

Supply Chain of Automotive Industry in Bangladesh: Feasibility and Sustainability with BoP.

By

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in partial fulfillment of the requirements for the degree of
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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.
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Abstract/ Executive Summary

Bangladesh has got independence in the year of 1971. Almost 52 years are passing, but we are still using Japanese used car which is called recondition vehicle. It is high time to think about using locally manufacturer vehicles. So, will the customer buy locally manufactured vehicle and will supply chain be shifted to manufacturing over long established Japanese reconditioned vehicle importing? The study will come up with the answer of future supply chain of automotive industry in Bangladesh along with prime factor. Research has been designed with hypothesis question and the answer will be determined by analyzing the responses of the survey questions. Integration of Bottom of pyramid marketing concept modality is also designed to support the prime factor. Moreover, sustainable concept is designed for the benefit of business entity considering social, environmental, and economical.

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I would like to thank my thesis supervisor, Md. Hasan Maksud Chowdhury, who guided me in every step of my thesis work. Especially for importance of data authenticity, concept regarding research questionnaire, SPSS software learning he guided me tremendously. By which my thesis work gets nicely done.

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List Of Acronyms

BIW: Body in White Condition

BOP: Base of Pyramid

CBU: Complete Body Unit

CKD: Completely Knocked Down

ED: Electro Deposition

GDP: Gross Domestic Product

KMO: kaiser-Mayer-Olkin

LC: Letter of Credit

PV: Passenger Vehicle

SPSS: Statistical Package for the Social Sciences

SD: Supplementary Duty

TBS: The Business Standard

VAT: Value Added Tax

Chapter 1

Introduction

Total market size of passenger vehicle in Bangladesh in the year of 2022 is around 34,334 (Brand New + Recondition, considering Microbus in the Passenger vehicle segment.). Whereas Sedan is 16,695, Jeep/SUV is 10,240 and Microbus is 7399 [1]. In addition, brand new vehicles is around 4800 (14%) and the rest 86% is reconditioned car. And in 2021, total number of registered car was in total 28592, where sedan was 16,049, Jeep was 7602 and Microbus was around 4941. It is observed a 20% YoY growth in the passenger vehicle segment, which is a significant percentage and indicates the growing purchasing power of Bangladeshi people. To extend, SUV growth is around 35% and sedan is stagnantly 4%. Which indicates with the global trend, in Bangladesh also the SUVs are getting more popularity than sedans.

Unfortunately, the manufacturing of automobiles was absent in the industry and the supply chain was mostly on a trading basis importing of recondition complete body unit (CBU) from Japan. Only 1% of the whole industry was doing assembly with painting and 2% is only assembly in year 2022. Resulting, no localization of parts or raw materials, no skilled manpower and no backward integrated supply chain. But PHP and Fair technology is the starter company who started semi manufacturing like assembly with painting.

PHP (Brand: Proton) is the first who introduced semi-Automobile manufacturing (Assembly with Painting). The products are mostly sedans. To extend, Proton is not succeeding to achieve good market share within the industry. Fair Technology (Brand: Hyundai) is the second to do semi-Automobile manufacturing with painting operations with assembly of around 1000 over parts (Ref: Prothom alo). The products of Fair Technology are mostly SUVs. Others assemblers without painting facility are Rangs (Brand : Mitsubishi) , M.A Enterprise (DFSK), Hossain group (DFSK, Bangla Car), State owned Pragati industries (Mitsubishi, Mahindra).

Moreover Govt. is emphasizing on local production by exempting VAT, and SD. So, there is a huge opportunity of manufacturing vehicle in the upcoming years. To sum it up, the thesis actually conducted in the aim for future prediction of the type of supply chain questioning will the supply chain be based on manufacturing or just by importing CU PV. To extend the study also consists of feasibility analysis and establishing modality of sustainable strategical concept with it.

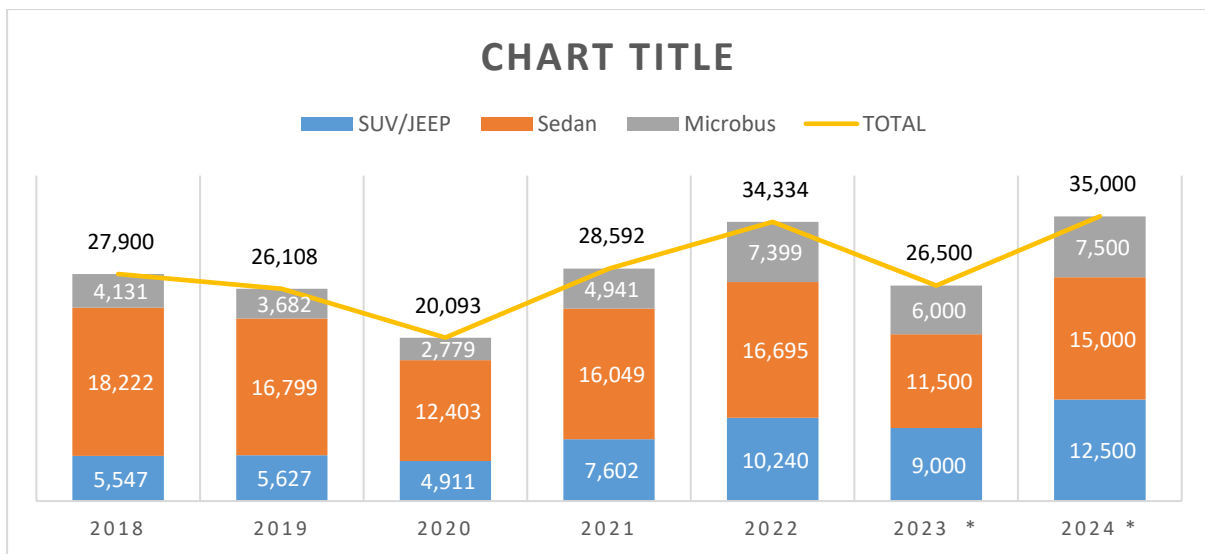


Figure 1: Automotive Industry MS and Growth [1]

DESCRIPTION	TYPES	2018	2019	2020	2021	2022	2023 *	2024 *	MS%
Total	SUV/JEEP	5,547	5,627	4,911	7,602	10,240	9,000	12,500	34%
	Sedan	18,222	16,799	12,403	16,049	16,695	11,500	15,000	43%
	Microbus	4,131	3,682	2,779	4,941	7,399	6,000	7,500	23%
	TOTAL	27,900	26,108	20,093	28,592	34,334	26,500	35,000	100%
	YoY Gr. %		-6%	-23%	42%	20%	-23%	32%	

Table 1: Automotive Industry market data [1]

In Figure 1 the Market data of Bangladesh from Y 2018- Y 2022 was presented which was described in early stage of introduction. To extend, market data of 2023 and 2024 was projected based on current trend, statistics and future economic factors.

1.1 Literature Review

As discussed earlier that, recondition passenger vehicles dominated the market share (86% at 2022) of the automotive industry in comparison to locally assembled or manufactured cars. So ultimately the price is too much higher for recondition vehicles. As, govt. is emphasizing local manufacturing by exempting VAT and SD, there is a huge opportunity of manufacturing passenger vehicles and cut down the price.

Many research paper has been published showing that Bangladesh populations purchasing power has increased and in future there will be a significant growth in GDP. As the socioeconomic condition develops, the use of automobiles or motor vehicles trend is going upward, It is generally admitted that with the increasing income and purchasing power people enhance their living standard by increasing consumption, though nowadays in some cases the use of personal vehicles is considered as a necessity (Hasan, 2022). TBS report suggested the need for dropping the ongoing national plan to get some gasoline car plants through ensuring a much-protected market for merely screw-driving assemblers. Conventionally, purchasing a vehicle in Bangladesh has not been financially feasible for middle-income families partly due to its exorbitant cost (Amik et al., 2021). Recently, the demand for vehicles in Bangladesh has been found to rise over this pandemic period (Anwari et al., 2021). Quality is thought to be the main decision criterion often observed in consumer decisions in the car market. The relationship between price and quality in the used car market is very significant (Betts & Taran, 2003). According to Maryam Zomorodi, 2022 the Base of the Pyramid (BoP) An important market that is receiving increasing attention by firms relates to the poorest or middle-income country.

Linking to the 1st part of Literature review, Now, the question is will Bangladeshi PV customers will buy locally manufactured cars over imported car? That answer we need to extract from the thesis result. If yes, what is the feasibility of doing manufacturing in Bangladesh?

1.2 Objectives

The thesis has prime objectives with a bird's eye view. Whereas Secondary objectives are stated also to support the prime objective.

Prime Objectives:

- ✓ To determine the future supply chain of Automotive Industry of Bangladesh
(Passenger Vehicle)
- ✓ Link up supply chain with sustainable concept of Bottom of the pyramid marketing strategy.

Secondary Objectives:

- ✓ To determine: will people buy locally manufactured passenger vehicles rather than imported passenger vehicles.
- ✓ Affordability of consumers regarding imported passenger vehicles due to price hike.
- ✓ What is the prime factor behind the supply chain shift (price, Quality, Features, After Sales Service, Spare Parts, Warranty)
- ✓ Feasibility Analysis for the prime factor behind the supply chain shift.
- ✓ Proposing a link between future supply chain and sustainability concept: Bottom of Pyramid.

1.3 Methodology

The Study of the research consists of market study, manufacturing process of automotive, current supply chain of automobile, future forecasting and feasibility analysis through quantitative research, linking the future supply chain with sustainable Bottom of pyramid, conceptual qualitative research approach. A survey questionnaire is asked to the respondents, mainly user of passenger vehicle and within good income range. Various data analysis procedures has been conducted to verify the applicability of data like : Normality Test, KMO test, Reliability Test (Cronbach Alpha). And most importantly Chi Square fit test is conducted for verifying the outcome.

1.4 Scope

The thesis will consist of detailed automotive industry overview of Bangladesh, History of Automotive industry, manufacturing process as descriptive part. On the other hand, detailed research has been conducted to determine the future supply chain of automotive industry and feasibility of the prediction or forecast. In addition, a modality of Bottom of pyramid concept can be linked to the industry for sustainability. In the survey part, the respondent of this study consists of almost 100 passenger vehicle users. Because it is important for the respondents to have experience of using passenger vehicles to answer the questions. In total 18 questions will be asked, in which 05 are demographic questions (age, income range, passenger vehicle user type (brand new user or recondition vehicle user), automotive brand they used (like : Toyota, Mitsubishi, Hyundai, Honda etc), sex. , 06 are for segment A and hypothesis and 07 are for segment B research questions.

1.5 Importance of the study

The main importance of the study will benefit the business owners who are connected with the automotive industry. It will be easier for the business house to make decision and positioning of their product and business. To exemplify: If the research result comes up with the positive feasibility status for the manufacturing industry, by then business house can make decision whether to import or not, whether to open advance LC or not (because sometimes lead time so huge for ordering to receiving product). In addition, small business units can make understand the opportunity of their automotive products mostly for spare parts. A huge localization opportunity can be revealed based on the results of the study.

Integration of Bop marketing concept modality is important to benefit the business units along creating positive impact to social, environmental and economical.

1.6 Model development

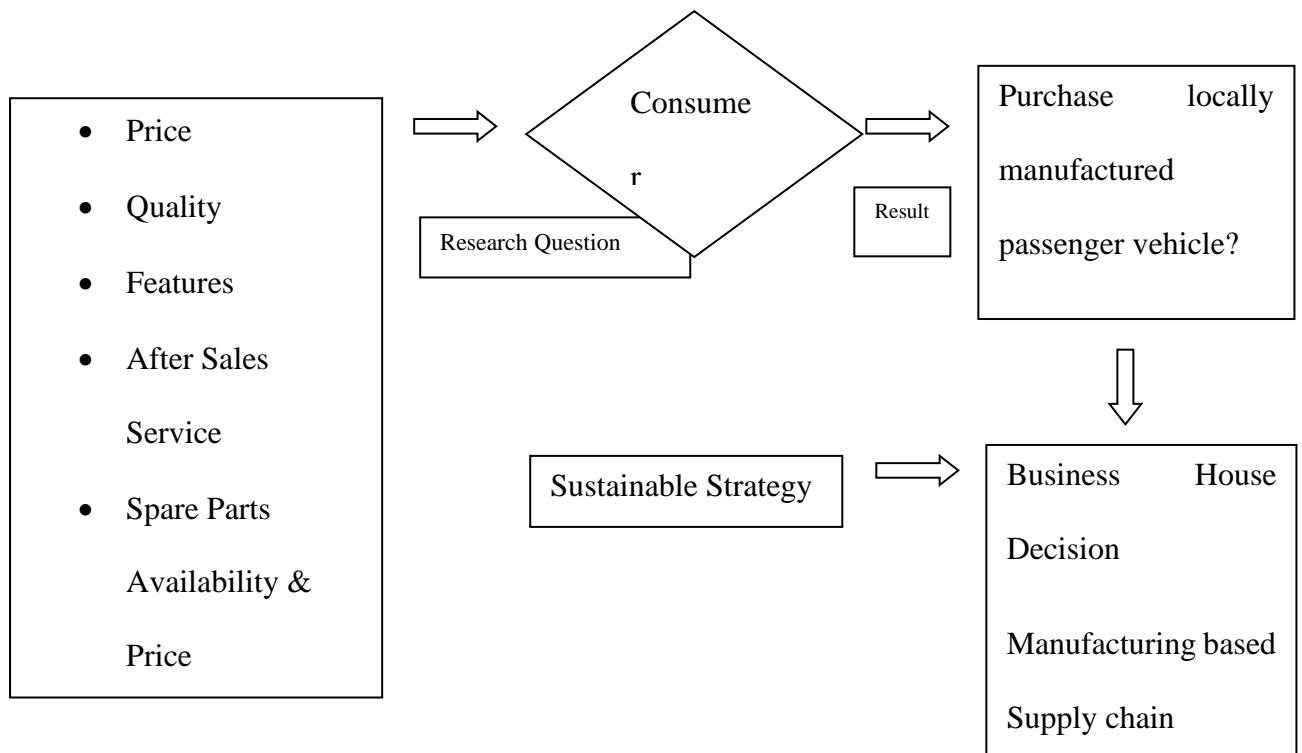


Figure 2: Model Development

1.6 Hypothesis Statements:

H1: "Price is significantly a factor for purchasing Locally Manufactured PV.

H2: "Quality is significantly a factor for purchasing Locally Manufactured PV.

H3: "Feature is significantly a factor for purchasing Locally Manufactured PV.

H4: "Spare Parts Availability & Price is significantly a factor for purchasing Locally Manufactured PV.

