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An Investigation of the Feasibility of Growing Into the Manufacture of Electric Cycles

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Abstract

Purpose: A vast array of businesses and institutions engaged in the creation, advancement, production, promotion, and retailing of automobiles make up the automotive sector. In terms of revenue, it is among the biggest sectors in the world.

Theoretical framework: The automotive sector excludes businesses like auto repair shops and motor fuel filling stations that are devoted to maintaining cars after they are delivered to the final consumer. Buildmet, a company with an annual revenue of 80 crore, wants to expand beyond civil construction into a different manufacturing industry.

Design/methodology/approach: That's when a start-up company approached them with the concept and design to produce electric bikes and assemble e-bikes.

Findings: The goal of this research is to determine if expanding into the electric cycle manufacturing industry is viable. To determine if they can proceed with the new endeavor, a feasibility study is being carried out.

Research, Practical & Social implications: The purpose of the feasibility study is to determine four key factors. These are the following: market, financial, industry, and organizational feasibility.

Originality/value: The firm also wants to make environmentally sustainable two-wheelers that are socially and healthy responsible. These kinds of endeavors are currently becoming widely accepted. They are receiving lower GST and tax exemptions. Some states, like Tamil Nadu, intend to exclude electric vehicles and their producers from paying taxes altogether.

Keywords: *E-vehicle, Automobile, Investment Manufacturing, E-cycle, Business Management, Industry Innovation and Infrastructure*

1. Introduction

India is becoming a more urbanized country, and this has resulted in an alarming increase in car pollution. In large cities, automobile pollution has grown to be a significant issue. People who are affected by this pollution have experienced headaches and coughing. queasy feeling, eye irritation, and different bronchial and vision issues. Air pollution is estimated to be a contributing factor in 4.2 million deaths annually. The principal contaminants released by cars are particulate matter, sulfur dioxide, nitrogen dioxide, hydrocarbons, lead/benzene, and carbon monoxide. The fleet's exponential growth is the primary contributor to vehicular pollution. Two-stroke engines, low-quality gasoline, outdated cars, bad maintenance, clogged roads, poor road conditions, outdated automotive technology, and outdated traffic management systems are some of the other causes of vehicular pollution in metropolitan settings. Between 1951 and 2019, the number of automobiles in India grew from 0.3 million to 295.8

million. 39 major cities account for around half of all automobiles. In descending order of contribution, two-wheelers account for the majority of vehicle air pollution, followed by four-wheelers (such as cars, jeeps, taxis, etc.), trucks, and buses. Effect of vehicle pollution: The environment and human health are both negatively impacted by vehicle emissions. The harmful impacts that car emissions have on human health and the environment are many. Acute exposure to pollutants, particularly carbon monoxide, can have both direct and indirect consequences, ranging from decreased vision to malignancies and, in certain circumstances, death. It is thought that the respiratory and cardiovascular systems are directly impacted by these contaminants. Specifically, elevated concentrations of Sulfur Dioxide and Suspended Particulate Matters have been linked to heightened mortality, morbidity, and compromised lung function. Introducing electric vehicles is one of the best ways to solve all of these issues. However, the most important consideration when adopting electric cars is that the electricity needed to run them needs to be generated sustainably through the use of renewable energy sources. Sustainable energy is a type that may be utilized repeatedly and provides our energy needs without running the risk of running out or being exhausted. Since sustainable energy is readily available and doesn't affect the environment, it should be encouraged. To ensure that the polluter pays concept is applied globally, he also discusses the significance of carbon taxes. In doing so, he hopes to lessen the amount of greenhouse.

Free Ride Mechanism

In rural regions, especially in low-income countries, bicycles are a widespread form of transportation. However, they are also becoming more and more popular in metropolitan areas, especially among prosperous and successful individuals. Roadsters, fancy, kids, and other bicycle varieties make up the majority of the bicycle market in India. A variety of other bicycles are available, such as hybrid bikes, touring bikes, mountain bikes, sports bikes, and so on. Bicycle markets may be classified into retail and institutional sectors according to the end user. Residents or those who purchase bicycles from retail establishments for their own use or the usage of loved ones are included in the retail sector. Institutional sales, on the other hand, are typically made in large quantities, with potential clients occasionally including Central or State Governments as well as groups or clubs. Corona has given us a lot of new perspectives. Individuals are exploring new avenues for maintaining their health as they have grown more health-conscious. It is evident from the expansion of the bicycle business that cycling has become a popular form of regular exercise. Because cycling provides a whole body workout in an exciting and energizing way, the new normal has further accelerated the industry's growth. People are aware of the health advantages of cycling, including its ability to ward against major illnesses including heart attacks, strokes, some types of cancer, depression, diabetes, obesity, and arthritis. Regardless of age, cycling is an enjoyable, low-impact, and healthful kind of exercise. Riding a bicycle also contributes to building strength and endurance and provides an excellent muscular workout. It is regarded as an easy and time-efficient workout as well.

