

The goals of supplier capacity building are to enhance the supplier's ability to meet the company's needs, improve the quality and reliability of the supplied goods and services, and create long-term, mutually beneficial relationships. Steps include: Training & development, technical assistance, financial support, collaboration, performance monitoring & feedback and establishing long term partnership.

Automobile industries can provide training programs to suppliers to enhance their skills and knowledge in areas such as quality management, production techniques, safety standards, and compliance with regulations. This can be done through workshops, seminars, on-site training, or online learning platforms.

Technical support to assist suppliers in improving their manufacturing processes, product design, packaging, or logistics. This can involve sharing best practices, providing access to technical expertise, or facilitating knowledge transfer through mentorship programs.

Financial assistance to suppliers invest in necessary equipment, technology upgrades, or infrastructure improvements would help suppliers to increase

operational efficiency, enhance product quality, or expand their capacity to meet higher demand.

Engaging suppliers in collaborative projects can help them gain exposure to new markets, technologies, or best practices. This can involve joint research and development initiatives, co-creation of innovative solutions, or participation in industry-specific forums or networks.

It is important to regularly monitor supplier performance, assess their adherence to quality standards and delivery schedules, and provide constructive feedback. This helps suppliers identify areas for improvement and take corrective measures to enhance their performance.

Building strong, long-term partnerships with suppliers is crucial for continuous improvement. It fosters trust, open communication, and a shared commitment to success. Companies can work closely with suppliers to set performance goals, define Key Performance Indicators (KPIs), and establish mechanisms for regular communication and collaboration.

