A STUDY OF IMPACT OF RESEARCH AND DEVELOPMENT COST ON SELECTED AUTOMOBILE COMPANIES IN INDIA

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ABSTRACT

For decades, the automobile industry has influenced the world economy dramatically. Since a few years, the automobile industry has been hard at work transforming itself into a technologically advanced industry focused on smart and electrified vehicles and services. The automobile industry has evolved into one of the most important engines of economic prosperity. The automobile industry is a massive industry that includes a wide range of businesses involved in the design, development, manufacture, marketing, and sale of automobiles. Every country's vehicle sector is a significant source of money for the country's economy. This study examines the numerous R&D activities and commercial strategies used by the Indian automobile sector. The impact of R&D investment on these key firm performance metrics will be highlighted in this study, which will be valuable to automobile companies. This could be a useful piece of study for businesses when deciding how to allocate investment funds. For this study researchers using sample of three Automobile Companies for the period of 4 years from 2017-18 to 2020-21. As per the requirement of the research work statistical tools have been used by the researchers. The findings presented that profit before tax (PBT) & Sales has impact on R&D of selected Automobile companies and area where this amount was spent by selected Automobile companies in India.

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***Keywords:** Automobile Industry, Research & Development, indicators, Profit Before Tax, sales.*

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Introduction

One of the industries in India that is growing the fastest is the automobile industry. It ranks sixth in the world for the manufacture of both passenger and commercial vehicles, making it one of the biggest. This enterprise additionally fosters foreign exchange appreciation by exporting 1.5 million automobiles annually. In terms of total sales of passenger and commercial vehicles in 2020, India ranked as the world's fifth-largest auto market with 3.49 million units sold. It ranked as the seventh-largest manufacturer of commercial vehicles in 2019. Owing to a youthful population and expanding middle class, the two-wheeler segment leads the market in terms of volume. Additionally, the industry's growth was spurred by firms' growing interest in exploring rural areas. The car industry in India is the fifth largest in the world. India ranked fifth in the world for automobile manufacturing and seventh for commercial vehicle manufacturing in 2019. The Indian automotive industry, which includes component manufacturing, is expected to be valued between Rs 16.16 and Rs 18.18 trillion (US$ 251.4 and US$ 282.8 billion) by 2026.The automobiles sector is compartmentalized in four different sectors which are as follows:

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- Two-wheelers which comprise of mopeds, scooters, motorcycles and electric two-wheelers
- Passenger Vehicles which include passenger cars, utility vehicles and multi-purpose vehicles
- Commercial Vehicles that are light and medium-heavy vehicles
- Three Wheelers that are passenger carriers and goods carriers

The auto business contains a wide scope of organizations and associations engaged with the plan, improvement, assembling, promoting, and selling of engine vehicles. It involves Passenger Vehicles and Commercial Vehicles. Auto are fabricated utilizing the products of numerous enterprises, including steel, iron, aluminum, glass, plastics, glass, covering, materials, and microprocessors, elastic and then some. The auto business is a capital-escalated and information serious industry, assumes a significant part in the country's financial turn of events. Vehicle industry is perhaps the biggest business in India as well as worldwide.

We realize that advancement or innovative work are fuel for auto industry. Innovative work (R&D) venture is basically how much cash that an organization spends to foster new item/s and administrations typically every year. For instance, assuming a firm recruit's research researchers to foster new medications, the compensations of these specialists will be treated as R&D consumption.

Advantages of Automobile Industry

The vehicle business is upheld by different factors, for example, accessibility of gifted work for minimal price, hearty R&D focuses, and minimal expense steel creation. The business additionally gives incredible open doors to venture and immediate and roundabout work to talented and untalented work.

- **Saturated demand in developed countries**

The sales demand flattening in mature markets like Europe and Japan however in developing countries like India, it has seen growth.

- **Electric Vehicles**

The EV market is expected to grow at CAGR of 44% between 2020-2027 and is expected to hit 6.34 million-unit annual sales by 2027. The EV industry will create 5 crore direct and indirect jobs by 2030.

Limitations of Automobile Industry

- **China-risk of competition**

One of the biggest challenges of automakers outside China, is the risk of competing with China. In the last fifteen years, China has been the leading automotive market. The volume growth has helped the country to overcome other structural and competitive challenges. The biggest challenge for the planners of the automotive market in India is to plan a strategy keeping in mind China's outlook.

- **Carbon dioxide emission**

The major global automotive markets have been facing stringent legislation focusing on controlling carbon dioxide emission and other exhaust gas emissions. This is done to improve fuel economy. One of the key challenges in the industry is to make the right powertrains and technology choices to cater to changing social preferences in a changing regulatory environment.

Current Scenario of Automobile Companies

India is also a prominent auto exporter and has strong export growth expectations for the near future. In addition, several initiatives by the Government of India and major automobile players in the Indian market is expected to make India a leader in the two-wheeler and four-wheeler market in the world by 2020.

- Domestic automobiles production increased at 2.36% CAGR between FY16-20 with 26.36 million vehicles being manufactured in the country in FY20. Overall, domestic automobiles sales increased at 1.29% CAGR between FY16-FY20 with 21.55 million vehicles being sold in FY20.
- In FY21, the total passenger vehicles production reached 22,652,108.
- In October 2021, the total production volume of passenger vehicles (except for BMW, Mercedes, and Tata Motors & Volvo Auto), three wheelers, two wheelers and quad cycles reached 2,214,745 units.
- Two wheelers and passenger vehicles dominate the domestic Indian auto market. Passenger car sales are dominated by small and mid-sized cars. Two wheelers and passenger cars accounted for 80.8% and 12.9% market share, respectively, accounting for a combined sale of over 20.1 million vehicles in FY20.

