Evaluating Supply Chain Transformation of Passenger Vehicle Industry Towards Manufacturing in Bangladesh

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Abstract- Bangladesh is classified as a lower-middle-income economy by the World Bank, with a Gross National Income (GNI) per capita of $2,824. It is also designated as a Least Developed Country (LDC) by the United Nations, based on low income, human asset deficits, and economic vulnerability. However, in February 2021, the UN Committee for Development Policy (CDP) recommended Bangladesh for LDC graduation, recognizing its progress in income growth, human development, and economic resilience. Bangladesh, which is the second largest economy in South Asia gained independence in 1971. Nearly 54 years have passed, yet customers in the passenger vehicle segment predominantly rely on used, reconditioned cars imported from Japan. These vehicles, allowed for import up to five years after manufacture, continue to dominate the market. However, there is a growing need to shift toward locally manufactured, brand-new vehicles to advance the country's automobile sector. Establishing a domestic automobile manufacturing industry could drive employment, strengthen the local economy, and improve living standards. Thus, many prime points come into limelight like consumer behaviour, government support and infrastructural capability. This study explores the future of the automotive supply chain in Bangladesh, focusing on identifying key factors that could drive its transformation. Utilizing a hypothesis-driven research design, the study analyzes survey responses to uncover consumer preferences and emerging trends shaping the industry. The findings provide critical insights into the potential shift from a reliance on imported reconditioned vehicles to localized manufacturing, highlighting opportunities and challenges within the evolving automotive landscape of Bangladesh.

Keywords *- Supply Chain Management, Passenger Vehicle, Local Manufacturing, Price, Quality.*

1. Introduction

The total market size of passenger vehicles in Bangladesh in 2022 was approximately 34,334 units (including both brand-new and reconditioned vehicles, with microbuses considered part of the passenger vehicle segment). Among these, 16,695 units were sedans, 10,240 units were Jeep/SUVs, and 7,399 units were microbuses [1]. Brand-new vehicles accounted for around 4,800 units (14%), while the remaining 86% were reconditioned cars. In comparison, the total number of registered cars in the previous year (2021) was 28,592 units, comprising 16,049 sedans, 7,602 Jeep/SUVs, and 4,941 microbuses [1]. Based on the data from these two years, a 20% growth was observed in the passenger vehicle market. This growth indicates an increase in the purchasing capacity of a specific segment of the population in Bangladesh.

Another interesting observation is that the demand for SUVs increased by 25% in 2022 compared to 2021 [1]. This indicates a shift in customer preference toward SUVs over sedans, aligning with the global trend [2]. However, the overall vehicle market in Bangladesh experienced a 39% decline due to economic challenges and political turmoil [3]. Based on the current BRTA vehicle registration data, it can be projected that the total market size will be approximately 24,000 units by the end of 2024 [1].

It is unfortunate that Bangladesh, due to the absence of a domestic vehicle manufacturing industry, has not yet developed an internal supply chain. Instead, the country primarily relies on trading vehicles imported from foreign

countries, particularly Japan. This reliance has resulted in a lack of availability of parts and raw materials locally, which in turn hinders the growth of skilled manpower and the development of a robust internal supply chain for the automobile industry. However, initiatives by companies like PHP and later Fair Technology have introduced semi-manufacturing processes, including assembly and painting, as per the National Board of Revenue's SRO guidelines. The painting process for passenger vehicles typically involves five major layers: pre-treatment, ED-coating, priming, base coat, and top coat [4], [5], [6], [7]. The government provides duty benefits for the last two layers (base coat and top coat) due to the value addition they represent. Despite these efforts, only 1% of the car industry was engaged in assembly and painting activities in 2022. However, this figure has shown promising growth, increasing to 5-6% in 2023 [2]. This progress indicates a gradual shift toward localized manufacturing, though significant challenges remain in fully developing the industry and its supply chain.