H5: "After Sales Service is significantly a factor for purchasing Locally Manufactured PV.

Chapter 2

History of Automobile Industry

2.1 Beginning of the Industry: Europe Domination

The automotive industry encompasses a wide range of companies and organizations that are involved in the strategy, planning, design, supply chain, manufacturing, marketing, development, selling, and service of motor vehicles. By revenue, it is among the greatest industries in the world. Additionally, it is the sector where investment on R&D is the highest.

In 1769 Nicolas Joseph Cugnot constructed the first vehicle which was used for French military and the vehicle was steam drive and three wheeled. The vehicles mileage was 2.5 mph. Where in 1885 Karl Fredrich Benz invented first Automobile vehicle with gasoline driven internal combustion engine. The patent number was 37435.

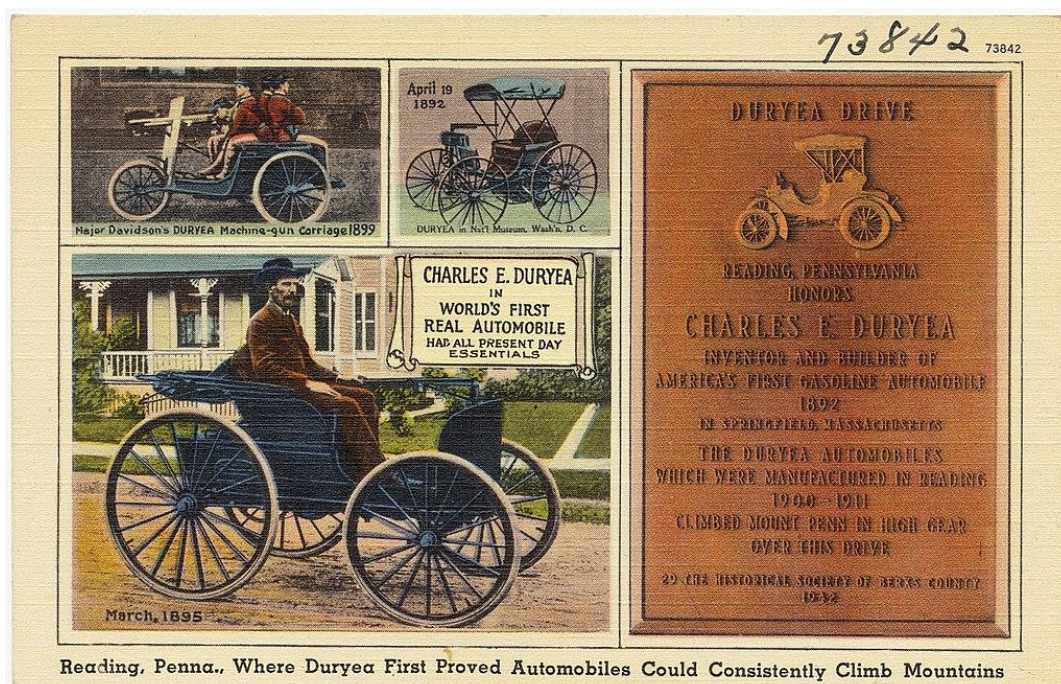


Figure 3: First automotive manufacturer



Figure 4: First automotive passenger vehicle

The Duryea Motor Wagon Company was the nation's first automobile manufacturer which was established in 1893 by brothers Charles and Frank Duryea. After commercial production, Duryea company sold thirteen cars by the year end of 1896. The first ten vehicles was sold in united stated of America and two vehicles was sold in London. In figure 4 the first automobile has been showed.

Ransom E. Olds used the assembly-line process in 1901 to create the renowned Oldsmobile, which Henry Ford incorporate to popularize Oldsmobile. Oldsmobile was the top selling car in the year of 1903. Manufacturing with moving assembly line used by Ford at first, whereas Oldsmobile used the static assembly line. This created a magic regarding fast manufacturing of the product. Because the time needed for manufacturing a car in an older facility without moving assembly line is very time and labor consuming. Whereas the moving assembly line manufacturing is Time and labor efficient.

Firstly, Ford Model T get introduced into the production line in 1908, bringing the era of the mass-produced automobile. Ford began to be associated with a consecutive production chain and the resulting mass production. The model changed the automotive industry. The Ford Model T was first considered to be the most economical car for US middle income citizens.

Ford Model T was successful because not only for its economical reason on purchasing, it has also inexpensive transportation operating cost and it's a symbol of rising middle class of US citizens in that time. To extend the age of US modernization.

90% of automobiles sold in 1919 had open tops. By 1929, 90 percent were shut. While the 1930s saw declining deals, it was likewise a period of pragmatic developments: a rear boot, closed bodies, and integrated fenders Indiana produced the first automobile powered by diesel in 1930.

Ninety percent of automobiles sold in 1919 had open tops. After that by 1929 Ninety percent were closed. Integrated fenders, closed bodywork, and a rear boot were among of the useful advances made during the 1930s, which also witnessed diminishing sales. In 1930, Indiana produced the first automobile with a diesel engine.

The European vehicle industry flourished following World War II. In figure 5, family-friendly vehicles of Europe like the model Consul (Ford) , Minor (Morris), and P4 (Rover) is shown. In the meanwhile, in Italy, the 250 series (Ferrari) was being the brand's most popular model. The Fiat 500 and Beetle (Volkswagen) saw tremendous success as compact automobiles. The Mini first hit the market in 1959. Volkswagen and Fiat 500 shown in Figure 6.



Figure 5: Ford Consul, Morris Minor and RoverP4.



Figure 6: Fiat 500 and Volkswagen Beetle

2.2 First Industrial Robot in Automotive: Unimate

The first industrial robot was employed in the manufacture of cars in 1961. George Devol and Joseph Engelberger, two innovators, had come up with it five years earlier and given the name Unimate. It was acquired by General Motors and put to use for die-casting operations. General Motors, which is the most automated automobile facility in the world on this side of the Atlantic, had a significant advantage over its rivals. The robots were able to produce 110 automobiles per hour, which was more than twice as fast as any other automotive plant at the time. GM revolutionized the auto business with the aid of the Unimate which is presented in figure 7. The Europeans quickly followed suit, installing Unimate robotic arms at firms like BMW, Volvo, Mercedes Benz, British Leyland, and Fiat to carry out tasks that were unpleasant and risky for humans.

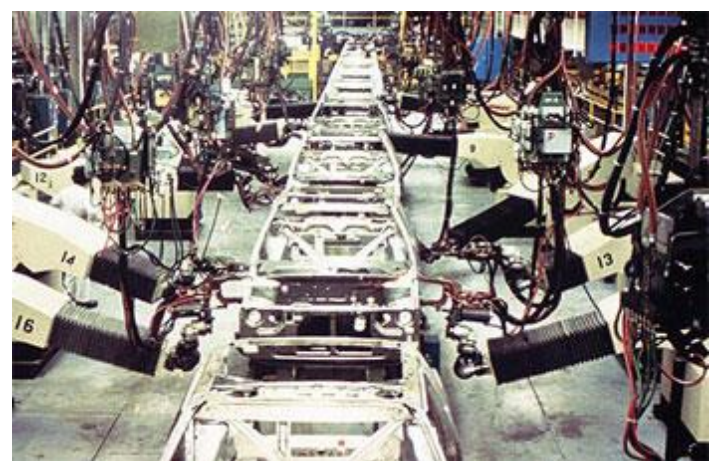


Figure 7: Unimate in Passenger Vehicle Production

2.3 1973 Oil Crisis : Beginning of Japan

Japan has developed into a prominent force in the automotive sector. One of the first Japanese sports car 240Z (Datsun) to succeed outside in 1969. To extend, in the year of 1973 oil crisis, the US market became stagnant, which paves the way for rising Asian giant Toyota and Nissan. BMW, a German automaker, was also favored. The huge American and Italian models were replaced by the affordable, dependable vehicles produced by these firms.

2.4 First Hybrid Car

The Toyota Prius was the first hybrid car to be mass-produced in 1997. Two years later, Honda released the Insight as a follow-up. Over a million hybrid vehicles had been sold by 2007. That amount has twice magnified by 2009. Additionally, more automobiles have switched to diesel fuel.

2.5 First Electric Vehicle (EV)

Tesla Motors began production in 2008 with the Roadster, the first generation. And Tesla made the Electric vehicle popular in automobile industry.

Chapter 3

Manufacturing Process of automotive passenger vehicle:

In Figure 8 The main Process of Automobile has been presented in block diagram

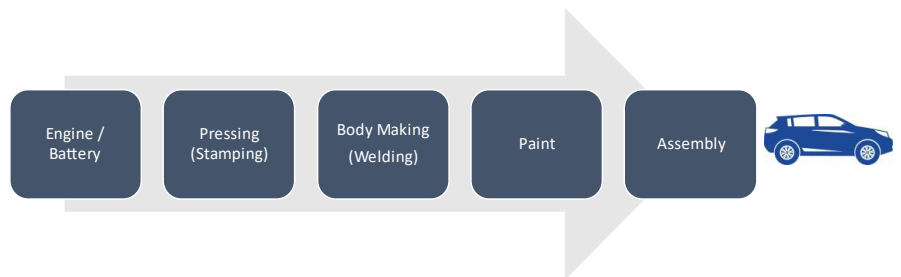


Figure 8: Process flow of automotive manufacturing in brief

Manufacturing Process Flow

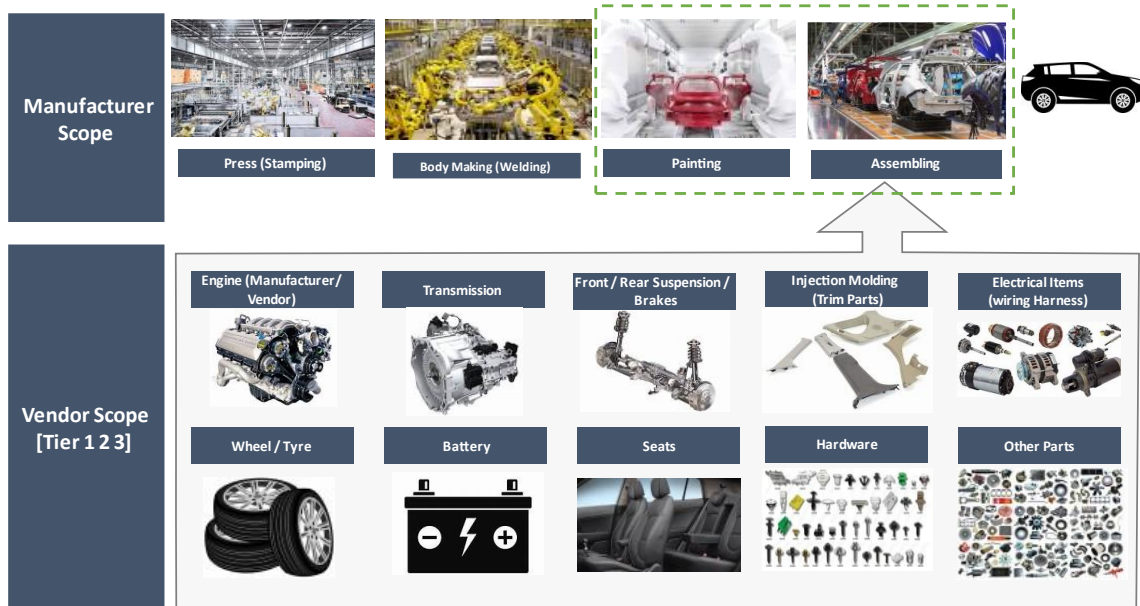


Figure 9: Process flow of automotive manufacturing in broad

In Figure 9, the automobile process flow has been shown with real pictures of stamping, Body making and assembling. In addition the assembly parts like engine, transmission, suspension, body parts, electric items, wheels, tires, battery, seats and other parts also shown.

3.1 Pressing:

The blanks are first cut from steel coils using a coiling equipment. These base sheets are bordered and could be partially pre-punched depending on the requirements. Oils and greases