Indian E-Bike Market

A bicycle with an integrated electric motor that may help with propulsion is called an electric bicycle, or simply an e-bike. In addition to offering research on market demand, the India e-bike market includes the most recent trends and technical advancements. The market has been divided into segments based on the application, propulsion type, and market share of the leading Indian e-bike manufacturers. The market has been divided into two segments based on the kind of propulsion: throttle-assistance and pedal assistance. The market has been divided into two segments based on Application Type: Cargo and City/Urban. Future-proof transportation seems to be e-bikes, particularly pedelec models. Additionally, they mix the convenience of a vehicle with the enjoyment of riding, making them an excellent form of transportation, particularly for leisure activities. Customers may also ride these bikes across tough terrain, which would be challenging to traverse without an electric motor. In India, e-bikes are growing in popularity due to these features. E-bikes have the potential to become a highly environmentally friendly substitute for the vast number of people who use two-wheelers, as they contribute up to 75% of India's traffic pollution. In recent years, there has been a surge in demand for e-bikes in India. However, the e-bike has also seen a downturn during and after the COVID-19 pandemic, along with other sectors, because of the severe regulations, full shutdown of manufacturing sites, and covid guidelines.

2. Literature Review

The history of the electric bicycle is closely associated to that of the conventional bicycle and motorcycle. In his thesis (Performance Analysis of Pedal Electric Cycles: An Objective and Subjective Approach), Jan Cappelle (2008) traces the beginnings of the principle of the e-bike to the steam bicycle from Machaux/Perraux, which was in production from 1867 to 1871. Though various patents were documented in the 1890s, no major break-through was recorded, mostly since bicycles were generally degraded to be transportation of the poor and the research was concentrating on the automobile industry. “The electrically assisted bicycle or pedelec as it is known today dates from the late80’s” (Cappelle, 2008, p.5). The first successful sales were by Yamaha, a Japanese automotive brand, who invented the pedal assist system (PAS) in 1993. EV Global motors, founded by American car icon, Lee Iacocca in 1997, produced an electric bicycle model named E-bike SX and it was one of the early efforts to popularize e-bikes in the United States (Tergesen, 1997). Since then, there has been a steady growth in the production and sales of e-bikes, with various innovations in types of batteries and designs. By 2007, e-bikes made up to 10 to 29% of all two-wheeled vehicles in China (Johnson, 2013). Though many types of e-bikes are available, there are broadly two types, based on the relationship between the motor and human power: one with a pedal assist and the other with an added throttle. E-bikes with pedal-assist: the electric motor is propelled by pedalling. Also called pedelecs, they have a sensor to detect the pedalling speed, force or both. The motor disables automatically on braking. Thus, the delivered motor power depends on the cyclist’s effort. The amount of motor power depends on the number of sensors and the kind of batteries used, but usually do not go beyond 25km/hr. E-bikes with power-on-demand: The two-wheelers are equipped with an electric motor with throttle along with pedals. The amount of motor power is more or less independently adjustable from the human power input (Cappelle, 2008). There is also a variation without pedals, with only power-on-demand (POD), but these are usually classified as mopeds due to their ability to run without human power. ‘Power kits’ are also available with instructions to convert conventional bicycles into electric. Cappelle (2008) further details out various classifications according to the ease of assembly, location of motor and the working principle of pedelec, but these are outside the scope of this project.

Figure. 1. Porter Forces

Proposed Model Analysis and Interpretation

To specify a business's corporate and legal structure, an organizational feasibility study is conducted. Along with the guiding principles of the company and the expertise the founders can offer, it also contains professional background information about them. A company and organizational structure description, internal and external principles, professional qualifications, and resumes are often included in an organizational feasibility study.