Table 1: Passenger Vehicle Market Size in Bangladesh (2018-2024) [1]

DESCRIPTION	TYPES	2018	2019	2020	2021	2022	2023	2024*	CAGR%	MS%
Total	SUV/JEEP	5,547	5,627	4,911	7,602	10,240	7765	8,900	9.6%	**37%**
	SEDAN	18,222	16,799	12,403	16,049	16,695	10784	9,800	-10.2%	**40%**
	MPV	4,131	3,682	2,779	4,941	7,399	5072	5,500	8.4%	**23%**
	TOTAL	**27,900**	**26,108**	**20,093**	**28,592**	**34,334**	**23,621**	**24,200**	-1.5%	**100%**
	YoY Gr. %		**-6%**	**-23%**	**42%**	**20%**	**-31%**	**2%**		

The products of Fair Technology are mostly SUVs. Other assemblers without painting facility are Rangs (Brand: Mitsubishi), M.A Enterprise (DFSK), Hossain group (DFSK, Bangla Car), State owned Pragati industries (Mitsubishi, Mahindra) [8].

Moreover the Govt. is emphasizing on local production by exempting VAT, and SD. So, there is a huge opportunity of manufacturing vehicle in the upcoming years. Therefore, it is important to aim for future prediction of the type of supply chain questioning "will the supply chain be based on manufacturing" or "just by importing CBU PV". The current study came up with all the answers by conducting data analysis using SPSS data analysis and scrutinized the prime factor for the change.

Table 1 & Figure 1 showed passenger vehicle market in Bangladesh from Y 2018 to Y 2024. including projected data of 2024 based on current trends, statistics, economic and political factors.

2. Literature Review

During literature survey it is revealed that the vehicle purchase capacity of Bangladeshi people has been increased in comparison to previous time. It is predicted that GDP will increase if the political situation become stable by holding a solid economy. There is a trend of purchasing private vehicles particularly in Dhaka city in recent years which also proved Bangladesh reached lower-middle income status in 2015 [3].

Besides as public transport is not available always; therefore, people need to buy vehicles to fill up the gap as they have no alternative left [9]. 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 [8]. Conventionally, purchasing a vehicle in Bangladesh has not been financially feasible for middle-income families partly due to their exorbitant cost [10]. Recently, the demand for vehicles in Bangladesh has been found to rise over this pandemic period [11]. 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 [12]. The Base of the Pyramid (BoP) is an important market that is receiving

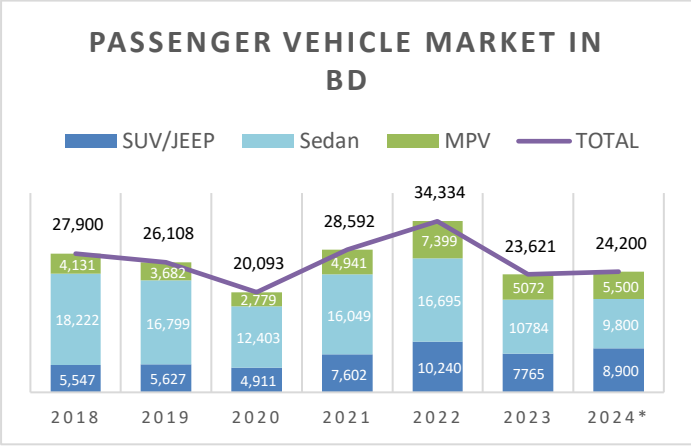

Figure 1. Passenger Vehicle Market in Bangladesh

increasing attention by firms relates to the poorest or middle-income country which is focused on low price and budget [13], [14], [15]. Furthermore, the adoption of Green Supply Chain Management (GSCM) in automobile manufacturing can offer significant environmental and economic benefits [16]. This approach aligns with global sustainability trends and can enhance the competitiveness of locally manufactured vehicles. A critical question emerging from the literature review is whether Bangladeshi passenger vehicle (PV) customers will prefer locally manufactured cars over imported ones. This paper delves into this question in detail, exploring consumer preferences, market dynamics, and the potential for localized manufacturing to meet customer expectations while contributing to the growth of the domestic automotive industry.

As discussed earlier, recondition passenger vehicles dominated the market share (86% at 2022) of the automotive industry in comparison to locally assembled or manufactured cars. Considering the price is too high for fully imported CBU vehicles and the Govt. is emphasizing local manufacturing by exempting VAT and SD, there is a huge opportunity of manufacturing passenger vehicles with a price cut down.