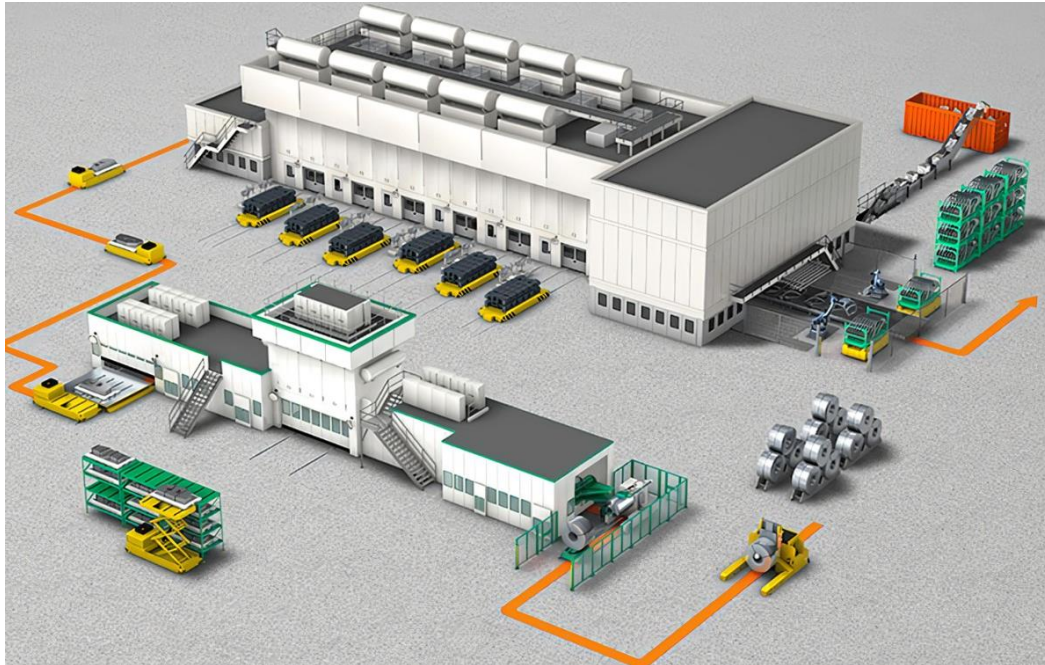


Figure 10: automotive manufacturing facility

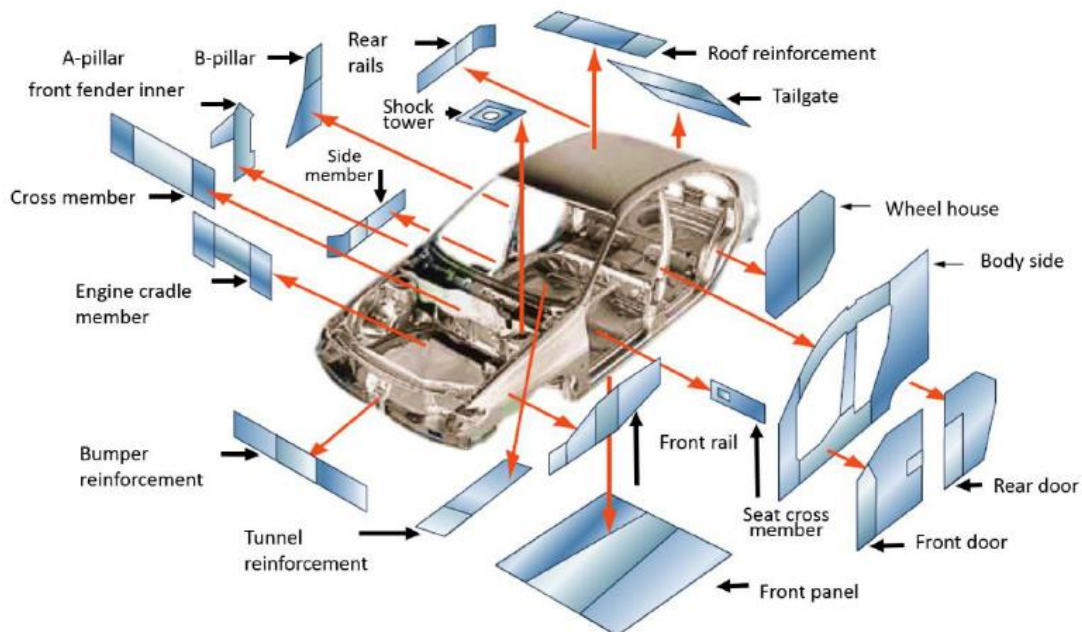


Figure 11: Passenger vehicle body parts

are applied to the sheet multiple times during the process to lubricate it. or use in pressing and punching operations on metal. If the elastic limit of the material is surpassed, cracks will form in the sheet metal. With multi-stage formation, this is prevented. Presses are connected one to another. The press line refers to this network of presses. The hydraulics, lubrication, and compressed air supply to the presses and grippers are crucial elements of a pressing plant. With a scrap press, the debris produced by the pressing and punching process is treated for recycling [7,10].

3.2 Body Shop:

A crucial component of manufacturing, particularly in the auto sector, is welding. Over the lifetime span of vehicle, its parts must resist a tremendous amount of wear and tear. To produce a reliable, long-lasting component, the procedure uses pressure and heat. Resistance welding, TIG welding, arc welding, , spot welding, MIG welding and other procedures fall within the category of welding.

TIG welding is a technique used to create intricate items, such bicycle frames. This is a slower weld because of the process' intricacy. Nonetheless, the extra time is required to produce a product that is accurate.

The greatest applications for metal inert gas (MIG) welding are those that call for simplicity and speed. A wire is supplied in the direction of the heated tip to form the weld.

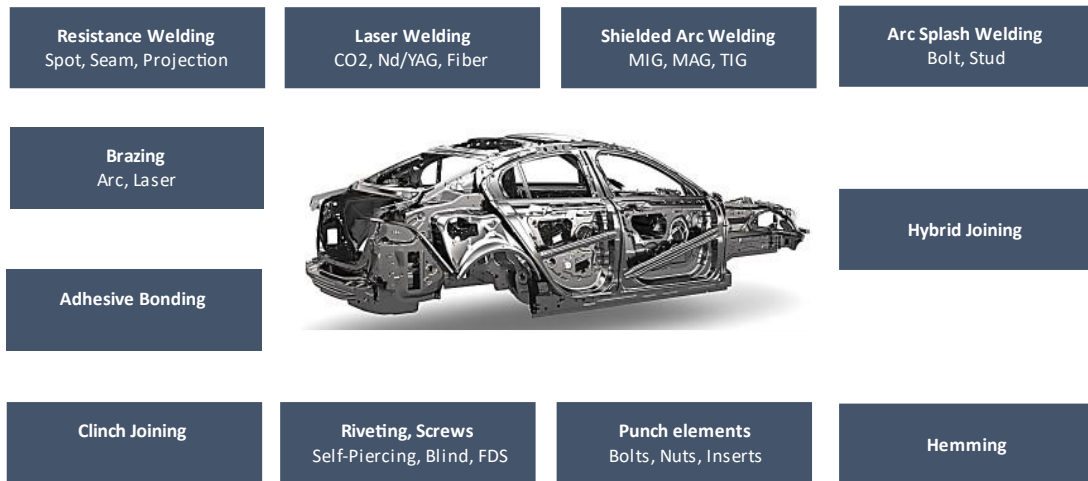


Figure 12: Passenger vehicle body making.

In the automotive industry, laser welding is frequently employed for high-volume, high-accuracy applications. Both microwelds and massive industrial equipment are welded using this adaptable technique. The market is anticipated to expand over the following four years due to this and other factors.



Figure 13: Passenger vehicle body welding through robots in body shop.

TIG welding is a successful procedure for thin workpieces and specialized metals in the automobile industry due to its precise and controlled application.

Special thin-walled pipe, small diameter pipes and tubes, as well as other precise, dependable components can be produced by TIG welding machines. Moreover, TIG welding offers possibilities for filler metal to create incredibly robust welds that won't corrode or split over time.

In the automobile sector, MIG welding can produce thicker metals in greater quantities. MIG welding is the best technique for assembling the body and interior parts of automobiles in the automotive sector. Even a range of thin and thick metals can be successfully welded using this method. Due to its high strength, light weight, resistance to corrosion, recyclable nature, and thermal and electrical conductivity aluminum is considered best for MIG welding and is being utilized more frequently in automotive applications. In comparison to other welding techniques, improvements in MIG welding brings more stability, durability, and productivity at a lower cost in the process[10].

3.3 Paint Shop:

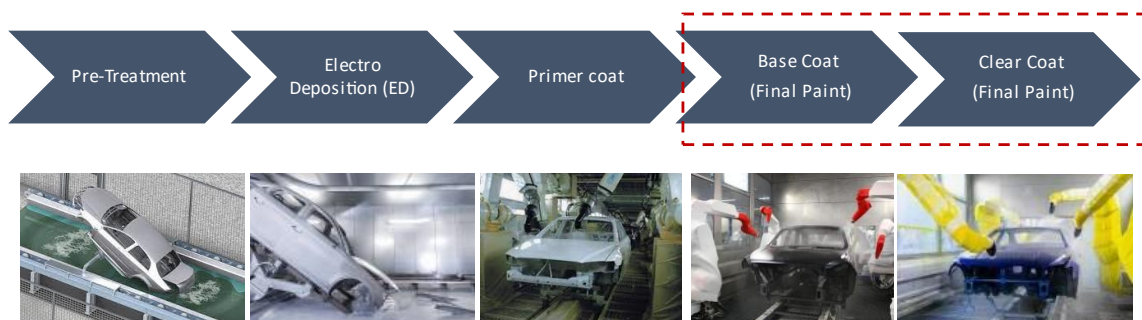


Figure 14: Paint Shop process flow.

3.3.1 Pretreatment:

The final structure was created by welding the sheet metal parts of an automobile's body which is known as BIW (body-in-white). Pretreatment is the 1st step in the process of preparing the

Body in white for the following coating. Using three basic liquid sink processes called degreasing, phosphating and conditioning, pretreatment entails washing and cleaning the body surface to get rid of any leftover oils which is waste of welding residues and stamping process [7]. It is also possible to perform a further preparatory cleaning using hot water with a pH of 9. The primer will adhere better to the metal with pretreatment. An inert coating of metal phosphate is applied during phosphate treatment to provide resistance to the propagation of corrosion. Surfactants and Alkaline salts such as sodium carbonate, caustic soda, and trisodium phosphate made up the degreasing solution. Surfactants, which are detergents, are used on the BIW to emulsify oils and lubricants. The KOD spray (knock-off-degrease spray) stage and the dip sequence are two of the usual sequences that make up the degreasing zone. The benefit of using these two is that the high-pressure spray will remove a sizable percentage of the oil and grime [7,8].

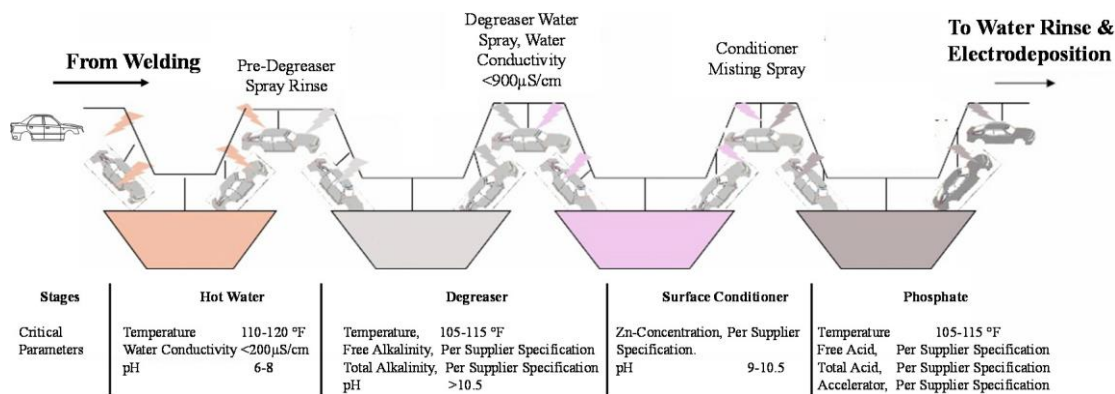


Figure 15: Pretreatment

The subsequent process, Activation which is known as surface conditioning, produces the nucleation sites needed for the formation of phosphate crystals. Crystallization nuclei that form on the metal surface rises, which improves the bonding processes for the ensuing phosphate sequence. An aqueous dispersion of titanium orthophosphate with a pH range of 8–10 is generally applied for conditioning. Ultimately nitrate ions, phosphate ions, zinc, phosphoric acid, other divalent metal ions and hydrogen ions accelerating chemical make up liquid dip

phosphate solution. Free acid corrodes the steel surface, releasing hydrogen. In the meanwhile metal phosphate ions precipitate as crystalline particles onto the surface. When phosphating, the main aim is to leave a dense, thin and uniform conversion layer on the cleansed surface[8].

3.3.2 Electrodeposition (ED) :

Automobiles have coatings applied to the metal frames and underbody to stop corrosion, but not to other surfaces like the roof. Priming of the structural metals are done before further coatings are applied when they are not coated to avoid corrosion.

The main coating used in contemporary cars to stop corrosion is a electrodeposition solution named SCGA with a formation of 90% Zn plus 10% Fe composition which is named as GA material. It augments spot welding execution and limits ED gas pin (paint quality deficiencies) contrasted with the SGC arrangement, i.e., GI material with 100 percent Zn during electrodeposition; However, the SGC method is still used in Europe. In prior many years, the SCGM consumption assurance innovation was utilized, and it decreased the requirement for an ED gas pin. However, its cost was higher than that of the GA material coating.

The electrodeposition coat, often known as the E-coat, was initially introduced in the 1960s and protects against rust and corrosion. Since then, E-coat usage has rapidly increased. 10% of all automobiles had electrocoating by 1970, and 90% had it by 1990. It is currently the most widely utilized coating method in the automobile industry.

Since it was initially launched, the E-coat process has expanded quickly and seen significant development. The anodic E-coat technique was utilized between 1964 to 1972, and the cathodic E-coat has been conducted since 1976. At this time, there have also been changes in the E-coat film's thickness. Thicknesses began at 25 m and stayed there until 1976, When the cathodic process was implemented in 1976, a thickness of 18 m was introduced. It remained at this worth until 1984, when the film thickness was expanded to 35 m. Thicknesses at first began at 25 m

and stayed that way until that time. Until 1992, when E-coat film thicknesses were diminished to their current degree of 20 m [5,] this nearly thick film was being used.

A combination of resin, binder, a paste containing the colors, and a solvent make up the E-coat composition. Metal components are positively charged during anodic electrodeposition, whereas the paint is negatively charged. Anodic coatings provide good color and gloss control and are hence typically utilized for interiors. The metal part in cathodic electrodeposition is negatively charged, while the paint is positively charged. When compared to the anodic process, the amount of iron that can enter the paint film is lower during the cathodic process. Due to their superior performance and resistance to corrosion, cathodic coatings have largely replaced anodic coatings in North America. The E-coat method is thought to be environmentally friendly because it only requires a 0.5% solvent solution [8,9].

The balance of acidic and caustic components in the ED tank is determined by the pH of the solvent in the tank. The neutralizing agents and functional groups in the resin dominate the equilibrium. More voltage must be used with the risk of rupture consequences because a lower pH in the cathodic ED tank reduces film thickness. The pretreatment chemicals have the potential to adversely affect pH. Conductivity and pH will drift out of specification in this

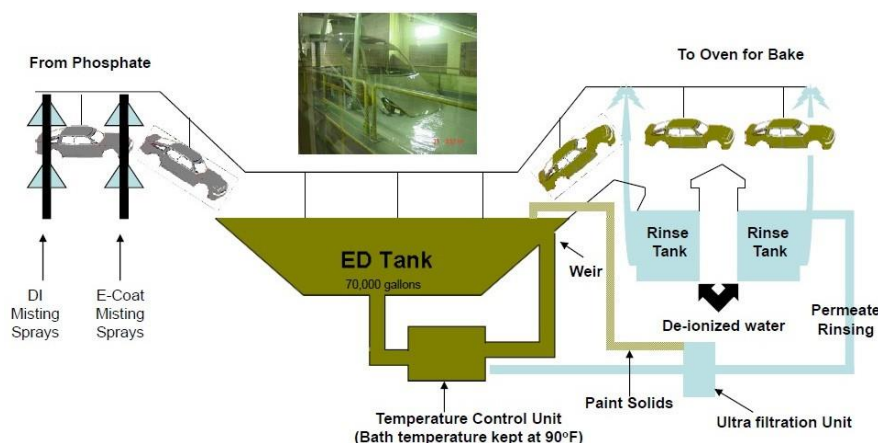


Figure 16: Electrodeposition

situation, and corrections must be performed by resupply ultrafiltrate with deionized water (D.I.) water[8,9].

E-coating involves dipping car bodies in a coating solution, as seen in Figure 5, and then running an electric current through the body and the liquid ED paint solution. An even coating thickness is created by encouraging the ED paint to adhere to the metal substrate. The end product is an insoluble, deposited coating that adheres firmly to the prepared body and has a very high solids content.