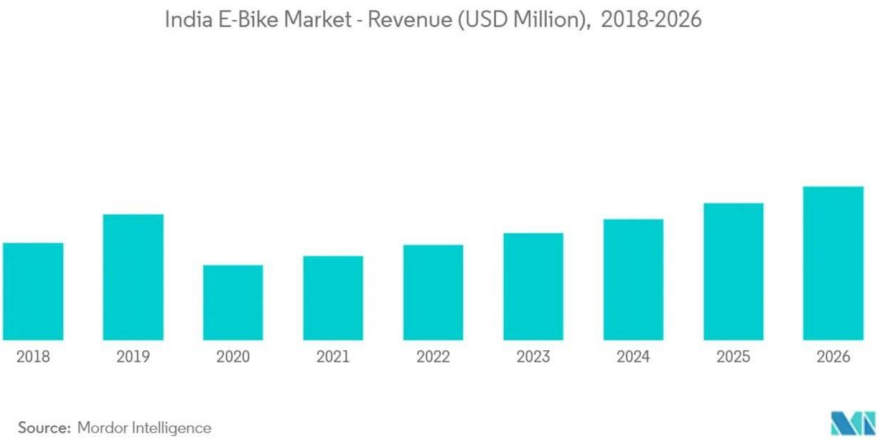


Fig. 2. Indian E-bike market revenue

Fig. 3. Four stages disruptive trend

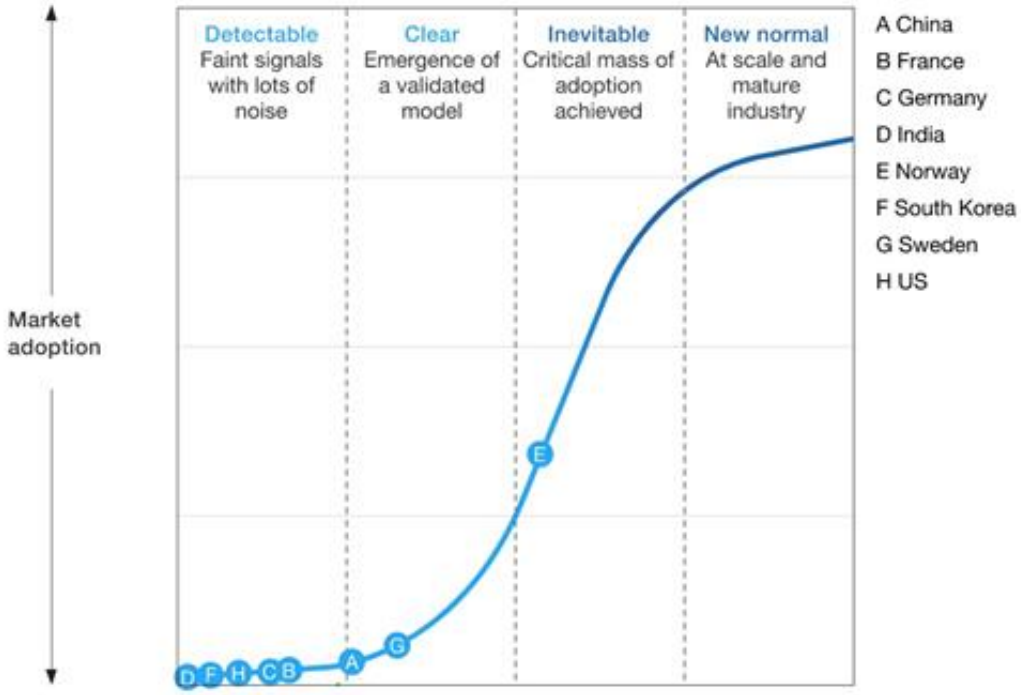
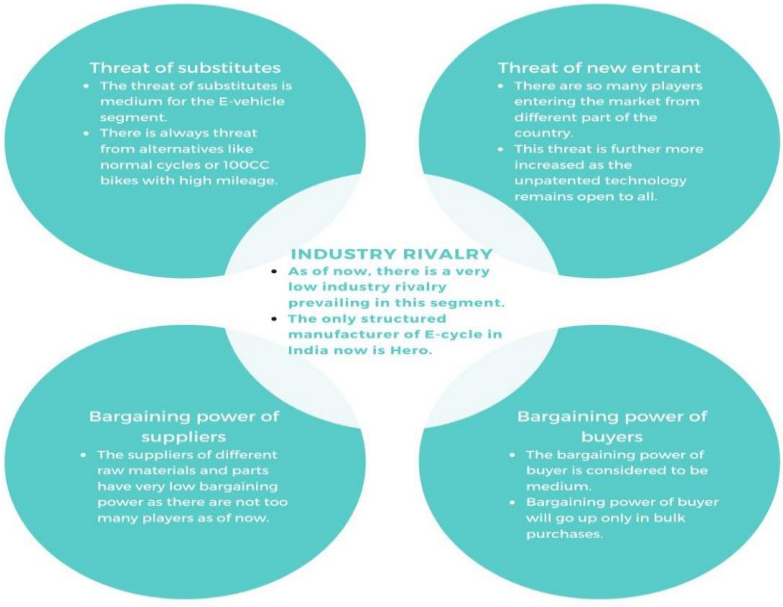