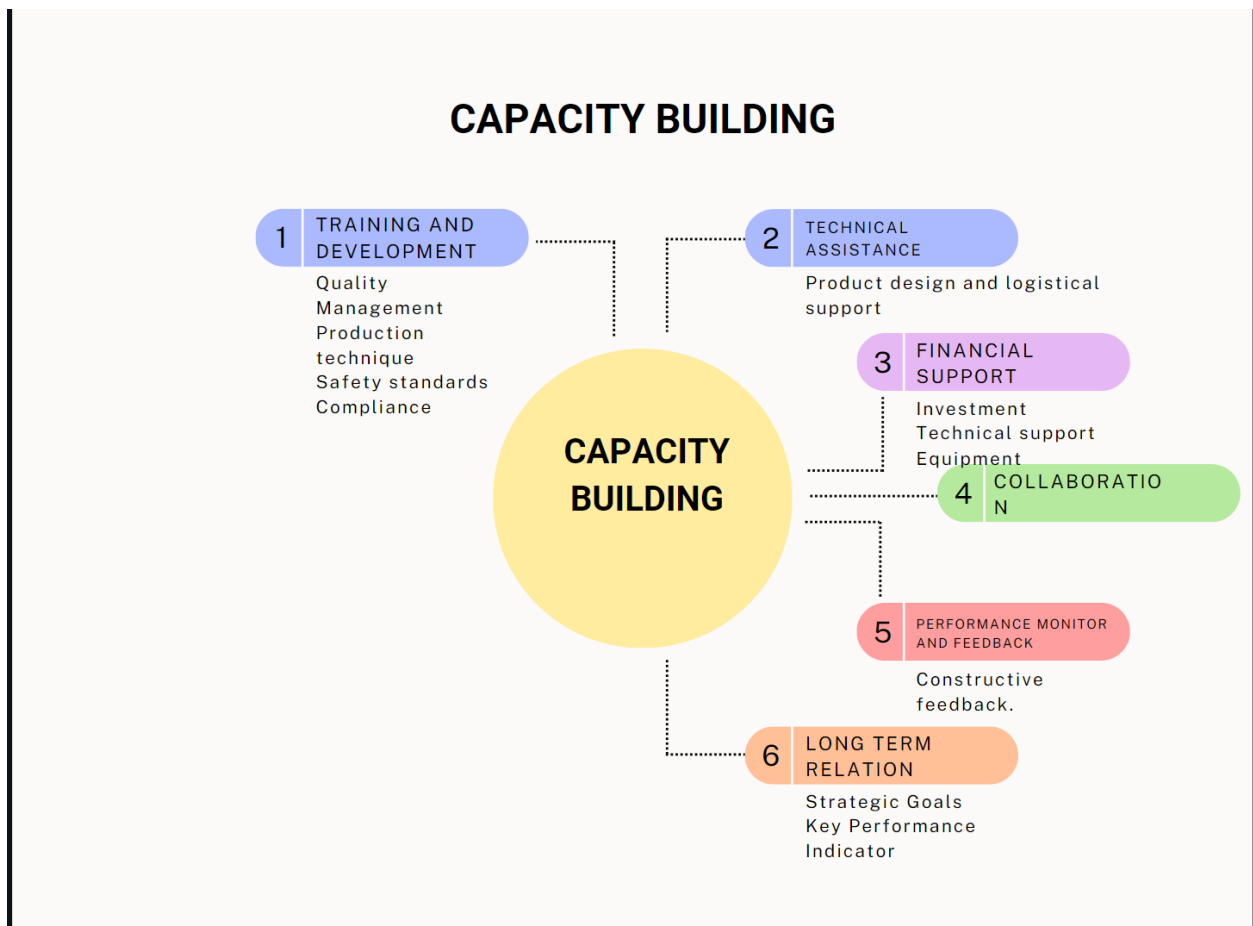


Figure 12: Supply Chain Model For Suppliers Capacity Building, Proposed By The Researcher

7.2.3 Localisation of Components

Localisation in the automobile industry refers to the process of adapting and manufacturing vehicles and their components in a specific market or country, rather than importing them. The local suppliers should be encouraged to gradually increase the localisation of components, aiming for maximum localisation over time. This helps reduce import dependency, lowers costs, and strengthens the local supply chain. It involves market analysis, product adaption, supply chain optimisation and manufacturing.

The first step of market analysis is demand assessment. Here demand for specific vehicle types and components in the target market is evaluated on the basis of

consumer preferences, economic conditions and environmental regulations. Next step is to analyse local competitors based on their market share, strengths, weaknesses, and the level of local content in their products. Final steps is adhere the local regulations regarding emissions, safety standards, and the required percentage of local content, if any.

Product Adaptation includes design modification and prototyping and testing. It is needed to make necessary design modifications to the components to meet local specifications, regulations, and consumer preferences. Once design is modified the prototypes are of the localised components is developed and to ensure they meet the required standards rigorous testing is conducted.

Supply Chain Optimisation involves logistic planning and integration with global supply chain. The factors need to be considered for logistic planning are: lead times, inventory levels and transportation costs. It is required to ensure that the localised supply chain is integrated with the global supply chain for seamless operations, especially if some components are still sourced from abroad.

For manufacturing localised components technology transfer is vital. Manufacturing process is set up based on acquired technology. Then it is needed to plan the manufacturing capacity to meet current and future demands while ensuring flexibility for demand fluctuations.