During use, the electrodeposition tank is fed with a mixture of binder, resin and pigments comprising of a paste. An electric current is applied in the solution of tank of 80%–90% deionized water and 10%–20% paint solids is lowered onto the car body (consisting of resin, binder, and pigment). The deionized water serves as a vehicle for the constantly stirring paint solids. The resin serves as the structural foundation of the finished paint layer and offers corrosion resistance, toughness, and longevity. Color and shine are provided by pigments. Purging the paint and managing voltage are crucial for regulating paint performance during cathodic E-coating.

The deposition process is slowed as the coating's thickness increases due to how insulating it gets. To keep a smooth surface as a vehicle body leaves the tank, paint solids that stick to the surface yet are not connected to it are washed off and recuperated as ED solids utilizing a ultrafiltration unit.

After finishing the E-coat, the car body is placed in a bake oven, where it is heated to 160 degrees Celsius for 10 minutes to enhance film curing and maximize performance attributes. Corrosion prevention is less impacted by heating duration and oven temperature than film adhesion to the body and chip resistance. Before the body moves on to the next application

stage, some surface sanding is typically done to remove or eliminate imperfections since it affects the brilliance and glossiness and of the topcoat[7,8,9].

3.3.3 Rust-Proof Materials: Sealer/ PVC:

The final phase involves applying PVC to seal seams and coat the underbody. The lower entryway parts and rocker board spots where PVC are set as an enemy of chipping security, In addition to a cross-section of this layer in relation to the other coatings on the parts of the body. A delicate tip preparing coat is ordinarily likewise applied in this third stage to increment chip obstruction. This layer is applied to the front of the hood, a vulnerable area to chipping shock, using a high-elastic resin between the ED and primer coatings.

In the third phase, a somewhat flat black pigment known as a blackout coating is applied to the radiator supports, wheel housing, and underneath of the body[8].

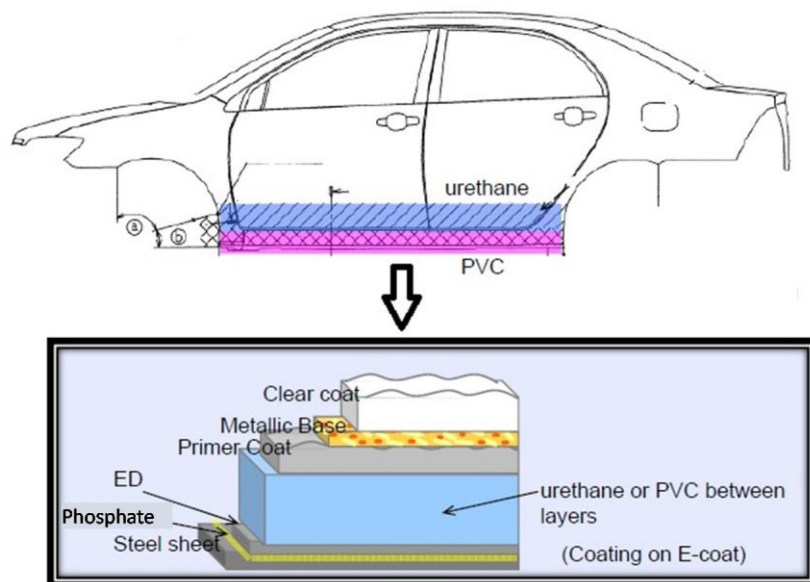


Figure 17: The anti-chipping material coating on lower doors and rocker panels.

3.3.4 Priming:

Priming is the fourth coating phase. It could be powdered, solvent-borne, or water-borne. Little scratches and defects that may have been made during earlier procedures or by the intermediary sanding or grinding that was used to remove small impurities are filled and rectified by the primer. As a result, the primer increases paint endurance. It likewise offers extra security against consumption and amplifies attachment among it and the E-coat and basecoat. At an automobile assembly factory, primer coating activities are typically carried out in three stages: inside coating, exterior coating, and cutting in an oven. The inside coating of the doors, engine compartment, and baggage or trunk space is applied manually using spray painting. The basecoat is not sprayed on all the surfaces. To effectively transmit the basecoat's color, it is crucial that the primer's hue match.

3.3.5 Base Coat:

The basecoat, which is a component of the topcoat, is the 3rd layer to be applied to the car, consequent to the primer and before the clearcoat. There are currently over 40,000 recognized base coat colors, and each year, 1000 new colors are added to this list, giving the car its color.

Aluminum flakes, micas, and other kinds of light-interfering materials are examples of effect pigments. The lightness of the coating and its ability to distinguish between a gray, white or black scale depend on the angle of observation when using aluminum flake effect pigments; this phenomenon is known as lightness flip. Mica effect pigments have an effect known as a "color flop" where the hue, or color classification, changes depending on the viewing angle. Chroma or color saturation, or the degree of intensity and richness of the color, can be altered by varying a pigment's concentration. Hence, to create an infinite number of automotive

finishes with distinctive and distinctive values, colors, and chroma using a variety of pigments and effect materials is possible [8,9].

Automobile basecoats come in three varieties: solvent-borne medium solids (MS), water-borne, solvent-borne high solids (HS). The MS basecoats have a spray viscosity of 100 mPa.s at 1000 rpm and a solid content of 15%–20%. In order to comply with the EPA's recommendation that solvent-borne spray paints have higher solid levels and lower amounts of organic solvents in order to reduce VOC emissions, the basecoat HS were created from basecoat MS. As per their advantages for the environment, waterborne basecoats have replaced traditional basecoats in the U.S. vehicle production business since 2000[9].

3.3.6 Clear Coat:

The overall finish of an automobile is given longevity, resistance to environmental etching, and scratch resistance by the clearcoat, which is the final coating applied. It gives a gleam and profundity that could not in any case be as dynamic and prepares for harm like blurring welcomed on by UV beams from the sun. Additionally, the clearcoat makes maintenance and repairs simpler.

Environmental etch is a cosmetic problem brought on by the development of indelible water spots or irremovable bird droppings, tree resin, or other chemical stains on the surface of an automobile. Etching causes a loss of material as well as deformation of the clearcoat surface, which results in physical damage.

Automotive clearcoats are created with a combination of UVA (ultraviolet light absorbers) and HALS (hindered amine light stabilizer) compounds to provide them UV endurance. These substances' main purposes are to absorb UV light with a wavelength between 290 and 400 nm and to inhibit UV-induced breakdown of the polymeric backbone (via HALS). After four years of sun exposure, it has been observed that the concentration of UVAs in clearcoats drops by

roughly 50%; this depletion is due to photochemical breakdown and subsequent diffusion from the clearcoat. Free radicals produced on the coating's surface, where the UVAs are unable to adequately protect the polymer, or inside the coating at wavelengths where the UVAs are ineffective, the HALS enhances the UVAs' activity.

Because of their exceptional performance for automotive coating and well-understood and perfected application processes and chemistry, liquid clearcoats are the most widely used type in the world. According to various market demands or client specifications, the chemical makeup of liquid clearcoats varies significantly. [8,9,10].

The most widely used paint in the automotive industry is 1K acrylic melamine clearcoat due to its favorable cost-to-performance ratio. Ac and amino cross-linking agents (MF, melamine resins) are typically used as its foundation. Both carbamate melamine and acrylic melamine silane, two types of clearcoat, are more resistant to etching and scratching. The 1K and 2K epoxy corrosive clearcoats are among the most broadly utilized clearcoats as far as corrosive engraving opposition, while both 1K and 2K polyurethane clearcoats give an exceptional equilibrium of engraving and scratch obstruction. When produced as a 1K system, epoxy acid clearcoats, on the other hand, have a shelf life that is somewhat short.

In the automobile sector, waterborne clear coat was initially introduced in 1990 and is based on polyester acrylate that has been cross-linked with melamine resins and isocyanate. Due to their advantages for the environment, such as the lack of VOC emissions during application, powder clearcoats are becoming more and more common in the automotive sector.

Some more advantages of powder coatings : There is no wastewater or paint dirt produced during their process of application; there is nothing to clean application equipment or the spray booth with organic solvents; there is a reduction in the amount of energy used during application process because the air injected to the spray chamber can be recycled.

3.4 Assembly Line :

The powertrain, sometimes referred to as the **engine and gearbox** combination, serves as the drive unit's brain. The foundry produces the fundamental parts, such as the crankcase, cylinder head, or gearbox housing. After that, these components undergo mechanical processing to be finalized. Gear wheels and shafts are treated in a number of ways before being combined into gearboxes. Crankshafts, camshafts, connecting rods, and several other parts and sub-assemblies come together to form powerful gasoline, diesel, or hybrid drives in the engine manufacturing process. In this situation, sensors can assist the operator in ensuring the consistently high quality standards in serial production thanks to their high standards of repeatability and switch point stability.

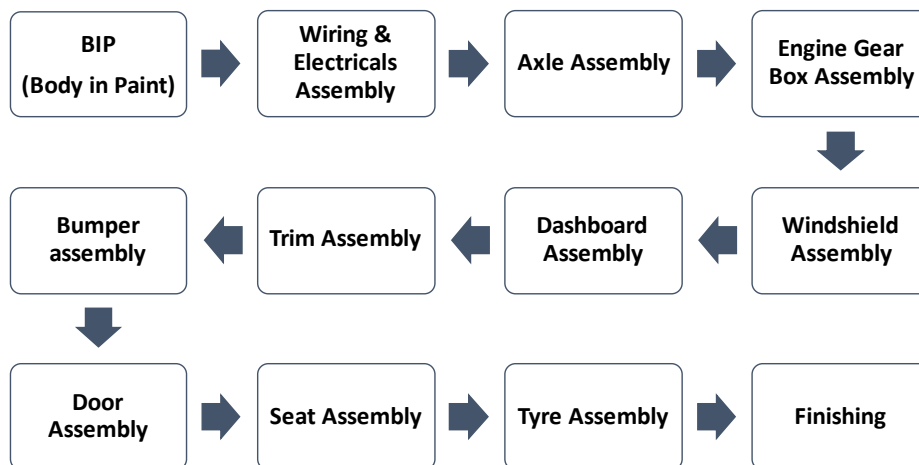


Figure 18: Assembly process flow

Grinding camshafts: For the quality of the shafts, the surface quality created here is crucial. The grinding emulsion needs to be applied continuously to ensure quality. The crankshafts are coded with data like production dates and batch information to ensure traceability. The code reader then reads this data and verifies it[9,10].



Figure 19: Assembly process pictorial

Chapter 4

Base of Pyramid: Marketing and Supply chain strategy

The techniques that organizations use to market and arrive at the BOP segment in contrast with the populace at the highest point of the pyramid are separate. There will be significant differences between the marketing strategies used elsewhere and those used to target areas with a high concentration of BOP customers. To Exemplify, One procedure utilized by Unilever zeroed in on a pricing. They were able to implement this strategy by reducing the quantity of a product they offer in order to offer it at a price that was affordable. Unilever made cleanser sheets that they could propose at a less expensive cost yet at the same time give a quality item to the shopper. Offering a price pack is another pricing strategy. A cost pack is when products of an item are pressed together at a more reasonable cost. One example of a product that BOP customers can purchase at a low price is the triple-pack of Pepsodent toothbrushes [14].

The Bottom of the pyramid alludes to the low-income population almost 66% of the population on the planet. The socioeconomic market at the bottom part of the pyramid (BOP) is very high in Bangladesh. Albeit this market is at the low-pay level, the market can possibly carry benefit to organizations and is viewed as the worldwide rising class. This neglected requirement of this market is an illustration of the fortune at the lower part of the pyramid idea. The market includes 80% of the world's functioning population with an all-out family pay of almost \$7 trillion.

It is vital to take note of that organizations entering BoP markets might encounter interesting supply chain difficulties (and open doors) and may consequently require explicit development methodologies to apply their plan of action inside these business sectors. Further investigation of how businesses manage their procurement, production, distribution, and sales in BoP markets and how they deal with the supply chain challenges identified. It will be beneficial to conduct in-depth investigations that concentrate on particular functions of the supply chain or specific industries.

At last, we accept that future exploration ought to look at the supply network designs of firms in different BoP markets to comprehend the effects of various LCs inside various BoP markets.

Chapter 5

Conceptual Framework: Hypothesis & Research Question

5.1 Hypothesis:

Hypothesis is an essential content of a research paper. The prime purpose of writing a hypothesis of the research paper is to predict the thesis's data, findings and conclusion. The hypothesis of the thesis is Passenger vehicle customers will purchase locally manufactured passenger vehicle in comparison to imported CBU. Here in the hypothesis, there are two variables such as independent variable and dependent variable. Less price locally manufactured passenger vehicle is independent variable. Whereas Purchasing of customer is dependent variable. In questionnaire segment A, the result of hypothesis will be determined.

5.2 Research Question:

In questionnaire segment B another research question is asked to the respondents to identify which factors contribution is important to strengthen the hypothesis. In questionnaire segment B the answers comprised of six factors which is price, quality, features, after sales service spare parts availability and cost, Warranty. In addition, question 3,4 and 7 are the questions based on sustainability like, for sustainability which factor is significant, question regarding reverse logistics, closed loop supply chain and base of pyramid.

Chapter 6

Research Method

6.1 Research Design:

The Research has been designed based on two questionnaire segments of A & B. Questionnaire segment A consists of twelve questions, which is a tool of proofing the hypothesis right or wrong. A calculative approach is In Questionnaire segment B, factors which contributed most to the hypothesis is questioned. Focusing on primary research method, the questionnaire is formed in Microsoft word and escalated to 100 respondents. And questions answer is taken visiting the respondents due to complexity of the topic and nicheness of the concern product. As the passenger vehicle market is a niche market, there is an importance of demographic significance like: User of passenger vehicle and income pattern etc.

6.2 Measurement:

For hypothesis feasibility measurement, questionnaire segment of A consists of 5-point Likert scales. Each scale item includes 5 response categories starting from numeral 1 which is verbally presented as “strongly disagree” and at the numeral 5 is “strongly agree”. In addition, other items such as numeral 3 verbally presents “neutral” whereas, numeral 2 represents “agree” and numeral 4 shows “disagree” perception of the respondents. Strongly disagree depicts a negative judgment towards the hypothesis whereas, strongly agree depicts strong judgments towards the statement. Neutral item shows neither disagree nor agree, often presents indecisiveness also. RQSA (Result of questionnaire segment A) is Calculative approach taken by summing up the response number of an respondents which will depict the result as a whole.