Fig. 4. Swot analysis for E-cycle

Fig. 5. Force Analysis

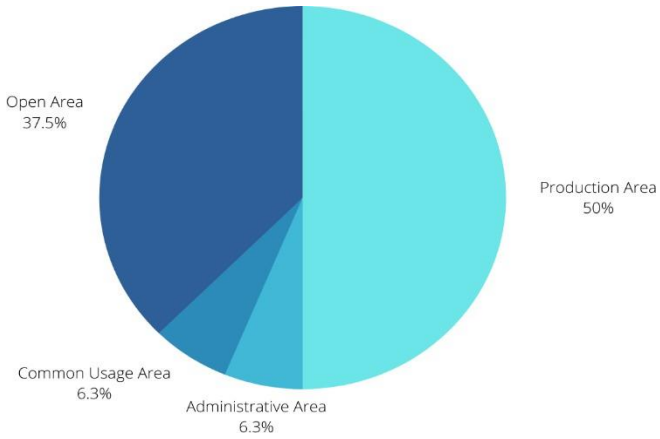


First, we can find the expected investment for the proposed project. The main investment will be constructing the building for the factory where production activity is going to happen. So as per estimations the required production area will be 40,000 sqft where the production activity is going to happen. Other than production area, administrative area, common usage area and open area are also required for the factory. The spilt wise and total space requirement is given below:

Table. 1. Split-wise and total space requirement

Particulars	**Space required (in sqft)**
Production area	40000
Administrative area	5000
Common usage area	5000
Open area	30000
Total	**80000**

Graph. 1. Distribution of land



To know the cost of the building the required space in sqft of the production area must be multiplied with per sqft cost. The per sqft cost is taken as per the current cost prevailing in the market and it is ₹400. So, the total cost of construction of the buildingwill be ₹ 1,60,00,000. The other expenses related to the project are given below:

Table. 2. Expenditure details

Cost of machinery and tools	₹ 1,47,38,000
Office infrastructure	₹ 22,50,000
Working Capital for 7 months	₹ 1,75,00,000
Total other expenses	**₹ 3,44,88,000**

So, by adding the cost of the building and other expenses such as cost of machinery & tools, working capital for 7-month, office infrastructure we get the total investment required for the proposed project.

Table. 3. Cost of building

Rate of construction of building (persqft)	₹ 400
Total cost of construction	**₹ 1,60,00,000**

Table. 4. Other expenses

Year	E-scooters - assembly	E-cycle (in Nos)
Year 1	1500	3000
Year 2	1650	3300
Year 3	1800	3630
Year 4	2000	4000
Year 5	2250	4400

Particulars	Y1	Y2	Y3	Y4	Y5
Revenue					
Sales	₹ 13,50,00,000	₹ 14,85,00,000	₹ 16,27,50,000	₹ 18,00,00,000	₹ 20,00,00,000
Expenses					
Production cost	₹ 9,00,00,000	₹ 9,90,00,000	₹ 10,84,50,000	₹ 12,00,00,000	₹ 13,35,00,000
Marketing cost (15%)	₹ 1,35,00,000	₹ 1,48,50,000	₹ 1,62,67,500	₹ 1,80,00,000	₹ 2,00,25,000
Overheads (5%)	₹ 67,50,000	₹ 74,25,000	₹ 81,37,500	₹ 90,00,000	₹ 1,00,00,000
Finance cost	₹ 33,00,000	₹ 33,00,000	₹ 25,00,000	₹ 20,00,000	₹ 15,00,000
Total expenses	₹ 11,35,50,000	₹ 12,45,75,000	₹ 13,53,55,000	₹ 14,90,00,000	₹ 16,50,25,000
Profit before Tax	₹ 2,14,50,000	₹ 2,39,25,000	₹ 2,73,95,000	₹ 3,10,00,000	₹ 3,49,75,000
Tax (25%)	₹ 53,62,500	₹ 59,81,250	₹ 68,48,750	₹ 77,50,000	₹ 87,43,750
Profit after Tax	₹ 1,60,87,500	₹ 1,79,43,750	₹ 2,05,46,250	₹ 2,32,50,000	₹ 2,62,31,250
Net Profit	12%	12%	13%	13%	13%