3. Research Methodology

This research study encompasses a market analysis, an examination of the automotive manufacturing process, an assessment of the current automobile supply chain, future forecasting, and a feasibility analysis using both quantitative and conceptual qualitative research approaches.

In the future, the study aims to link the evolving supply chain with sustainable Bottom of the Pyramid (BoP) strategies. A survey questionnaire is administered to respondents, primarily passenger vehicle users with a stable income range. Various data analysis procedures have been conducted to ensure the validity and reliability of the data, including the Normality Test, Kaiser-Meyer-Olkin (KMO) Test, and Reliability Test (Cronbach's Alpha). Most importantly, a Chi-Square Goodness-of-Fit Test is performed to verify the study's outcomes.

For the survey component, the study includes approximately 100 passenger vehicle users, as their experience with passenger vehicles is essential for answering the questions accurately. The questionnaire consists of 18 questions, including five demographic questions.

The hypothesis statements are given below:

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.

3.1 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 are 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 is a niche market, there is an importance of demographic significance like: (age, income range, passenger vehicle user type (brand new user or recondition vehicle user), automotive brand they used (like: Toyota, Mitsubishi, Hyundai, Honda etc.) and sex.

3.2 Measurement:

For hypothesis feasibility measurement, Questionnaire Segment A utilizes a 5-point Likert scale. Each item on the scale includes five response categories, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Additionally, 3 (Neutral) represents a balanced stance, 2 (Disagree) indicates disagreement, and 4 (Agree) reflects agreement with the statement. "Strongly Disagree" signifies a negative judgment toward the hypothesis, whereas "Strongly Agree" indicates strong support. The Neutral response reflects neither agreement nor disagreement and may also indicate indecisiveness. The Result of Questionnaire Segment A (RQSA) is determined using a calculative approach, where the sum of response values from all participants provides an overall measure of the hypothesis feasibility.

3.3 Data analysis:

For checking feasibility of research data Missing data analysis, Normality test, KMO and Bartlett's test, Total variance and Cronbach's alpha 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.

3.4 Sampling:

As explained earlier, the survey questions were administered through three questionnaire segments: Demographic Questions, Segment A, and Segment B. Data was collected primarily through printed questionnaires and personal interviews to ensure comprehensive responses from participants. Since the research focuses on passenger vehicles, which are used by a niche population, careful selection of respondents was essential to obtain accurate and relevant insights. For example, while the general population widely uses mobile phones, not everyone owns or uses a passenger vehicle. Therefore, a probability sampling method was employed to ensure a representative sample. It is crucial to analyze the association between supply chain (SC) operational capability and corporate competitive capability [17]. To achieve this, respondents must have prior experience using passenger vehicles and the financial capacity to purchase one.

4. Analysis:

4.1. Demographic Analysis:

In Demographic analysis in total five questions asked regarding sex (figure 2), age (figure 3), income range (figure 4), passenger vehicle user type (whether they are brand new PV user or recondition/2nd hand PV user) (figure 5), and automobile brand they use (figure 6). Among 100 respondents all the respondents answered all the questions.

In below Infographics it is shown 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 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 more than 60 years which is 29%. In addition, 80% of total respondents are recondition or secondhand passenger vehicle users. 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 respondents' income range is smart and above 1,00,000 lacs.

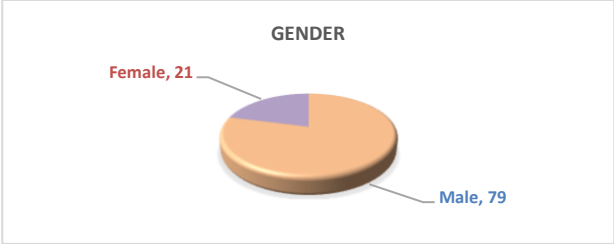

Figure 2: Demographic Analysis (Gender)