6.3 Data analysis & feasibility of research parameters:

For checking feasibility of research data Missing data analysis, Normality test, KMO and Bartlett's test, Total variance and Scree plot analysis has been observed. Based on the result of tests the parameters of the research such as answers and calculative approach proved to be feasible for the research and result.

6.4 Sampling:

As explained earlier, survey questions have been conducted through a questionnaire segments. consists of Demographic questions, Segment A and Segment B. In most cases, printed questionnaire and personal interview are taken to gather responses from the respondents. Because the prime topic of the research is regarding passenger vehicle which is used by a niche population. So, respondents' selection is very important to receive the best answers. To exemplify, a mass population is a user of mobile phone but not user of passenger. vehicle. So, It is important that the respondents should have idea regarding the passenger vehicle using. and must have the affordability of buying passenger vehicle.

Chapter 7

Analysis

7.1 Demographic Analysis:

Demographic Analysis is the study of a population, socioeconomic factors and their characteristics. In Demographic analysis in total five questions asked regarding sex, age, passenger vehicle user type (whether they are brand new PV user or Recondition/2nd hand PV user), automobile brand they uses and income range. Frequency analysis of the demographic characteristics of the respondents is shown in the Table 1. Among 100 respondents all of the respondents answered all of the questions.

In Figure: 20, by Infographic it shows the number of respondents in accordance with the gender, brand new buyer, age group, Automobile brands and income range. Almost all the automobile brands reflected in the survey, Age group considered 18-25, 26-30, 31-40, 41-50, 51-60 and 60 above. Income range calculated as per six segmentations.

It is resulted that among 100 respondents 79 are male and 21 are female. There are several age ranges in questions and according to respondents 41-50 years of age range is the highest which is 34% and second highest is the more than 60 years which is 29%. In addition, 80% of total respondents are recondition or secondhand passenger vehicle user. To Extend, most of the respondents has Toyota passenger vehicle which is the most popular brand in Bangladesh. 62% of total respondents use Toyota branded passenger vehicles. Brand Nissan is the second highest whereas Honda and Mitsubishi share the same market share of the respondents. In addition, most of the respondent income range is smart and above 1,00,000 lacs.

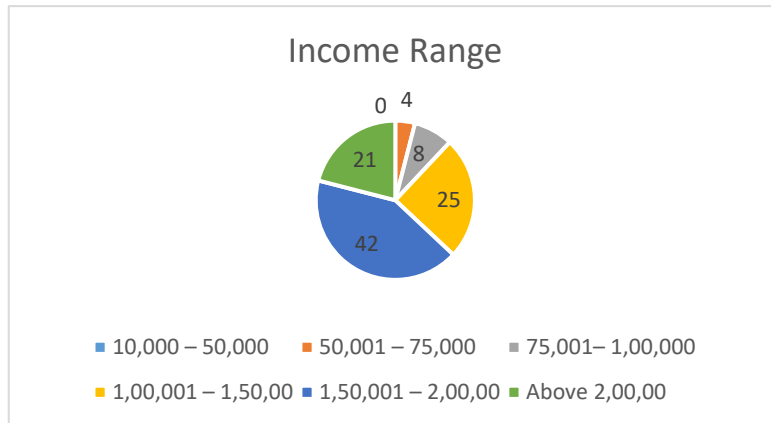
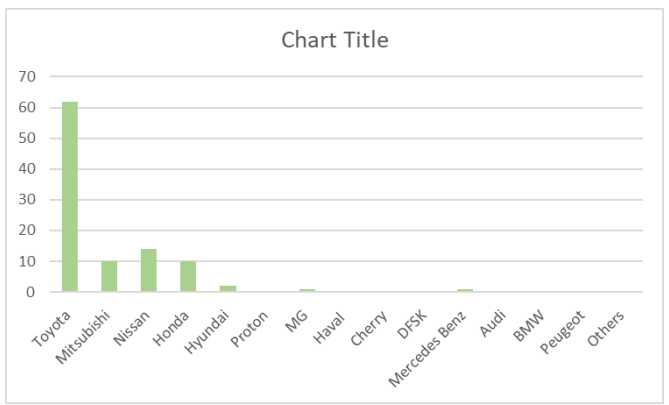
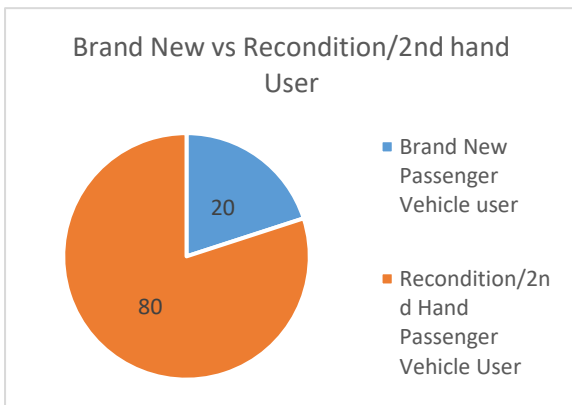
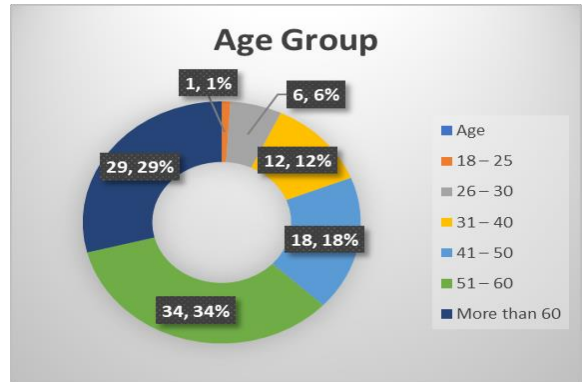
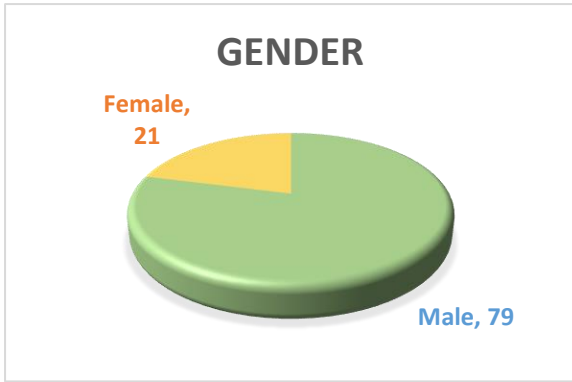


Figure 20 : Demographic data (Gender, Age Group, Brand New vs Recondition User, Income range)

7.2 Missing value Analysis:

Here in Table 3 it is shown that there is zero missing data that means every respondents actually inputted all the data.

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
RQSA	100	100.0%	0	0.0%	100	100.0%

Table 3 : Missing Value Analysis-SPSS Output

7.3 Descriptive Analysis:

Descriptive analysis is shown in table 4. Here mean value, confidence interval of mean, median, variance, std. deviation, range is shown. And most importantly Skewness and kurtosis is almost near to zero, which is good.

		Statistic	Std. Error
RQSA	Mean	25.10	.248
	95% Confidence Interval for Mean	Lower Bound 24.61	
		Upper Bound 25.59	
	5% Trimmed Mean	25.13	
	Median	25.00	
	Variance	6.152	
	Std. Deviation	2.480	
	Minimum	19	
	Maximum	30	
	Range	11	
	Interquartile Range	4	
	Skewness	-.141	.241
	Kurtosis	-.443	.478

Table 4 : Descriptive Data-SPSS Output

7.4 Normality test Analysis:

In Test of Normality, we tested whether the data is normally distributed or not. There are two tests which are Kolmogorov-Smirnov and Shapiro-Wilk test. In both test the result was more than 0.05 and which is for Kolmogorov-Smirnov is 0.79 and for Shapiro-Wilk test is 0.108, presented in table 5. Resulting, the data doesn't violate normality assumptions and the data are normally distributed and non-significant.

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
RQSA	.084	100	.079	.979	100	.108

a. Lilliefors Significance Correction

Table 5 : Normality Test-SPSS output

The histogram and Normal Q-Q plot is also given in Figure .. and ... In that histogram we observed the data is normally distributed.

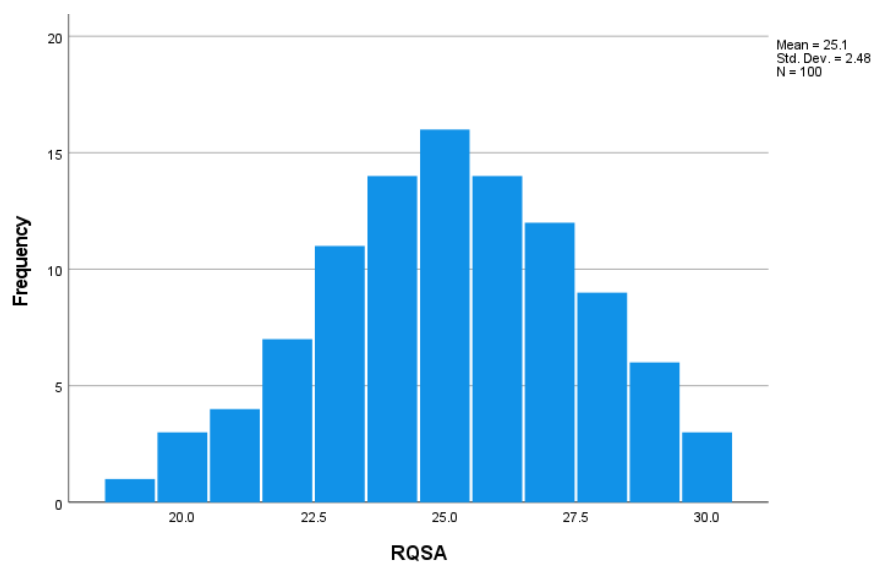


Figure 21: Histogram

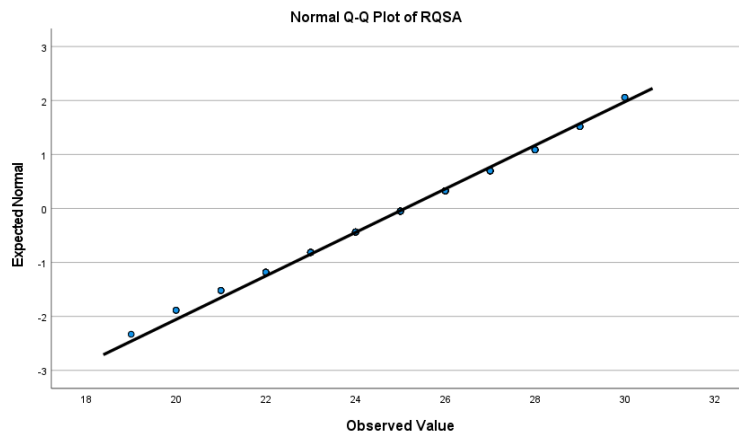


Figure 22: Q-Q Plot

7.5 KMO and Bartlett's Test:

The kaiser-Mayer-Olkin (KMO) index was 0.613, exceeding the recommended value of 0.6 (kaiser, 1970), Bartlett's Test of Sphericity (Bartlett's, 1954) reached statistical significance as $p = 0.002$ which is $p < 0.05$.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.613
Bartlett's Test of Sphericity	Approx. Chi-Square	35.124
	df	15
	Sig.	.002

Table 6 : KMO and Bartlett's Test-SPSS output

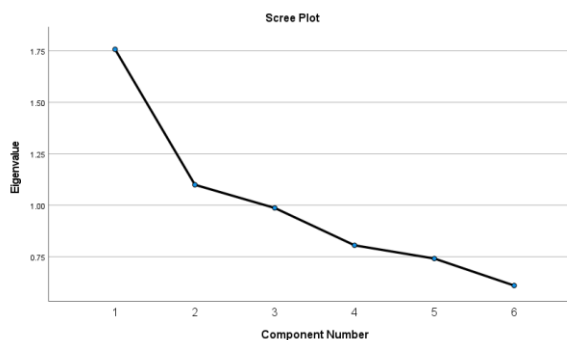


Figure 23: Scree Plot

7.6 Reliability analysis (Cronbach's Alpha) :

The internal consistency reliability is judged based on calculating Cronbach's alpha.

Cronbach alpha 0.7 or higher is acceptable. The Cronbach alpha result came as 0.745 which is in the acceptable range. In addition, Item statistics, Inter-item correlation matrix, Summary item Statistics, Item total statistics also shown in below tables.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.733	.745	12

Table 7 : Cronbachs Alpha reliability Test

Item Statistics			
	Mean	Std. Deviation	N
A1	4.61	.634	100
A2	4.45	.702	100
A3	3.58	.867	100
A4	4.29	.715	100
A5	4.24	.754	100
A6	3.93	.946	100
A7	4.60	.636	100
A8	4.35	.744	100
A9	3.82	1.077	100
A10	4.11	.863	100
A11	4.25	.809	100
A12	4.01	.904	100

Table 8 : Item Statistics

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
A1	1.000	.240	.067	.051	.219	.274	.787	.357	.148	.024	.212	.218
A2	.240	1.000	.081	.160	.118	.276	.204	.721	.162	.101	.174	.359
A3	.067	.081	1.000	.182	.140	.038	.132	.136	.687	.251	.022	.083
A4	.051	.160	.182	1.000	.132	.195	.036	.149	.160	.619	.240	.183
A5	.219	.118	.140	.132	1.000	.024	.223	.119	.253	.099	.613	.100
A6	.274	.276	.038	.195	.024	1.000	.272	.322	.097	.109	.129	.863
A7	.787	.204	.132	.036	.223	.272	1.000	.256	.100	.007	.138	.165
A8	.357	.721	.136	.149	.119	.322	.256	1.000	.016	.002	.139	.355
A9	.148	.162	.687	.160	.253	.097	.100	.016	1.000	.043	-.017	.054
A10	.024	.101	.251	.619	.099	.109	.007	.002	.043	1.000	-.098	.024
A11	.212	.174	.022	.240	.613	.129	.138	.139	-.017	-.098	1.000	.162
A12	.218	.359	.083	.183	.100	.863	.165	.355	.054	.024	.162	1.000

Table 9 : Inter Item Correlation Matrix

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	4.187	3.580	4.610	1.030	1.288	.097	12
Inter-Item Correlations	.196	-.098	.863	.961	-8.838	.037	12

Table 10 : Summary Item Correlation Matrix

7.7 Chi Square Fit Test:

H1: “Price is significantly a factor for purchasing Locally Manufactured PV.