Table. 5. Expenditure calculations

Sales and Cost: Company is going to produce and sell two variants E-Scooters and E-Cycles. Cycle market in India is about 12,000 crore and in Karnataka, it is around 2500 to 3000 crores. It is expected that 20 to 25% of this market will be acquired by E-bike segment in the coming years. 25% of cycle market in Karnataka is around 750 crore and this venture is targeting 1% of this market. (Source: India Today) Details of number of E-Scooters and E-Cycle that the company is expecting to produce for five years is given below:

Table. 6. Quantity produced and sold in a year

Cost of machinery and tools	₹ 400
Office Infrastructure	**₹ 1,60,00,000**
Working Capital - for 6-7 months	**₹ 1,75,00,000**
Total investment required	**₹ 5,04,88,000**

Table. 7. Sales information

Year	2W sales	E-cycle	Total
Year 1	₹ 6,00,00,000	₹ 7,50,00,000	₹ 13,50,00,000
Year 2	₹ 6,60,00,000	₹ 8,25,00,000	₹ 14,85,00,000
Year 3	₹ 7,20,00,000	₹ 9,07,50,000	₹ 16,27,50,000
Year 4	₹ 8,00,00,000	₹ 10,00,00,000	₹ 18,00,00,000
Year 5	₹ 9,00,00,000	₹ 11,00,00,000	₹ 20,00,00,000

Table. 8. Cost of production

Year 1	₹ 4,50,00,000	₹ 4,50,00,000	₹ 9,00,00,000
Year 2	₹ 4,95,00,000	₹ 4,95,00,000	₹ 9,90,00,000
Year 3	₹ 5,40,00,000	₹ 5,44,50,000	₹ 10,84,50,000
Year 4	₹ 6,00,00,000	₹ 6,00,00,000	₹ 12,00,00,000
Year 5	₹ 6,75,00,000	₹ 6,60,00,000	₹ 13,35,00,000
Year 1	₹ 4,50,00,000	₹ 4,50,00,000	₹ 9,00,00,000

From the above given data, we can understand the sales figures and cost of production of two variants E- Scooters and E- Cycle separately. The company is expecting to sell more e cycles and the revenue is also high from this variant.

Income Statement

The expected income for five years from the commencement of the business is given below: Sales is expected to grow from ₹ 13,50,00,000 in the first year to ₹ 20,00,00,000 in the fifth year. Production cost which is one of the major components of the expenses also increase from ₹ 9,00,00,000 to ₹ 13,35,00,000. This increase in cost is due to increase in the number of units which the company is producing. Marketing cost and overheads is expected to be 15% and 5% respectively. The PAT or Profit After Tax is expected to be ₹ 1,60,87,500 in the first year and ₹ 2,62,31,250 in the fifth year.

Graph. 2. Revenue expense after tax

Return on investment: The expected investment for the project is ₹ 5,04,88,000 and the expected average return per year from the project is ₹ 1,42,05,166. The discounting factor is set at 13% (bank interest) per year and the detailed spilt up is given below:

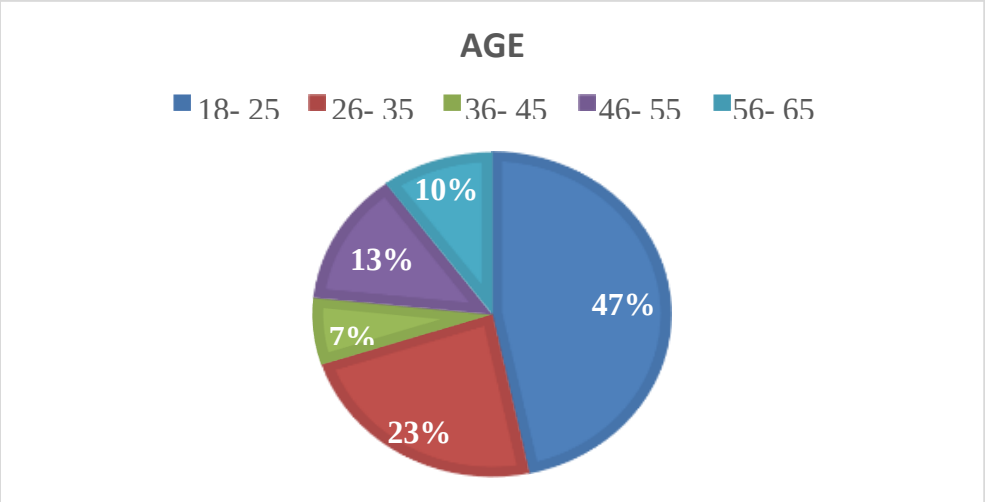
Table. 9. Return on investment

Average return per year	₹ 1,42,05,166
Investment	₹ 5,04,88,000
Return on Investment (ROI)	28%
Breakeven point	3.554200037