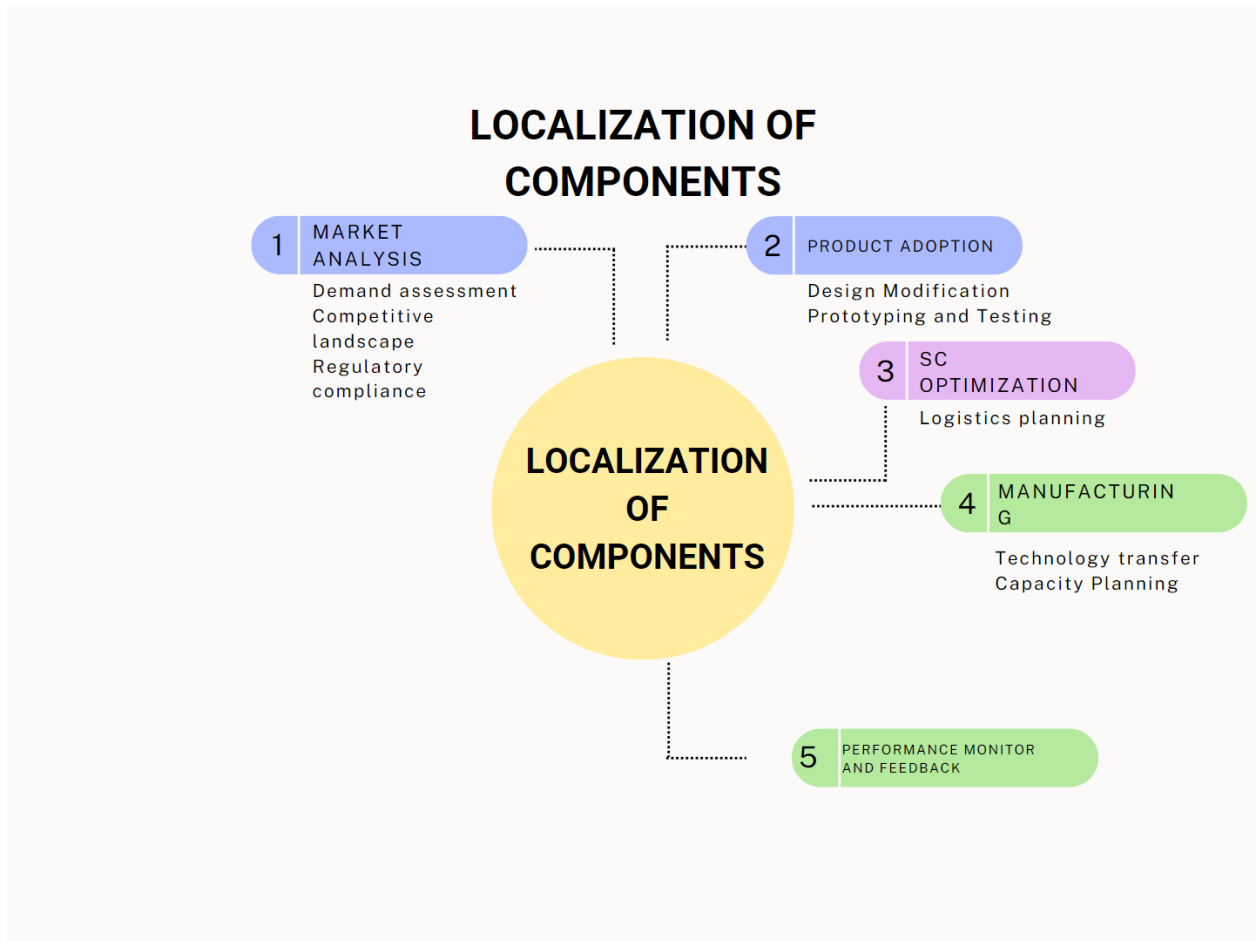


Figure 13: Supply Chain Model For Localisation Of Components, Proposed By The Researcher

7.2.4. Quality Control and Certification

Implementing quality control measures and obtaining necessary certifications for local suppliers is crucial. This ensures that the components produced meet international quality standards and are reliable for CKD assembly.

Quality control (QC) in vehicle assembly involves a series of inspections, tests, and feedback mechanisms to ensure that every vehicle meets the manufacturer's standards as well as regulatory requirements. The QC process encompasses

several key steps: material inspection, in process inspection, end of line testing, corrective action and continuous improvement.

The purpose of incoming material inspection is to ensure that all materials and components arriving from suppliers meet predetermined quality standards. This is done through visual inspections, dimensional measurements, material testing etc. In process inspection monitor and control the quality during the assembly process. This is carried out at various stages of assembly (e.g., welding, painting, final assembly) where technicians inspect workmanship, fit, and function. End of line testing verifies that the fully assembled vehicle meets all functional and regulatory standards. Tests include dynamic tests (e.g., road testing for brakes, alignment, and noise), static tests (e.g., leak tests, electrical system checks), and visual inspections.

Corrective action addresses issues identified during inspections and tests. It involves root cause analysis, rework or replacement of defective components, process adjustments etc. Continuous improvement enhances quality over time based on feedback and data analysis. Methods are quality circles, six Sigma, lean manufacturing techniques.



Figure 14: Supply Chain Model For Quality Control And Certification , Proposed By The Researcher

Certification involves verifying that a vehicle meets specific regulatory standards and industry norms. This process is generally carried out by independent organisations or regulatory bodies. Certification include: homologation, type approval, quality manage system certification and environmental & sustainability certification.