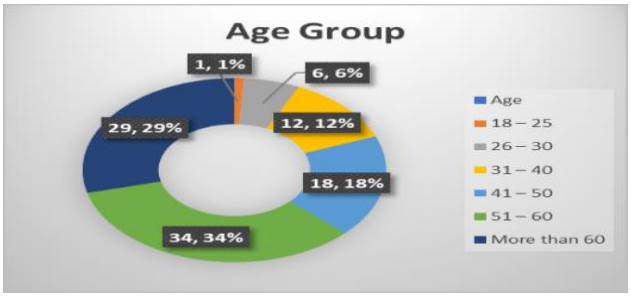

Figure 3: Demographic Analysis (Age Group)

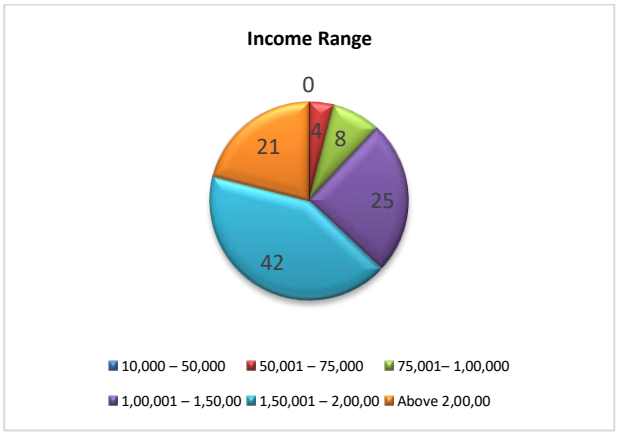

Figure 4: Demographic Analysis (Income Range)

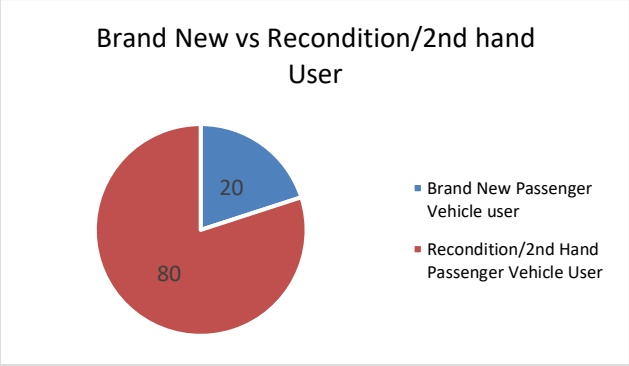

Figure 5: Demographic Analysis (Brand New Vs Recondition User)

4.2 Descriptive Analysis:

Descriptive analysis is shown in table 2. Here mean value, confidence interval of mean, median, variance, std. deviation, range is shown. And most importantly Skewness and kurtosis are almost near to zero, which is good.

Table 2: Descriptive Analysis

Descriptives

			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

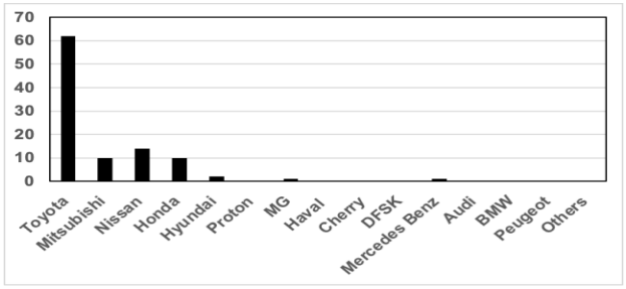

Figure 6: Demographic Analysis (PV Brand User Percentage).

4.3 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 3. Resulting, the data doesn't violate normality assumptions and the segmentations. data are normally distributed and non-significant.

The histogram plot is also given in figure 7. In that histogram we observed the data is normally distributed.