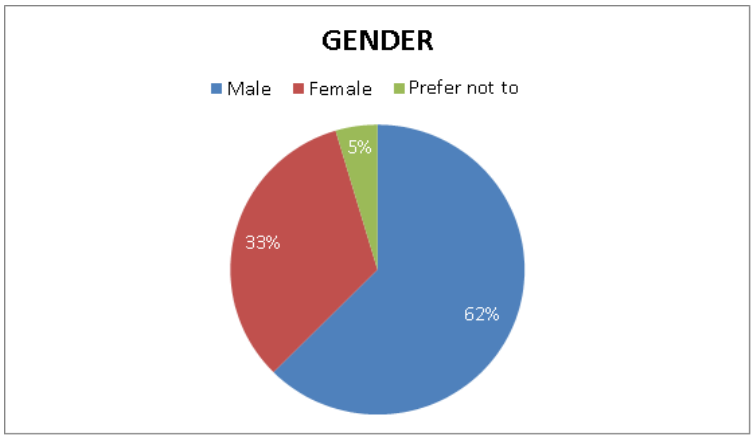
Table. 10. Year base ROI

Year	**Return**	**Discountingfactor @13%**	**Discountedcashflow**
Year 1	₹ 1,60,87,500	0.885	₹ 1,42,36,726
Year 2	₹ 1,79,43,750	0.783	₹ 1,40,52,588
Year 3	₹ 2,05,46,250	0.693	₹ 1,42,39,582
Year 4	₹ 2,32,50,000	0.613	₹ 1,42,59,660
Year 5	₹ 2,62,31,250	0.543	₹ 1,42,37,272
Total			**₹ 7,10,25,828**

Graph. 3. Age details

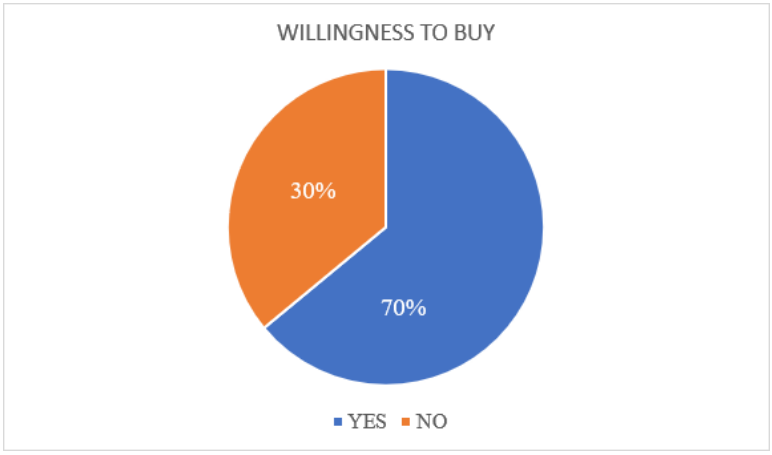


Graph. 4. Gender ratio

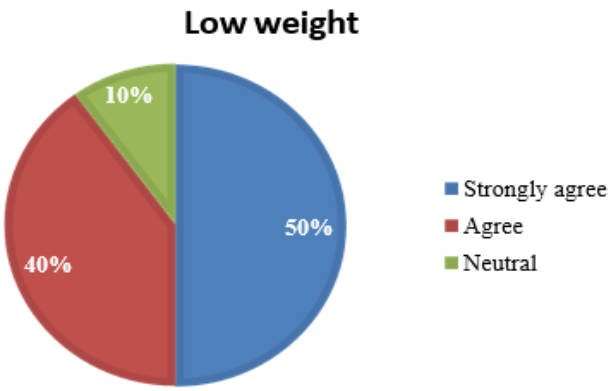


From the survey, it is understood that 70% of the people are willing to buy the E-cycle. Thus, we understand that more than 50% of the people are interested in owning an e- cycle. So, we can go on with the project.