Homologation is the process of certifying that a vehicle is roadworthy and complies with all applicable regulations and standards in a particular market. Approval is granted based on safety standards (e.g., crashworthiness), environmental regulations (e.g., emissions, fuel efficiency), and other regulatory directives.

Type Approval certifies that a vehicle type meets specified performance and safety standards before mass production. Authorised body test a representative vehicle model by an covering aspects such as emissions, noise levels, and safety features and issues the certificate.

Quality Management System Certification like: ISO 9001, IATF 16949 certifies that the manufacturer's quality management system meets international standards, ensuring consistent quality in production processes. It is done through external audits by accredited bodies, documentation review, and process evaluation.

Environmental and Sustainability Certifications: ISO 14001 (Environmental Management), ISO 50001 (Energy Management) demonstrate commitment to environmental management and energy efficiency in manufacturing processes.

7.2.5. Strategic Inventory Management

Efficient inventory management practices, such as JIT or VMI, is implemented to minimise inventory holding costs while ensuring a steady supply of components for CKD assembly.

Strategic inventory management is an essential aspect of supply chain management and operations that involves the careful planning, control, and execution of inventory levels to meet business objectives effectively. It aligns inventory levels and operations with the broader business strategy to ensure efficiency, cost-effectiveness, and customer satisfaction. It involves: demand forecasting, inventory optimisation, safety stock, lead time management, supplier management and product life cycle management.

Accurate demand forecasting is crucial for effective inventory management. It involves using historical sales data, market trends, and predictive analytics to estimate future product demand, helping businesses maintain optimal inventory levels.

Inventory Optimisation is the process of finding the right balance between too much and too little inventory. It includes determining the optimal reorder points and order quantities that minimise costs (including holding, ordering, and shortage costs) while meeting customer demand.

Keeping safety stock involves holding a buffer inventory to protect against variability in demand or supply. The right amount of safety stock is crucial to prevent stock outs without tying up too much capital in inventory.

The time between placing an order and receiving it is known as lead times. Understanding and managing this time is vital for minimising stock outs and reducing the need for excessive safety stock.

Developing strong relationships with suppliers and understanding their capabilities can help in reducing lead times, improving product quality, and achieving more favourable terms, all of which contribute to more effective inventory management.

Different stages of a product's lifecycle have different inventory management needs. Strategic inventory management takes these stages into account, adjusting strategies for introduction, growth, maturity, and decline phases.