A Chi Square test for independence with $\alpha = 0.05$ was used to assess whether Purchase of Locally manufactured PV is related to Price factor. The Chi-Square test was statistically significant, χ^2 (N=100) is 34.617, $p < 0.001$, significant with Phi coefficient of 0.588, indicating “**Price is significantly a factor for purchasing Locally Manufactured PV**” with higher concentration as Phi value is equal or above 0.5.

Locally Manufactured PV Purchase vs CBU Purchase * Price vs Other Factors Crosstabulation

			Price vs Other Factors		Total
			P	P N	
Locally Manufactur Purchase vs CBU Purchase	LM	Count	48	19	67
		Expected Count	34.2	32.8	67.0
Purchase	LM N	Count	3	30	33
		Expected Count	16.8	16.2	33.0
Total		Count	51	49	100
		Expected Count	51.0	49.0	100.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	34.617 ^a	1	<.001		
Continuity Correction ^b	32.159	1	<.001		
Likelihood Ratio	38.579	1	<.001		
Fisher's Exact Test				<.001	<.001
Linear-by-Linear Association	34.271	1	<.001		
N of Valid Cases	100				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.17.

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.588	.000
	Cramer's V	.588	.000
N of Valid Cases		100	

Table 11 : Chi Square Fit Test Results of H1

H2: “Quality is significantly a factor for purchasing Locally Manufactured PV.

A Chi Square test for independence with $\alpha = 0.05$ was used to assess whether Purchase of Locally manufactured PV is related to Quality factor. The Chi-Square test was statistically significant, χ^2 (N=100) is 52.48, $p < 0.001$, significant with Phi coefficient of - 0.654, indicating **Quality is adversely related to purchasing Locally Manufactured PV**. To extend, Consideration of quality is a prime factor for CBU purchase not for locally manufactured PV.

Locally Manufactured Purchase vs CBU Purchase * Quality vs Other Factors Crosstabulation

		Quality vs Other Factors		Total	
		Q	N Q		
Locally Manufactur Purchase vs CBU Purchase	LM	Count	2	65	67
		Expected Count	16.8	50.3	67.0
	LM N	Count	23	10	33
		Expected Count	8.3	24.8	33.0
Total	Count	25	75	100	
	Expected Count	25.0	75.0	100.0	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	52.480 ^a	1	<.001		
Continuity Correction ^b	48.982	1	<.001		
Likelihood Ratio	53.996	1	<.001		
Fisher's Exact Test				<.001	<.001
Linear-by-Linear Association	51.955	1	<.001		
N of Valid Cases	100				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.25.

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	-.654	.000
	Cramer's V	.654	.000
N of Valid Cases		100	

Table 12 : Chi Square Fit Test Results of H2

H3: “Feature is significantly a factor for purchasing Locally Manufactured PV.

A Chi Square test for independence with $\alpha = 0.05$ was used to assess whether Purchase of Locally manufactured PV is related to Feature factor. The Chi-Square test was statistically not significant, χ^2 (N=100) is 1.585, $p > 0.05$, indicating the hypothesis is wrong and **Feature is not significantly a factor for purchasing Locally Manufactured PV.**

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.585 ^a	1	.208		
Continuity Correction ^b	.404	1	.525		
Likelihood Ratio	1.464	1	.226		
Fisher's Exact Test				.253	.253
Linear-by-Linear Association	1.570	1	.210		
N of Valid Cases	100				

Table 13 : Chi Square Fit Test Results of H3

H4: “Spare Parts Availability & Price is significantly a factor for purchasing Locally Manufactured PV.

A Chi Square test for independence with $\alpha = 0.05$ was used to assess whether Purchase of Locally manufactured PV is related to Spare Parts Availability & Price factor. The Chi-

Square test was statistically significant, χ^2 (N=100) is 5.981, $p < 0.05$, indicating “**Spare Parts Availability & Price is significantly a factor for purchasing Locally Manufactured PV**”.

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.981 ^a	1	.014		
Continuity Correction ^b	4.752	1	.029		
Likelihood Ratio	7.014	1	.008		
Fisher's Exact Test				.016	.011
Linear-by-Linear Association	5.922	1	.015		
N of Valid Cases	100				

- a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.60.
- b. Computed only for a 2x2 table

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.245	.014
	Cramer's V	.245	.014
N of Valid Cases		100	

Table 14 : Chi Square Fit Test Results of H4

H5: “After Sales Service is significantly a factor for purchasing Locally Manufactured PV.

A Chi Square test for independence with $\alpha = 0.05$ was used to assess whether Purchase of Locally manufactured PV is related to Feature factor. The Chi-Square test was statistically not significant, χ^2 (N=100) is 1.735, $p > 0.05$, indicating the hypothesis is wrong and **After Sales Service is not significantly a factor for purchasing Locally Manufactured PV.**

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	1.735 ^a	1	.188		
Continuity Correction ^b	.688	1	.407		
Likelihood Ratio	1.611	1	.204		
Fisher's Exact Test				.328	.200
Linear-by-Linear Association	1.718	1	.190		
N of Valid Cases	100				

Table 15 : Chi Square Fit Test Results of H5

To extend for Chi square fit test, we need two categorical variables. One categorical variable is Locally manufacturing PV purchasing (Yes/No: CBU Purchasing), Calculated from RQSA (Result from questions segment A) between 24.6- 30 which are 67 customers. On the other hand B1.a answers are measured as second categorical variable which are the factors (Price, Quality, Features, Spare Parts price and availability, After sales service.

Chapter 8

Result and Feasibility Analysis

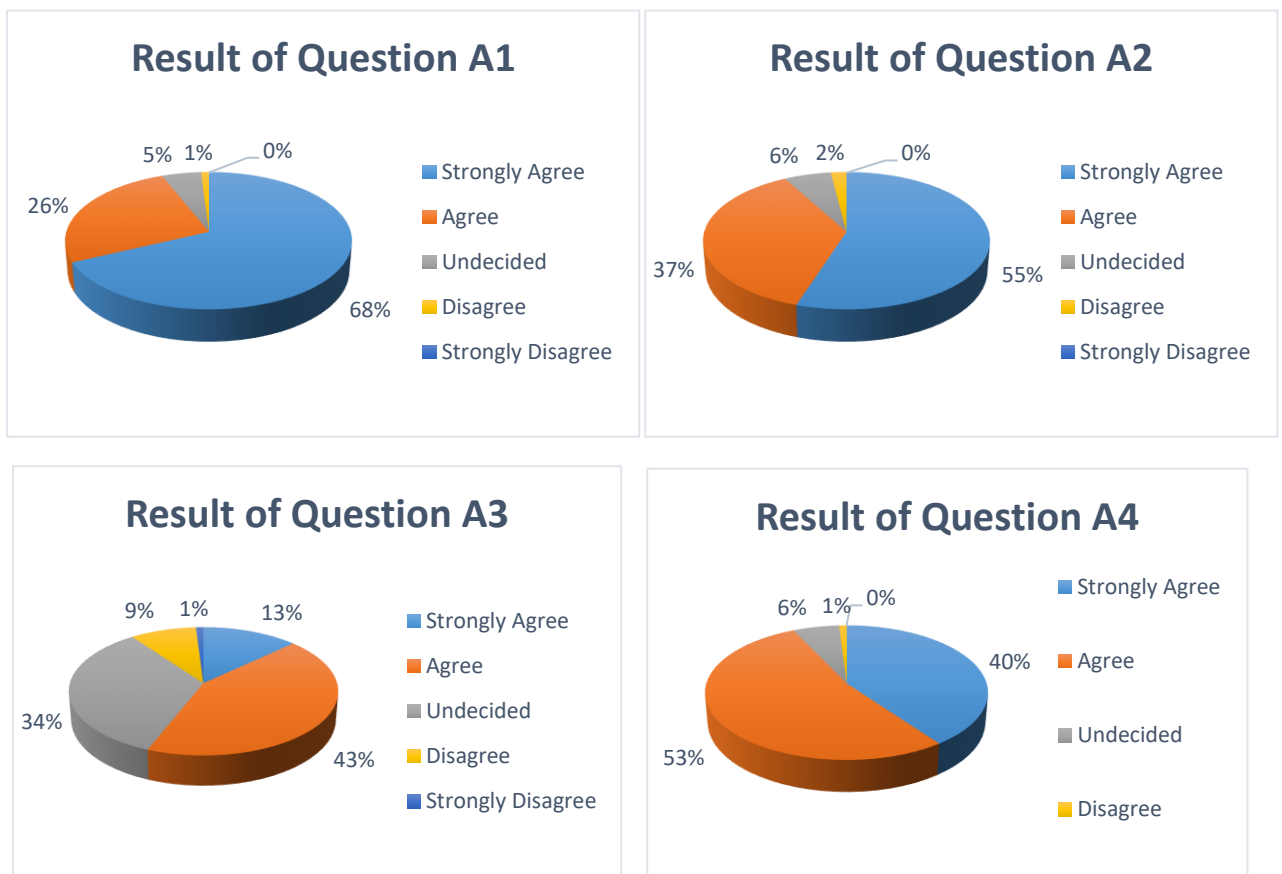
8.1 Responders Willingness to buy Locally Manufactured PV

8.1.1 Result outcome of Question Segment of A:

For Question A1: The Study asked the respondents that, “As a User of Passenger vehicle (PV) will you Buy cost competitive locally manufactured PV against fully imported Brand New or Reconditioned CBU PV” It is observed that, 94 percent respondents expressed willingness to buy local PV with 68% showing strong willingness. The details are presented in Figure 23 (Result of Question A1)

For Question A2: The Study asked the respondents that, “Do you think fully imported Completely Built Up (CBU) PV will have high selling price due to high forex, global war and economic turmoil in upcoming years and unaffordable for you”. It is observed that 94 percent respondents expressed willingness to buy local PV with 68% showing strong willingness. The details are presented in Figure 23 (Result of Question A2)

For Question A3: The Study asked the respondents that, “As a User of Passenger vehicle (PV) do you feel locally manufactured PV Quality will be good against CBU PV.” It is observed that 13 respondents strongly agreed, 43 respondents agreed, 34 respondent’s undecided, 9 respondents disagreed and 1 respondent strongly disagree. The result shows that in total only 56 respondents agreed with the statement. Whereas disagreed respondents’ number is largest in the question segment. The details are presented in Figure 23 (Result of Question A3).



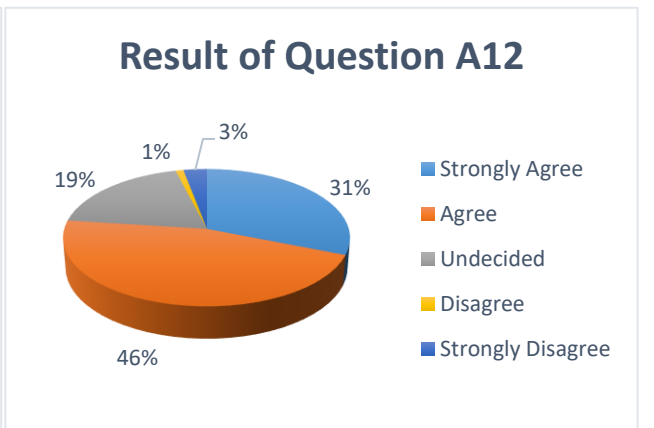
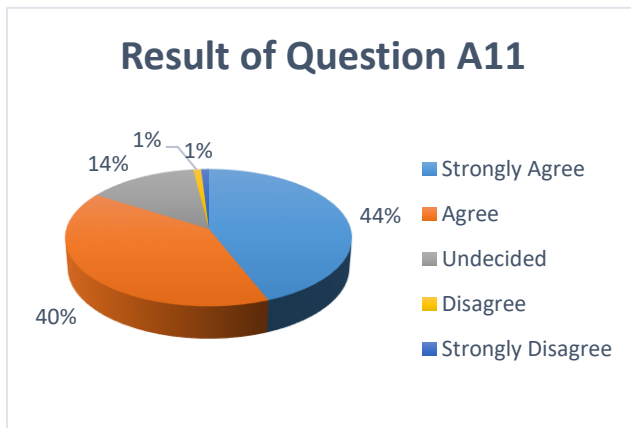
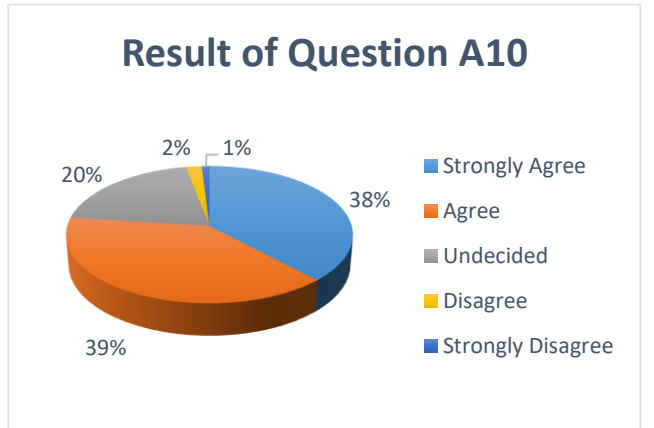
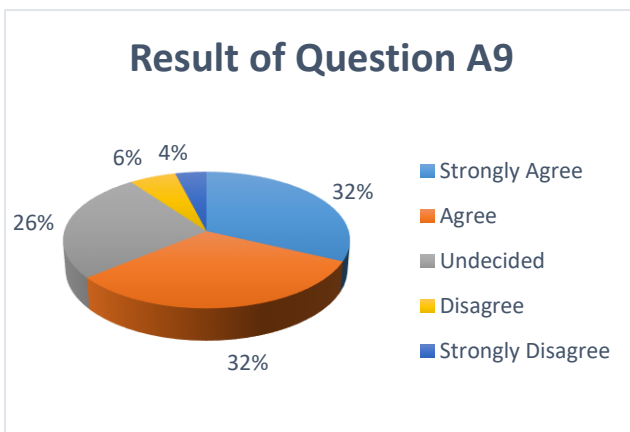
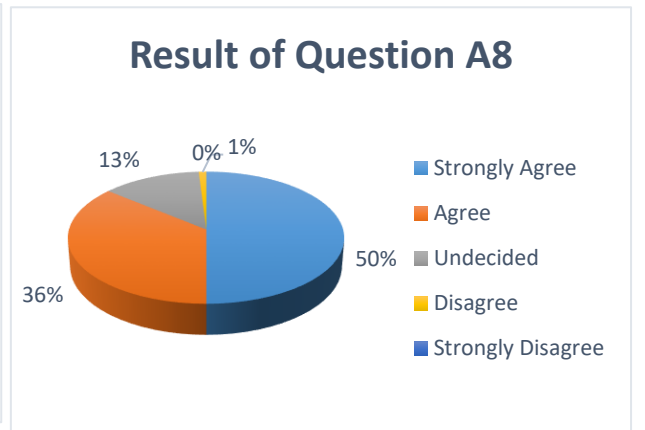
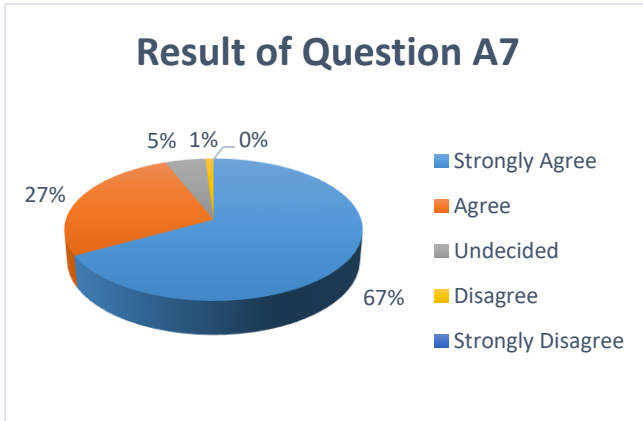