Graph. 5. Interest to buy product

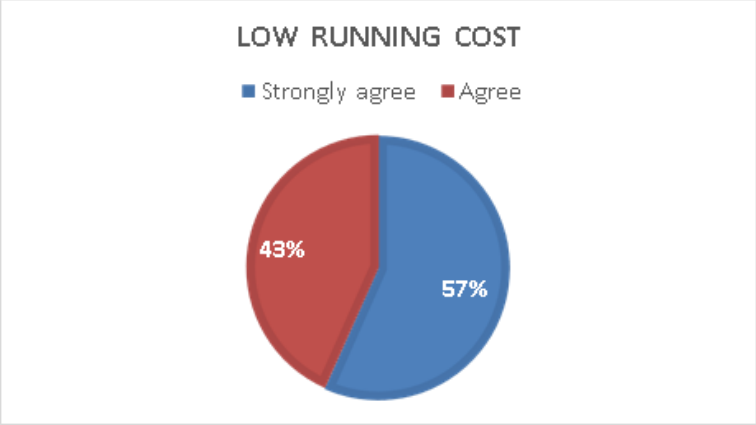


Graph. 6. Illustration of Low weight



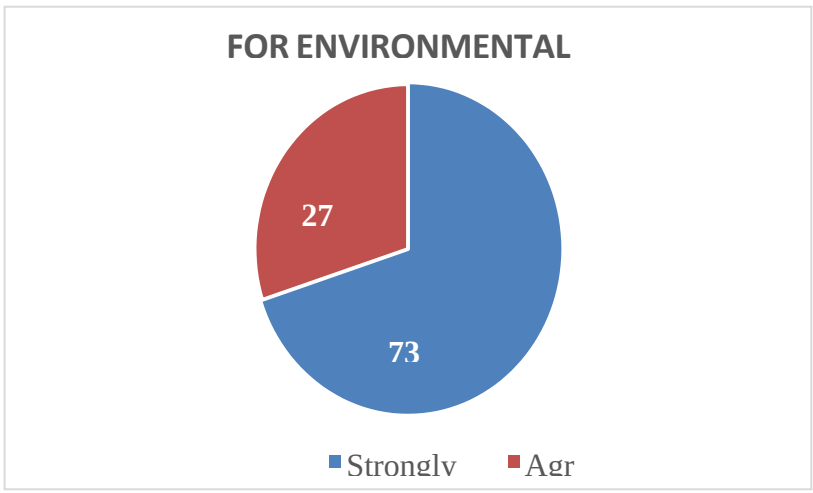
During the market survey, we were keen to know what the features were the buyers were giving maximum importance in the purchase of an electric cycle. About 90% of the participants agreed that they consider low weight as a criterion for choosing E-bike. Out of the 90%, 50% strongly consider light weight cycles. 10% of the participants had a neutral opinion on this criterion.

Graph. 7. Illustration of Low running cost



57% of the participants strongly agree that they prefer electric cycles since they have a low running cost compared to motorcycles. About 43% agreed upon the same

Graph. 8. Environment ratio



About 73% of the people who participated in the survey chose E-cycles due to environmental reasons. They were being more environmentally conscious and prefer to have an eco-friendly product. From this survey, we understand that all the participants of the survey prefer to have an E-cycle. Thus, we understand that there is enough demand for e-cycles in the market.

2. Conclusion

The electronic vehicle sector in India is at the initial stage. All the early entrants with good quality products are most likely to be successful. Understanding the market and finding the target segment is the most important aspect while going into manufacturing of an innovative product. Marketing plays a vital role in getting the product to the right customer. All the traditional marketing channels should be utilized into popularizing the brand name among the public. By doing a detail analysis to understand whether Buildmet should go in partnership with the start-up, I have conclude that it is the ideal time for the company to step into a new venture. All the industrial, organizational, financial and market are in favor of thus, we conclude that the project proposed by the start-up is feasible for Buildmet. I would strongly advise the top management of the company to go forward with this start-up to go forward with this new venture.

3. References

[1] Advertising cost super bowl. (2011). Encyclopedia of Sports Management and Marketing. https://doi.org/10.4135/9781412994156.n6.

[2] Briesch, R. A. (2010). Promotional Bob — contributions to sales promotions. Perspectives on Promotion and Database Marketing, 115–123. https://doi.org/10.1142/9789814287067_others03.

[3] Cappelle. J. (2008). Performance Analysis of Pedal Electric Cycles: An Objective and Subjective Approach.