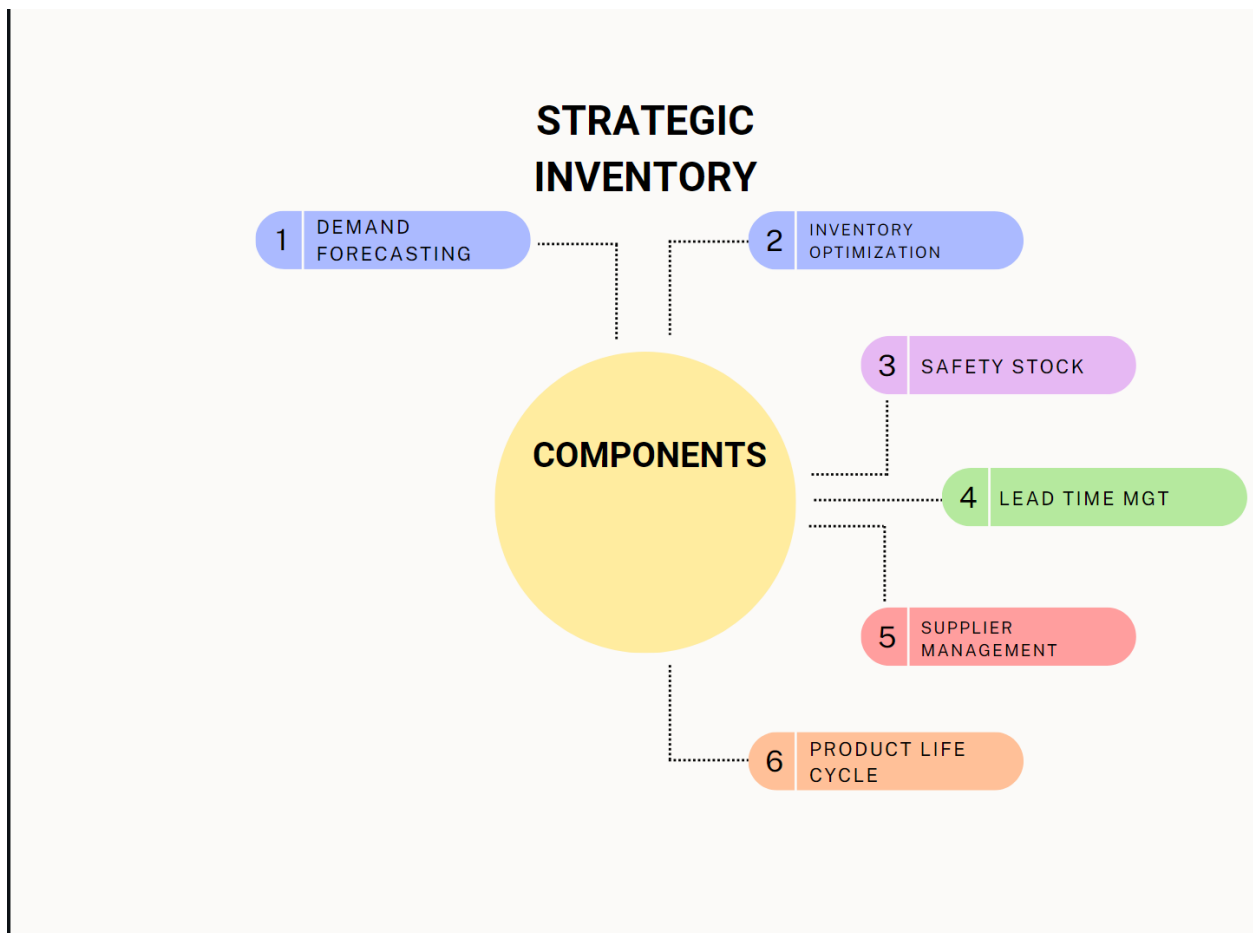


Figure 15: Supply Chain Model For Strategic Inventory Control , Proposed By The Researcher

Strategic Approaches may include JIT, ABC analysis, Economic Order Quantity (EOQ), VMI and technology leverage.

JIT aims to minimise inventory levels by aligning production schedules closely with demand forecasts. The goal is to receive goods only as they are needed in the production process, reducing inventory holding costs. ABC Analysis employs inventory categorisation technique and identifies items that require more attention by dividing inventory into three categories (A, B, and C) based on their importance, which could be determined by sales volume, revenue contribution, or other criteria. This allows businesses to prioritise their focus and resources on the most critical items.

EOQ helps to determine the optimal order quantity that minimises the total holding costs and ordering costs. Under VMI, the supplier takes responsibility for managing and replenishing inventory based on predefined criteria. This can lead to more efficient inventory management by reducing the burden on the buyer and leveraging the supplier's expertise.

Leveraging technology, such as inventory management software, RFID tags, and IoT devices, can significantly improve inventory accuracy, visibility, and efficiency. Advanced analytics and AI can further refine forecasting and decision-making processes.

7.2.6. Continuous Improvement and Innovation

The supply chain model should encourage continuous improvement and innovation in both CKD assembly processes and local supplier capabilities. This can include investments in research and development, technology adoption, and promoting a culture of innovation within the industry.

Continuous improvement is a core principle in many business and manufacturing philosophies, such as Lean Manufacturing, Six Sigma, and Total Quality Management (TQM). It is centred around the idea that processes, products, and services can always be improved. It involves the either Plan-Do-Check-Act (PDCA) or Define- Measure- Analyse- Improve-Control (DMAIC) frameworks:

In PDCA Cycle problem or improvement opportunity is clearly defined, data is collected to understand the problems or improve opportunities identified, changes that could improve the situation is predicted and then devise a implementation plan. Next step is to implement the plan and documentation of the changes. Then result is evaluated, data is analysed to ensure the impact of the changes and lesson

is learnt from the mistake. Final step is standardisation of the improvement and identification of new improvement.