Table 3: Test of Normality

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

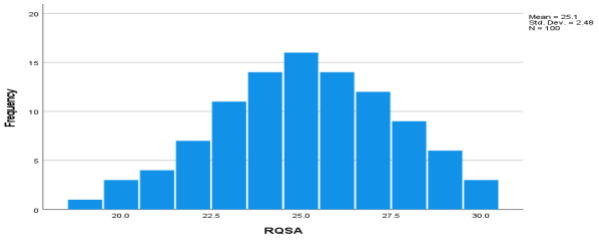

Figure 7: Normality Distribution

4.4 KMO and Bartlett's Test:

The kaiser-Mayer-Olkin (KMO) index was 0.613 (table 4), exceeding the recommended value of 0.6 (kaiser, 1970), bartletts Test of Sphericity (Bartletts, 1954) reached statistically significant as p= 0.002 which is p<0.05.

Table 4: KMO and Bartletts Test

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

4.5 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 (table 5).

Table 5: Cronbach's Alpha Test

Reliability Statistics

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

4.6 Chi Square Fit Test

H1: Price is significantly a factor for purchasing locally manufactured PV.

A Chi Square test for independence with α = 0.05 was used to assess whether Purchase of Locally manufactured PV is related to Price factor. The Chi-Square test was statistically significant, $\chi 2$ (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 (table 6).

Table 6: Chi Square Fit Test (A)

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

Table 7: Chi Square Fit Test (B)

Symmetric Measures

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

H2: Quality is significantly a factor for purchasing locally manufactured PV.

A Chi Square test for independence with α = 0.05 was used to assess whether Purchase of Locally manufactured PV is related to Quality factor (table 7). The Chi-Square test was statistically significant, $\chi 2$ (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.

H3: The Feature is significantly a factor for purchasing locally manufactured PV.

A Chi Square test for independence with α = 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, $\chi 2$ (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.

H4: Spare parts availability &price is significantly a factor for purchasing locally manufactured PV.

A Chi Square test for independence with α = 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, $\chi 2$ (N=100) is 5.981, p< 0.05, indicating "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.

A Chi Square test for independence with α = 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, $\chi 2$

(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.

5. Result:

Chi Square ($\chi 2$) fit test result of the hypothesis H1, H2 and H4 was statistically significant, $\chi 2$ (N=100) ***p< 0.05.*** Here, Chi Square ($\chi 2$) for H1, H2 & H4 are accordingly 0.588, 0.654, 0.245. whereas H1 has the highest effect stating, "Price is significantly a factor for purchasing locally manufactured PV" (table 8).

Table 8: Hypothetical research output

Hn	Hypothesis	Status	Effect
H1	"Price is significantly a factor for purchasing Locally Manufactured PV"	statistically significant, $\chi 2$ (N=100) *p< 0.05*	Phi = 0.588 Higher Effect
H2	"Quality is significantly a factor for	statistically significant, $\chi 2$ (N=100) *p<*	Phi = -0.654 Higher Negative

	purchasing Locally Manufactured PV	*0.05*	Effect
H3	"Feature is significantly a factor for purchasing Locally Manufactured PV"	statistically not significant, $\chi 2$ (N=100) $p > 0.05$	NA
H4	"Spare Parts Availability & Price is significantly a factor for purchasing Locally Manufactured PV.	statistically significant, $\chi 2$ (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, $\chi 2$ (N=100), $p > 0.05$	NA

6. Discussion:

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. Because while operating Chi Square ($\chi 2$) 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" (table 8).

7. Conclusion:

Bangladesh holds significant potential for transitioning from importing reconditioned vehicles to establishing a robust automobile manufacturing industry. This shift is supported by several factors, including changing consumer behavior, steady GDP growth, government incentives such as VAT and SD benefits, exchange rate volatility, and challenges in importing Completely Built-Up (CBU) vehicles due to LC obstacles.

The study reveals that customers are increasingly likely to prefer locally manufactured vehicles in the coming years, driven by their competitive pricing compared to reconditioned passenger vehicles. This shift indicates a transformation in the automotive supply chain, moving from a reliance on imports to a focus on raw material sourcing and local manufacturing. Furthermore, the development of localized production, skilled manpower, and export opportunities for manufactured passenger vehicles (PVs) will play a pivotal role in this transition.

The research also highlights the potential of the bottom-of-the-pyramid marketing concept as a catalyst for sustainable manufacturing. By addressing social, environmental, and economic aspects, this approach can pave the way for a more inclusive and sustainable automotive industry in Bangladesh.

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