Figure 24: Pie chart of Result of question segment A

Scale/Q	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Total=
Strongly Agree (5)	68	55	13	40	40	29	67	50	32	38	44	31	507
Agree (4)	26	37	43	52	46	43	27	36	32	39	40	46	467
Undecided (3)	5	6	34	6	13	24	5	13	26	20	14	19	185
Disagree (2)	1	2	9	1	0	0	1	1	6	2	1	1	25
Strongly Disagree (1)	0	0	1	1	1	4	0	0	4	1	1	3	16
Total=	100	100	100	100	100	100	100	100	100	100	100	100	1200

Table 16 : Result of question segment A

For Question A4: The Study asked the respondents that, “As a User of Passenger vehicle (PV) do you agree that locally manufactured PV will have sufficient Warranty, after sales service facility, spare parts availability.” It was observed, 40 respondents strongly agreed , 53 respondents agreed, 6 respondents undecided, 1 respondent disagreed and 0 respondent strongly disagreed. The result depicts that in total 90 respondents agreed with the statement. The details are presented in Figure 23 (Result of Question A4).

For Question A5: The Study asked the respondents that, “Does “Made in Bangladesh” tag will create positive impact on purchasing PV.” It was observed, 40 respondents strongly agreed, 45 respondents agreed, 13 respondent’s undecided, 0 respondents disagreed and 2 respondents strongly disagreed. The details are presented in Figure 23 (Result of Question A5).

For Question A6 : The Study asked the respondents that, “Does “Made in Bangladesh” tag will create positive impact on purchasing PV..” 29 respondents strongly agreed , 43 respondents agreed, 24 respondent’s undecided, 0 respondents disagreed and 4 respondents s strongly disagreed. The details are presented in Figure 23 (Result of Question A6).

RQSA :

A calculative approach of questions A1 to A12 is RQSA elaborated as result of questionnaire. segment of A. The calculation is the summation of 5-point Likert scale. So, by observing the RQSA and individual personnel answers of the research questions assumptions can be made. All the questions of Segment A directly or indirectly depict the Passenger vehicle customers

will purchase locally manufactured passenger vehicle in comparison to imported CBU.

To Sum it up, in terms of strongly agreed and agreed respondent's responses is high for question statement of A1, A4, A2, A7, A8, A11 resulting below points.

- Customers agree to buy cost competitive or cheaper locally manufactured PV.
- Customers assurance factors of locally manufactured PV will be there as per respondents such as warranty, after sales service facility, spare parts availability.
- Imported CBU is unaffordable for customers.

Whereas based on high indecisiveness and disagreement of Question A3, A6, A9 “**quality concern, Manpower Skill, Political stability of locally manufactured PV**” is also a consideration.

8.1.2 Result outcome based on Question Segment of B:

The result of question segment A depicts that customer will buy locally manufactured PV. The aim of questionnaire segment of B that, which factors will impact for the result and what is the contribution. A summary of answer of the respondents against question segment of B is shown in table. Here the most answered factor is price, spare parts and Quality. To put into a nutshell, below factors will drive serially for purchasing locally manufactured passenger vehicles:

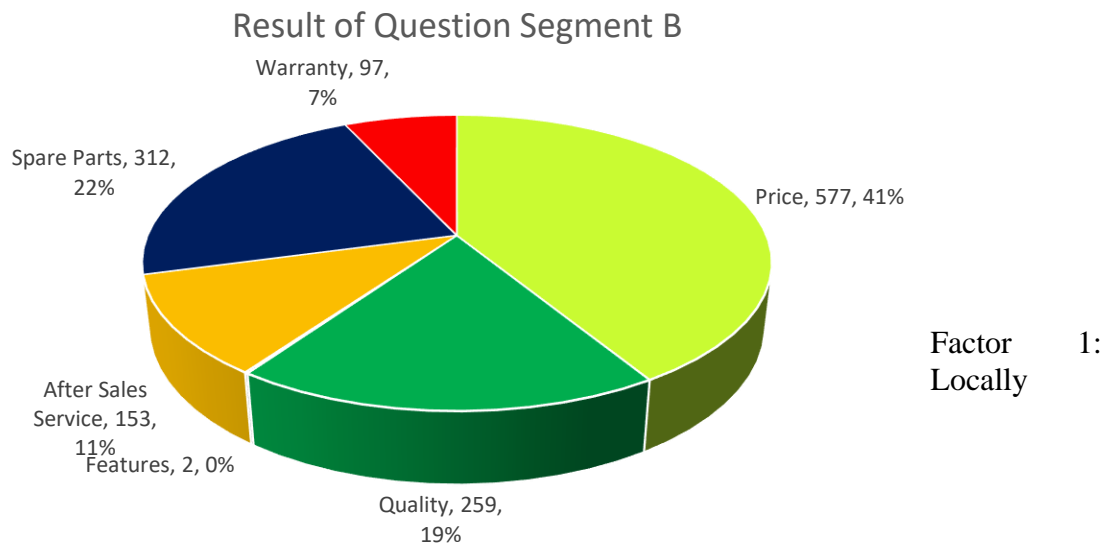


Figure 25: Result of question segment B

manufactured PV's Price should be lower than imported CBU PV, factor 2:

Spare parts availability and affordable price **and** factor 3: Quality concern of locally

manufactured PVs are highest amongst the factors. So, it can be stated that **price and spare parts** is the prime factor **for which Passenger vehicle customers will purchase locally**

manufactured passenger vehicle in comparison to imported CBU. Whereas quality is also a concern.

8.2 Feasibility:

The research design came up with the conclusion of **Passenger vehicle customers will purchase locally manufactured passenger vehicle in comparison to imported**

CBU and price is the prime factor. Now we will check the feasibility that, whether the manufactured product will be less costly than imported CBU.

By looking on to Manufacturing Duty structure formulation By GoB as per S.R.O-165/2022/178 Bangladesh Govt. is emphasizing on local manufacturing. As mentioned earlier, usually painting for automobile passenger vehicles is processed in five steps which are

phosphate coating, Electro deposition Coating, primer coat, Base coat and Topcoat. In category-1 If manufacturers ensure Body making in Welding/Body shop, ensure ED, Primer, Base coat & Topcoat then VAT and SD is exempted up to 2030. On the other hand, for only doing painting of base and topcoat a manufacturer can get VAT and SD exemption up to 2025. Very interestingly, subject to VAT and SD exemption results in – Body, Engines, and some parts (which TTI is 89%) duty will be reduced to below 40%. And Majority Parts (TTI 37%) duty will be reduced to 20%, whereas the total duty will be reduced to 30-40%. Which is almost 97% less for up to 1600 cc, 182% less for up to 2000 cc, 412% less for up to 2500 cc. To extend the TTI (Total Tax Impact) for imported CBU up to 1600cc is 127%, 1601 cc -2000 cc is 212%, 2001 cc – 2500 cc is 442%. So, the price will reduce to a significant amount. The components of the final price is FOB value, Freight cost, LC charges, Customs Duty, Shipping and port charges, Clearing and C&F agent cost, Bank interest, operational cost, Mark up and VAT.

Cost Components
FOB Price
Freight
CFR
LC Opening Charge
Insurance
Cost of Vehicle
Customs Landing Load
Assesable Value
Custom Duty
Regulatory Duty
Supplementary Tax
VAT
AIT
AT
Total Item Tax

Supplementary Tax, Value Added tax, Advance Tax Exempted Resulting Total Tax Reduced (70% less for up to 1600 cc, 182% less for up to 2000 cc, 412% less for up to 2500 cc.)

Global Taxes and Com
Total Tax
Port, Transit, Clearing, C&F
Total landing Cost
Bank Interest
Operational Cost
Cost Price
Mark Up
VAT
Selling Price

Table 17 : Cost Component of product pricing

8.3 Result in a Nutshell:

Observing 5-point Likert scale it can be stated that, Customers will purchase locally manufactured Passenger vehicles over CBU imported vehicle. Because almost 974 responses come as strongly agreed and agreed. It is also observed statistically that the significant factor is price behind purchasing locally manufactured PV. Operating Chi Square (χ^2) fit test of the hypothesis H1, H2 and H4 was statistically significant whereas H1 has the highest effect stating, **“Price is significantly a factor for purchasing Locally Manufactured PV”**.

Hn	Hypothesis	Status	Effect
H1	“Price is significantly a factor for purchasing Locally Manufactured PV”	statistically significant, χ^2 (N=100) $p < 0.05$	Phi = 0.588 Higher Effect
H2	“Quality is significantly a factor for purchasing Locally Manufactured PV	statistically significant, χ^2 (N=100) $p < 0.05$	Phi = -0.654 Higher Negative Effect
H3	“Feature is significantly a factor for purchasing Locally Manufactured PV”	statistically not significant, χ^2 (N=100) $p > 0.05$	NA
H4	“Spare Parts Availability & Price is significantly a factor for purchasing Locally Manufactured PV.	statistically significant, χ^2 (N=100), $p < 0.05$	Phi = 0.245, Lower to medium effect

H5	“After Sales Service is significantly a factor for purchasing Locally Manufactured PV.	statistically not significant, χ^2 (N=100), $p > 0.05$	NA
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Table 18 : Result in a Nutshell

8.4 Linking with BoP:

The research design came up with the conclusion of **Passenger vehicle customers will purchase locally manufactured passenger vehicle in comparison to imported CBU and Price is the prime driver for feasibility.** As price is the prime factor so for sustaining the manufacturing it must need to find out other sources to decrease price. Excellent marketing concept of Base of pyramid can be introduced with Bangladesh manufacturing of automotive industry. Because in Bangladesh mostly upper income range customers buy passenger vehicle. So, to increase the MS, new customer segment can be pitched. Middle income range customers can be targeted with Bop marketing concept. A Bop Modality integration with supply chain is shown in the below figure :

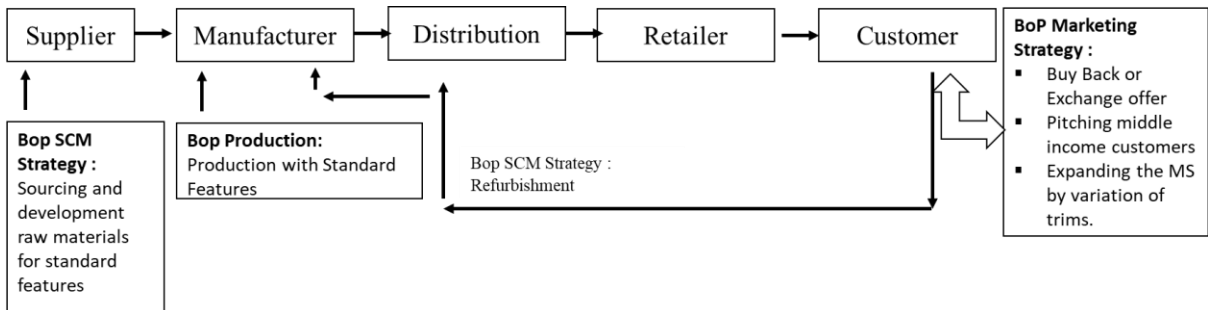


Figure 26: Supply Chain Entities and BoP Modality

The product price can be lowered down by configuring the vehicle with standard features like cloth seats over leather seats, Halogen lights over LED lights, Standard sound system, smaller tire size, manual AC etc.

Features	Perceived Value
Leather Seat	BDT 1,00,000
LED Headlights	BDT 1,00,000
Standard sound system	BDT 50,000
Smaller tire Size	BDT 5,000
Manual AC	BDT 25,000
Standard interior trim	BDT 20,000
Total=	BDT 3,00,000

For a BDT 30,00,00 vehicle, if 3,00,000 reduced then 10% of the Price is reduced

Table 19 : Perceived value of Premium Features

In the above table we observed by changing some premium specs to standard specs we can reduce price in a significant range.

In value chain of supply chain the integration of Bop is shown in the figure. Here in Inbound logistics Sourcing Standard Featured raw material over premium feature can provide an competitive cost advantage. In operations, Using renewable sources at factory for Lower operations cost in the long run and thus cut downs the factory cost. Refurbishment of Product and Re-manufacturing can bring new lower cost products and also can form a new business. Most importantly in the field of marketing Bop can Increase MS by targeting new buyer segment of passenger vehicle in Bangladesh (Middle income customer), Understanding their necessity Pitching safety features of PV vs two-wheeler. A Bop Modality integration with value chain is also constructed in the below figure.