Figure 16: Supply Chain Model For Continuous Improvement , Proposed By The Researcher

7.2.7. Other Inherent Factors

Building strong relationships with local suppliers is essential for a successful supply chain model. Collaboration, communication, and transparency between automobile manufacturers and suppliers can help optimise the supply chain, improve production efficiency, and address any issues promptly. Implementing the local sourcing model requires strong collaboration between automobile manufacturers, government bodies, industry associations, and local suppliers. It aims to create a sustainable and locally integrated supply chain for CKD operations, leading to increased localisation, cost efficiency, and economic growth in the automobile industry in Bangladesh.

Sustainability practices needs to be injected into supply chain model. Opportunities to be evaluated to minimise waste, reduce emissions, and promote responsible sourcing and recycling within the CKD operations. Implementation performance metrics and tracking systems to monitor the effectiveness of the supply chain model is vital. Regular evaluation and refining processes is needed to adapt with changing market demands and improve overall efficiency.

It is noted that developing a supply chain model is an iterative process. Continuous evaluation and improvement are key to ensure its effectiveness and adaptability to evolving industry dynamics.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

This chapter first highlights the conclusion. Then it discusses the recommendations.

8.1 Conclusions

The development of a supply chain model for CKD operations in the automobile industry of Bangladesh holds significant potential for boosting the sector's growth and competitiveness. By implementing an efficient supply chain framework, manufacturers can effectively manage the flow of parts and components, reducing lead times, costs, and potential disruptions. Additionally, collaborating with local suppliers, developing robust quality control measures, and implementing advanced technologies can further enhance the supply chain's effectiveness. Moreover, fostering partnerships and knowledge sharing with global industry players can aid in acquiring best practices and improving overall efficiency. As Bangladesh strives to establish itself as a global automotive manufacturing hub, the adoption of a robust supply chain model for CKD operations is pivotal to support the industry's development and position the country as a competitive player in the global automobile market.

Despite the relatively young age of the automobile industry in Bangladesh, it has shown promising growth potential, with increasing investments and initiatives to develop a robust and sustainable automotive sector. The effort has revealed some issues which include skilled manpower, resources, inventory control, planning, regulatory framework and research & development.

The study established that skilled workforce could maximise productivity, save money, contribute to improved profitability and stronger growth. The study further revealed that the CKD operations needed manufacturing facilities, machinery, equipment, raw materials, components, supply chain management, quality control transportation & logistics. Ensuring the availability of the required components could be a challenge in CKD operations. Delayed or unreliable supply of components could disrupt the assembly process and lead to production delays.

The study found that planning played a critical role in the supply chain of CKD operations in the automobile industry. The study revealed that effective production planning was essential to ensure the availability of required components and parts for assembly. The study further revealed that accurate demand forecasting is vital for CKD operations to optimise production schedules and inventory management. It is also found that planning could help in optimising logistics and transportation activities associated with CKD operations. It also could help to identify and mitigate risks that can impact CKD operations.

The study revealed that the R&D in the supply chain of CKD operations could identify quality gaps and potential areas for improvement. The efforts could enable the localisation of various components needed for CKD operations and streamline the production process and minimise costs. Study further revealed that R&D facilitated the adoption of new technologies and innovation.

The study pointed out that costs efficiency, quality control, timely delivery, inventory management, supplier collaboration, and localisation opportunities among others are the effect supply chain on CKD Operation of automobile industry. A well-managed supply chain ensures cost efficiency, influences the

quality of CKD operations, ensures timely delivery of the components, helps in maintaining optimal inventory, fosters strong relationships with suppliers and facilitates the identification and development of local suppliers, helping to enhance local manufacturing capabilities and promote economic growth.

The study identified that lack of skilled manpower, inadequate resources, improper inventory control, poor planning, absence of regulatory framework and lack of R&D are some of the challenges militating against supply chain for effective CKD operation in the automobile industries of Bangladesh. Lack of skilled manpower and inadequate resources have decelerated supply chain and CKD efforts of the automobile industries.. Improper inventory control and poor planning has always been hindrance to development of supply chain for CKD operation. The study revealed that lack of R&D efforts is an impediment to the development of supply chain model for effective CKD operation.