[4] Celik Z. (2022). The moderating role of influencer attractiveness in the effect of Brand Love, Brand Trust, Brand Awareness and brand image on Brand Loyalty. İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi. https://doi.org/10.46928/iticusbe.1050122. .

[5] Chinnaiyan, R., Kondaveeti Sai, and P. Bharath. "Deep Learning based CNN Model for Classification and Detection of Individuals Wearing Face Mask." *arXiv preprint arXiv:2311.10408* (2023

[6] Chinnaiyan, R., Prasad, G., Sabarmathi, G., Swarnamugi, Balachandar, S., Divya, R. (2023). Deep Learning-Based Optimised CNN Model for Early Detection and Classification of Potato Leaf Disease. In: Bhateja, V., Yang, XS., Ferreira, M.C., Sengar, S.S., Travieso-Gonzalez, C.M. (eds) Evolution in Computational Intelligence. FICTA 2023. Smart Innovation, Systems and Technologies, vol 370. Springer, Singapore. https://doi.org/10.1007/978-981-99-6702-5_47

[7] Das, S. *et al.* (2023). Crowd Monitoring System Using Facial Recognition. In: Bhateja, V., Carroll, F., Tavares, J.M.R.S., Sengar, S.S., Peer, P. (eds) Intelligent Data Engineering and Analytics. FICTA 2023. Smart Innovation, Systems and Technologies, vol 371. Springer, Singapore. https://doi.org/10.1007/978-981-99-6706-3_50

[8] Dhurup M., Mafini, C., & Dumasi, T. (2014). The impact of packaging, Price and brand awareness on brand loyalty: Evidence from the paint retailing industry. Acta Commercii, 14(1). https://doi.org/10.4102/ac.v14i1.194

[9] Dobbs. (2014). Guidelines for applying Porter's five forces framework: a set of industry analysis templates. Competitiveness Review, 24(1), 32-45.,

[10] Iyyappan, M., Kumar, A. "Software Quality Optimization of Coupling and Cohesion Metric for CBSD Model", Computational Methods and Data Engineering. Advances in Intelligent Systems and Computing, vol.1257, 2021. Springer, Singapore. https://doi.org/10.1007/978-981-15-7907-3_1

[11] Iyyappan. M, A. Kumar, S. Ahmad, S. Jha, B. Alouffi, "A component selection framework of cohesion and coupling metrics," Computer Systems Science and Engineering, vol. 44, no.1, pp. 351–365, 2023.

[12] Jinesh Desai, Sumeet Khurana, N.K. Totala. (2022). Competitive Challenge of suppliers with vendors in B2B. Journal of Global Economy, 18(4), 251–260. https://doi.org/10.1956/jge.v18i4.666.

[13] Johnson, T. (2007). Cheap and green, electric bikes are the rage in China, McClatchy Newspapers.

[14] Keller, K. L. (1993). Conceptualizing, measuring, and managing customer-based Brand Equity. Journal of Marketing, 57(1), 1. https://doi.org/10.2307/1252054.

[15] Kyuhyun Lee (2010). The social influence of organizational buying behavior: The effect of social identity and group Norm in organizational buying of Government. Journal of Consumption Culture, 13(4), 67–84. https://doi.org/10.17053/jcc.2010.13.4.004.

[16] Manjunatha, B., & Sampath Kumar, B. T. (2018). A study of usage of internet among the students and Faculty of Dental Sciences in Chitradurga and davanagere districts, Karnataka. Asian Journal of Information Science and Technology, 8(3), 88–93. https://doi.org/10.51983/ajist-2018.8.3.194.

[17] Muhamad, Z.-M., Ruslan, N. A., Ibrahim, N., Saili, A. R., & Ismail, N. A. (2021). Factors affecting consumers' choice in purchasing local fresh fruits: Case of melaka tengah. IOP Conference Series: Earth and Environmental Science, 685(1), 012020. https://doi.org/10.1088/1755-1315/685/1/012020.

[18] Sungheetha, Akey. "Emotion Based Prediction in the Context of Optimized Trajectory Planning for Immersive Learning." *arXiv preprint arXiv:2312.11576* (2023).

[19] Sungheetha, Akey. "Optimized Deep Learning Models for AUV Seabed Image Analysis." *arXiv preprint arXiv:2311.10399* (2023).

[20] Tergesen. Anne. (1997). INVESTING IT; A Bet on Electric Bikes, or at Least on Lee Iacocca. The New York Times