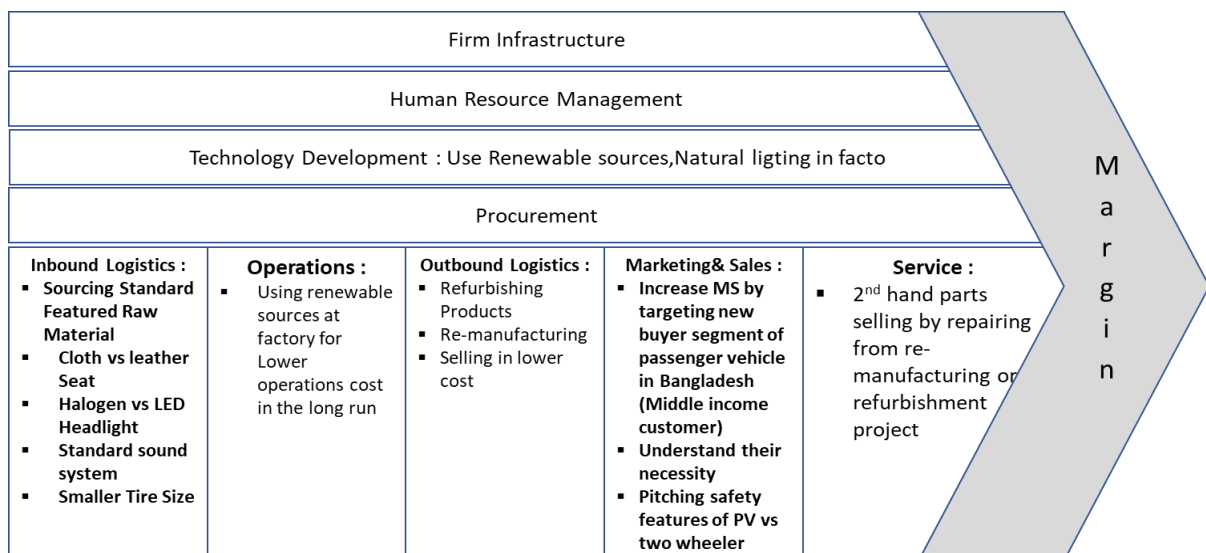


Figure 27: Value Chain Entities and BoP Modality

Chapter-9

Conclusion

Bangladesh has a great future scope of doing automobile manufacturing over reconditioned imported vehicles for many reasons like Consumer behavior changing, GDP increase of Bangladesh, Govt. emphasizing on manufacturing by provide VAT, SD benefits, exchange rate volatility, LC obstacle of CBU import and many more. In the study, it is observed that customers will prefer Bangladeshi manufactured product in the upcoming years as per competitive advantage over price against reconditioned passenger vehicle. To extend, Bottom of pyramid marketing concept can be a catalyst in the path of sustainable manufacturing considering social, environmental, and economic aspects. To put it into a nutshell, Automotive supply chain will shift from just importing to raw materials supply of manufacturing. In addition, localization, manpower development and export opportunity will be opened.

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Appendix A.

Result of Question segment B :

Q/A	Price (1)	Quality (2)	Features (3)	After Sales Service (4)	Spare Parts (5)	Warranty (6)	
B1a	77	23					100
B1b		13	2	5	62	18	100
B2a	88	6			6		100
B2b					74	26	100
B3a	92			8			100
B3b		50		29	21		100
B4a	76	4		20			100
B4b				52	48		100
B5a	75	10		15			100
B5b		75			15	10	100
B6a	85	11		4			100
B6b		67		2	10	21	100
B7a	84			8	8		100
B7b				10	68	22	100
Total Count=	577	259	2	153	312	97	

Government of the People's Republic of Bangladesh
Ministry of Finance
internal Property Division
{Value Added Tax and Supplementary Tariff)
Notification'
Date: 01 June 2022 AD

S.R.O. No. 165-Law/2022/178 VAT.

value added tax and Supplementary Tariff law, 2012 (47 no. law of year 2012) clause 126 of sub clause (1) by power, government customs act. 1969 (lv of 1969) of First Schedule's columns (1) against heading number 87.03 against column (2) mentioned HS Code 8703.21.31, 8703.22.21, 8703.23.21, 8703.23.41, 8703.23.61, 8703.31.21, 8703.31.41, 8703.32.21, 8703.32.41 and 8703.32.61 against column (3) mentioned up to 2500 cc motorcar and motor vehicle (SUV), Then the product is mentioned,

(Ka) Upon fulfilling condition of below mentioned table 1, in locally production VAT and necessary Raw materials needed for producing the product and machineries items, VAT (AIT incl,) and ST is exempted up to 30 June 2030 AD.

(Kha) Upon fulfilling condition of below mentioned table 2, in locally production VAT and necessary Raw materials needed for producing the product and machineries items, VAT (AIT incl,) and ST is exempted up to 30 June 2025 AD.

(Ga) Upon fulfilling condition of below mentioned table 2, not more than 5% locally production VAT and necessary Raw materials needed for producing the product and machineries items, VAT (AIT incl.) and ST is exempted from 01 July 2025 AD to 30 June, 2030 AD.

Table-1

Ka) BIDA or Bangladesh Hi-Tech Park certified manufacturing organization declaration certification needed.

Kha) Makers Code and Type Approval should be taken from BRTA.

Ga) Manufacturer must have proper body manufactured in Body / welding shop

Gha) Manufacturers brand approved Electro deposition (ED) and Primer Coat including all consequent painting process enabled paint shop must be there.

Uma) Four pole lifter, two pole lifter, scissor lifter, Zib crane, break force reader, Air compressor, 3D wheel alignment machine, Rain shower testing facility, fuel dispenser, side sleep, universal diagnostic tools, under body inspection pit, test trunk wave, Belgium, pit pot and rope, automatic pneumatic air gun, wireless air gun etc.

(Ca) Goods produced organization must manage system of assembling section, testing, quality control and pre delivery inspection.

(Cha) There must make technical contract between related goods produced organization and brand manufacturing subject to create efficient human resources to working employee for gradually technology handover through training.

(Ja) Have followed to minimum Euro 3 emission Standard for environment friendly car production and have to keep certificate of brand manufacturer for that purpose.

Jha) Have to keep sales, retail machinery and service, after sales management under related organization for giving proper service to customer.

Table-2

Ka) BIDA or Bangladesh Hi-Tech Park certified manufacturing organization declaration certification needed.

Kha) Makers Code and Type Approval should be taken from BRTA.

Ga) Four pole lifter, two pole lifter, scissor lifter, Zib crane, break force reader, Air compressor, 3D wheels alignment machine, Rain shower testing facility, fuel dispenser, side sleep, universal diagnostic tools, under body inspection pit, test trunk wave, Belgium, pitot and rope, automatic pneumatic air gun, wireless air gun etc.

Gha) Manufacturers brand approved Primer Coat including/excluding body can be imported, but final paint must not be painted, all final painting process should be done in the paint shop.

(Uma) Goods produced organization have to management system of assembling section, testing, quality control and pre delivery inspection.

(Ca) There must make technical contract between related goods produced organization and brand manufacturing subject to create efficient human resources to working employee for gradually technology handover through training.

(Cha) Have followed to minimum Euro 3 emission Standard for environment friendly car production and must keep certificate of brand manufacturer for that purpose.

(Jha) Have to keep sales, retail machinery and service, after sales management under related organization for giving proper service to customer.

Questionnaire for Thesis

First Part: Demographic Questionnaire

<p>D1. Sex of the answerer.</p> <p><input type="radio"/> Male <input type="radio"/> Female <input type="radio"/> Other</p>	<p>D4. Which Automobile brand you have for transportation</p> <p><input type="radio"/> Toyota 1 <input type="radio"/> Mitsubishi 2 <input type="radio"/> Nissan 3</p> <p><input type="radio"/> Honda 4 <input type="radio"/> Hyundai 5 <input type="radio"/> Proton 6</p> <p><input type="radio"/> MG 7 <input type="radio"/> Haval 8 <input type="radio"/> Cherry 9 <input type="radio"/> DFSK 10</p> <p><input type="radio"/> Mercedes Benz 11 <input type="radio"/> Audi 12 <input type="radio"/> BMW 13</p> <p><input type="radio"/> Peugeot 14 <input type="radio"/> Others 15</p>
<p>D2. Age of the answerer.</p> <p><input type="radio"/> 18 – 25 <input type="radio"/> 26 – 30 <input type="radio"/> 31 – 40 <input type="radio"/> 41 – 50</p> <p><input type="radio"/> 51 – 60 <input type="radio"/> More than 60</p>	<p>D5. Income Range</p> <p><input type="radio"/> 10,000 – 50,000</p> <p><input type="radio"/> 50,001 – 75,000</p> <p><input type="radio"/> 75,001– 1,00,000</p>

<p>D3. PV User type Q1</p> <p>o Brand New Passenger Vehicle user</p> <p>o Recondition/2nd Hand Passenger Vehicle User</p> <p>o Non-User</p> <p>o Others</p>	<p>o 1,00,001 – 1,50,00</p> <p>o 1,50,001 – 2,00,00</p> <p>o Above 2,00,00</p>
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Second Part: Segment A

<p>A1. What is your opinion on purchasing cost competitive locally manufactured PV against fully imported Brand New or Reconditioned CBUPV.</p> <p>o Strongly Disagree o Disagree</p> <p>o Undecided o Agree o Strongly Agree.</p>	<p>A4. As a User of Passenger vehicle (PV) do you agree that locally manufactured PV will have sufficient Warranty, after sales service facility, spare parts availability.</p> <p>o Strongly Disagree o Disagree</p> <p>o Undecided o Agree o Strongly Agree.</p>
<p>A2. Do you think fully imported Completely Built Up (CBU) PV will have high selling price due to high forex, global war and economic turmoil in upcoming years and unaffordable for you.</p> <p>o Strongly Disagree o Disagree</p> <p>o Undecided o Agree o Strongly Agree.</p>	<p>A5. Does “Made in Bangladesh” tag will create positive impact on purchasing PV.</p> <p>o Strongly Disagree o Disagree</p> <p>o Undecided o Agree o Strongly Agree.</p>
<p>A3. Does “Bangladesh” has the capacity (Technology, skilled manpower) of manufacturing purchasing PV.</p> <p>o Strongly Disagree o Disagree.</p> <p>o Undecided o Agree o Strongly Agree.</p>	<p>A6. Do you think, Bangladeshi Engineer and technicians are expert for automobile manufacturing process.</p> <p>o Strongly Disagree o Disagree</p> <p>o Undecided o Agree o Strongly Agree.</p>

<p>A7. Do you think, private investors of Bangladesh will be eager to invest on automobile manufacturing.</p> <p><input type="radio"/> Strongly Disagree <input type="radio"/> Disagree</p> <p><input type="radio"/> Undecided <input type="radio"/> Agree <input type="radio"/> Strongly Agree.</p>	<p>A8. Do you think, automobile manufacturing can be sustainable in terms of economic, social and environmental factors</p> <p><input type="radio"/> Strongly Disagree <input type="radio"/> Disagree</p> <p><input type="radio"/> Undecided <input type="radio"/> Agree <input type="radio"/> Strongly Agree.</p>
<p>A9. Do you think, automobile manufacturing supply chain will run smooth operations in Bangladesh in terms of political situation :</p> <p><input type="radio"/> Strongly Disagree <input type="radio"/> Disagree</p> <p><input type="radio"/> Undecided <input type="radio"/> Agree <input type="radio"/> Strongly Agree.</p>	<p>A11. Do you think automobile manufacturing will be supported by concern government entities and regulatory.</p> <p><input type="radio"/> Strongly Disagree <input type="radio"/> Disagree</p> <p><input type="radio"/> Undecided <input type="radio"/> Agree <input type="radio"/> Strongly Agree.</p>
<p>A10. Do you think, automobile manufacturing can reduce pressure of forex reserve regarding importing CBU's</p> <p><input type="radio"/> Strongly Disagree <input type="radio"/> Disagree</p> <p><input type="radio"/> Undecided <input type="radio"/> Agree <input type="radio"/> Strongly Agree.</p>	<p>A12. Do you think, automobile manufacturing can develop local manpower</p> <p><input type="radio"/> Strongly Disagree <input type="radio"/> Disagree</p> <p><input type="radio"/> Undecided <input type="radio"/> Agree <input type="radio"/> Strongly Agree.</p>

Third Part: Segment B (Select any two)

<p>B1 . As a customer purchasing PV what factor will be the most deciding factor.</p> <p><input type="checkbox"/> Price</p> <p><input type="checkbox"/> Quality</p> <p><input type="checkbox"/> Features</p> <p><input type="checkbox"/> After sales Service</p> <p><input type="checkbox"/> Spare Parts Availability and cost</p> <p><input type="checkbox"/> Warranty</p>	<p>B4. For Incorporating of Reverse Logistics and closed loop supply chain sustainable concept in supply chain which below factor will be affected?</p> <p><input type="checkbox"/> Refurbish Product cost will be less.</p> <p><input type="checkbox"/> Good Quality output.</p> <p><input type="checkbox"/> Premium Features incorporation.</p> <p><input type="checkbox"/> After sales Service cheaper.</p> <p><input type="checkbox"/> Less Spare Parts cost.</p> <p><input type="checkbox"/> Extended Warranty period.</p>
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<p>B2. For high manufacturing Volume what could be the below factor?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Price decrease. <input type="checkbox"/> Quality Concern. <input type="checkbox"/> Premium Features incorporation. <input type="checkbox"/> After sales Service cheaper. <input type="checkbox"/> Less Spare Parts cost. <input type="checkbox"/> Extended Warranty period. 	<p>B5. Customer Satisfaction will achieve for which below factor?</p> <ul style="list-style-type: none"> <input type="checkbox"/> If Product Price is lesser <input type="checkbox"/> Good Quality. <input type="checkbox"/> Premium Features incorporation. <input type="checkbox"/> Good After sales Service. <input type="checkbox"/> Less Spare Parts cost. <input type="checkbox"/> Extended Warranty period.
<p>B3. Will it be sustainable to do automobile manufacturing plant in Bangladesh, if yes then what are the below factors for sustainability?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Less Production Cost. <input type="checkbox"/> Good Quality output. <input type="checkbox"/> Premium Features incorporation. <input type="checkbox"/> After sales Service cheaper. <input type="checkbox"/> Less Spare Parts cost. <input type="checkbox"/> Extended Warranty period. 	<p>B6. For which below factor “Made in Bangladesh” Automobile product will replace Recondition CBU Toyota dominated importing?</p> <ul style="list-style-type: none"> <input type="checkbox"/> If Product Price is lesser <input type="checkbox"/> Good Quality. <input type="checkbox"/> Premium Features incorporation. <input type="checkbox"/> Good After-sales Service. <input type="checkbox"/> Less Spare Parts cost. <input type="checkbox"/> Extended Warranty period.
<p>B7. Which could be the main factor of introducing the Base of pyramid sustainability concept in automobile supply chain?</p> <ul style="list-style-type: none"> <input type="checkbox"/> Product Price must be for medium income segment. <input type="checkbox"/> Good Quality. <input type="checkbox"/> Premium Features incorporation. <input type="checkbox"/> Good After sales Service. <input type="checkbox"/> Less Spare Parts cost. <input type="checkbox"/> Extended Warranty period. 	<p>B1.a. As a customer, purchasing PV what factor will be the most deciding factor. (Select any one, same as B1)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Price <input type="checkbox"/> Quality <input type="checkbox"/> Features <input type="checkbox"/> After sales Service <input type="checkbox"/> Spare Parts Availability and cost <input type="checkbox"/> Warranty