The study also examined prospects of developing supply chain model for effective CKD operation in the automobile industries of Bangladesh. These include growing automobile markets, favourable government policies, cost advantage, increasing localisation efforts, rising export potential and infrastructure development.

The study identified the growing automobile market created opportunities for CKD operations as manufacturers can cater to the rising demand by assembling vehicles locally. Government policies played a crucial role in creating a favourable environment for manufacturers.

Study revealed significant domestic market provided manufacturers with the opportunity to achieve economies of scale and cost efficiencies. It further revealed that the localisation efforts of manufacturing automobile components in Bangladesh could create a robust and sustainable automotive industry in the country. Bangladesh has the potential to become a significant exporter of automobiles in the future. There has been a noticeable growth in the local automobile manufacturing sector, which indicates the potential for export opportunities. Infrastructure development initiatives in Bangladesh have played a crucial role in enhancing the country's economic growth, attracting foreign investment, improving livelihoods, and promoting regional connectivity.

The study proffered strategies to mitigate the challenges militating against supply chain model for effective CKD operations of automobile industries of Bangladesh. The strategies include development of skilled Manpower, promulgation of local content policy, improvisation of inventory control, efficient planning and institutionalisation of R & D efforts. Automobile industries of Bangladesh need a comprehensive plan to develop skilled manpower. To develop skilled manpower for the supply chain of CKD operations in the automobile industry of Bangladesh, needs education and training programme, the industry academia collaboration, certification and skill development programme, industry specific internship programme, continuous professional development and more importantly on job training and monitoring.

By formulating and implementing local content policies, Bangladesh can promote the development of a robust local supply chain for CKD operations in the automobile industry, leading to increased employment opportunities, technological advancement, and economic growth. Improvisation inventory control for the supply chain of CKD operations in the automobile industry of

Bangladesh can help reduce costs, minimise stock outs, and optimise production. The improvisation process involves: demand forecasting, collaborative planning, standardisation, strategic sourcing, adoption of technology and so on. The efficient planning of the supply chain for CKD operations in the automobile industry of Bangladesh leads to improved operational efficiency, cost savings, and better customer service. To institutionalise R&D efforts for the supply chain of CKD operations of automobile industries in Bangladesh the first and foremost requirement is to establish a dedicated R&D department. Partnerships and collaborations with local universities, research institutes, and technical colleges contributes to any R&D efforts.

The study has suggested a supply chain model for effective CKD operations in the automobile industries of Bangladesh. The study revealed that strong relationships with local suppliers in terms of collaboration, communication, and transparency could optimise the supply chain. It is established that implementing the local sourcing model requires strong collaboration between automobile manufacturers, government bodies, industry associations, and local suppliers.

The study further revealed that sustainability practices is needed for effective implementation of supply chain model. It is vital to monitor the effectiveness of the supply chain model. Regular evaluation and refining processes is crucial for adapting to changing market demands and improvng overall efficiency.

8.2. Recommendations

It is recommended that:

- a. Automobile industries of Bangladesh may formulate and implement a comprehensive plan to develop skilled manpower.

- b. National Assembly may enact local content policy.

- c. Stakeholders of automobile industries may establish data centre, encourage automation, standardise components and form a monitoring cell.

- d. All manufacturing unit may establish a full pledged planning department.

- e. Bangladesh Automobile industries may establish dedicated R&D department, establish a strong link with academia and collaborate each other on knowledge sharing and joint research.

Appendices:

1. Sample Questionnaire. 02 pages
2. Summary of the Respondent's Responses. 01 page

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APPENDIX1 TO
THESIS DATED
06/04/24

SAMPLE COPY OF QUESTIONNAIRE

SECTION A: INSTRUCTIONS

Dear Sir/Madam,

I am a student of Masters in Procurement and Supply Chain Management at BRAC Institute of Governance and Development, BRAC University, Dhaka. As a part of the programme I have embarked a research on “Development of Supply Chain Model for CKD Operation in Light of Bangladesh Automobile Development Policy” I need your cooperation in this regard.

Therefore, I request you to kindly fill the questionnaire below and give your candid opinion on the issues raised. To ensure anonymity your name and signature is not required. You are further requested to send your reply through e-mail zafiralamgir01@gmail.com

SECTION B: PERSONAL DATA

1. Sex:

M	F
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2. Age:

3. Organization:

4. Position:

SECTION C: QUESTIONNAIRE (TICK IN THE APPROPRIATE BOX)

1. Automobile industries of Bangladesh has adequate skilled manpower for effective CKD operations.

SA	A	U	D	SD
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2. Automobile industries of Bangladesh has adequate resources for effective CKD operations.3. Inventory Control of Automobile industries of Bangladesh is suitable for effective CKD operations.

SA	A	U	D	SD
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4. Planning of Automobile industries of Bangladesh is suitable for effective CKD operations.

SA	A	U	D	SD
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5. R &D of Automobile industries of Bangladesh is well coordinated for effective CKD operations.

SA	A	U	D	SD
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LEGEND:

SA: Strongly Agree, A: Agree, U: Undecided, D: Disagree, SD: Strongly Disagree

SECTION D: COMMENTS

1. What are the challenges militating against supply chain model development for effective CKD Operations of the automobile industries of Bangladesh?
2. How these challenges can be mitigated?

SUMMARY OF THE RESPONDENTS' RESPONSES OF ADMINISTRATIVE QUESTIONNAIRE

Administrative Propositions	Respondents' Responses						Rem
	SA	A	U	D	SD	% Disagreement	
(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Automobile industries of Bangladesh has adequate skilled manpower for effective CKD operations.	1	21	20	77	1	65 %	
Automobile industries of Bangladesh has adequate resources for effective CKD operations.	0	26	14	79	1	67 %	

Inventory Control of Automobile industries of Bangladesh is suitable for effective CKD operations.	3	33	8	75	1	63 %
Planning of Automobile industries of Bangladesh is suitable for effective CKD operations.	2	26	12	75	5	67 %
R &D of Automobile industries of Bangladesh is well coordinated for effective CKD operations.	1	17	9	91	2	78 %

Source: Compiled by the researcher from the responses of administrative questionnaire.

LEGEND: SA: Strongly Agree, A: Agree, U: Undecided, D: Disagree, SD: Strongly Disagree.

NOTES

Total Questionnaire Sent to: 132 persons

Response Received from: 120 persons

GLOSSARY

Original Equipment Manufacturers

These are the automobile companies that manufacture the vehicles. They are central to the supply chain model as they set the design specifications, quality standards, and overall production requirements.

Component Suppliers

These are the suppliers who provide the individual components required for the assembly of the vehicles. They supply parts such as engines, transmissions, chassis, electrical systems, and other mechanical components to the OEMs.

Distributors/Wholesalers

These stakeholders act as intermediaries between the OEMs and retailers or dealerships. They receive the CKD parts from the OEMs and distribute them to retailers or dealerships who assemble the vehicles.

Retailers/Dealerships

These are the entities responsible for the final assembly of the vehicles and distribution to end customers. They receive the CKD parts from distributors and handle the final assembly process, including inspection, quality control, and customisation according to customer requirements.

Logistics Providers

These stakeholders play a critical role in the transportation and delivery of CKD parts from suppliers to OEMs, distributors, and retailers. They manage the supply chain logistics, including warehousing, inventory management, transportation, and order fulfilment.

Government Agencies

Regulatory bodies and government agencies are key stakeholders in the supply chain model for CKD operations. They enforce import/export regulations, customs procedures, and ensure compliance with safety standards, environmental regulations, and taxation policies.

Financial Institutions

Banks and financial institutions play a critical role in providing financing options to OEMs, distributors, and retailers for the procurement of CKD parts, assembly equipment, and other operational expenses.

Industry Associations

Associations representing the automobile industry, such as trade associations or chambers of commerce, act as important stakeholders. They provide industry insights, advocate for the interests of the industry, and facilitate collaboration among stakeholders for knowledge sharing and best practices.

Customers

Ultimately, end customers are a vital stakeholder in the supply chain model. Their demands, preferences, and purchasing patterns impact the entire supply chain, including the design, quality, pricing, and availability of CKD vehicles.

Academic and Research Institutions

Academic institutions and research organisations can also contribute as stakeholders by providing research, analysis, and industry-specific expertise to support the development and continuous improvement of the supply chain model.