- In July-September 2021 quarter, the luxury car market registered sales of 8,500 units. Overall, automobile export reached 4.77 million vehicles in FY20, growing at a CAGR of 6.94% during FY16-FY20. Two wheelers made up 73.9% of the vehicles exported, followed by passenger vehicles at 14.2%, three wheelers at 10.5% and commercial vehicles at 1.3%.
- Indian automobile exports stood at 1,419,430 units from April 2021 to June 2021 as compared to 436,500 units in April 2020 to June 2020.

Here is World's top 5 companies in Automobile sector which has incurred R&D expenditure in between 4% to 8% of Sales amount. Due to coronavirus pandemic, this industry is facing the biggest fallback in turnover since their formation.

Sr. No.	Companies	R&D Exp	Sales	%	Currency (In Billion)	Year
1	Volkswagen	17	217	8%	USD	2020
2	Daimler	9	154	6%	Euro	2020
3	Toyota	10	257	4%	USD	2021
4	Ford	7	127	6%	USD	2020
5	General Motors	6	122	5%	USD	2020

- **Volkswagen**

The company's top products include Audi, SEAT, KODA, Bentley, Lamborghini, Bugatti, Porsche, Ducati, Scania, and MAN. The organization is committed to embracing electric propulsion, digital networking, and autonomous driving in order to make their drives safer, quieter, cleaner, and more intelligent. By 2050, the Volkswagen Group wants to be carbon-neutral.

- **Daimler**

2014 saw the introduction of the Mercedes-Benz Future Truck 2025 by one of the biggest commercial vehicle manufacturers worldwide. Future initiatives from Daimler include telematics, autonomous driving software, hybrid powertrain calibration, and research on EV batteries. By 2039, Mercedes-Benz hopes to have all of its new vehicles CO2 neutral.

- **Toyota**

It's a multinational Japanese firm. In order to expedite the research and development of artificial intelligence (AI) technologies, Toyota founded the Toyota Research Institute (TRI) in January 2016. TRI has made investments in cloud, robotics, AI, and autonomous transportation.

- **Ford**

It is United States based company. In May, Ford announced that it expects 40% of its global vehicle volume to be all-electric by 2030.

- **General Motors**

By the middle of the decade, GM will sell 30 all-electric models worldwide, and by the end of 2025, battery-electric vehicles would account for 40% of the company's U.S. entry. This information was disclosed by GM's Chairperson and CEO, Mary Barra, in November 2020.

A Case study on Ethanol Blending initiative in India

In India, a constant transition from petroleum products to sustainable energy sources is seen as necessary in light of the country's growing energy needs for street transportation while also addressing environmental concerns. The country's public biofuel policies mandate the use of ethanol-mixed petroleum. However, the basic raw material supply source that exists today is closely linked to the recurring notion of sugarcane harvesting and its associated expenses.

Furthermore, there are restrictions because, as of right now, ethanol is only deduced from the molasses course. The stock gaps may be filled by second-generation ethanol production employing lignocellulose wastes from sugarcane (used bagasse and sugarcane trash) and other horticulture wastes. According to pilot-scale research conducted beginning in 2009, this move is financially feasible, as evidenced by the reduction in the transformation cost of sugarcane bagasse from ₹ 68 (US$ 0.95) to ₹ 16.5 (US$ 0.24) per liter between 2011 and 2016. This contextual investigation examines how ethanol is mixed with fuel in the Indian context. It includes information on the situation today, predictions for the future, emerging trends, technological advancements, and strategies that are anticipated to lead to increased accessibility of ethanol for street vehicles. It is acknowledged that a special approach is actually needed to assist the tax assessment system and compel the horticulture motions.

- **Situation in India**

In India, the maturation process is the main method used to deliver ethanol from molasses. Simple carbohydrates are converted to carbon dioxide and ethanol by yeast's enzymes. In India, sugar cane contribute almost 90% of the ethanol produced. The idea of using the sugar business to create ethanol is dependent on public opinion, cheap costs involved, high efficiency, and ease of aging. 85–100 kg of sugar and 40 kg of molasses are produced from one ton of sugarcane. Based on the amount of absolute lessening sugar (TRS), the sugar industry mainly delivers three grades of molasses: A grade (half or above TRS); B grade (45-half TRS); and C grade (40-45% TRS). In India, B grade is mostly used to produce ethanol. The rerouting for fuel use occurs when the needs for contemporary and consumable reasons are satisfied. Another possibility for unprocessed substitute components may be sweet sorghum and maize.

Literature Review

Mishra (2018) this study analyzed connection between R&D cost and productivity of Indian drug organizations. This paper zeroed in on various components of R&D action that assistance to support the organization to acquire benefit. Experimentally it observed that there exists critical effect of R &D cost on firms' productivity

Vivek Sharma (2014) investigated Liquidity, Risk and Profitability of Maruti India Ltd. The review was a decade from 2001 to 2010. The gathered information were dissected utilizing different proportions and the specialist additionally applied t test. The investigation discovered that benefit of Maruti Suzuki India Ltd was palatable. The liquidity position of the organization was fluctuating yet was satisfactory. The concentrate likewise proved that the productivity was expanding at great speed showing the proficiency of the organization.

Nishi Sharma (2011) in a review broke down the monetary execution of Indian Automobile Industry. For this reason, the specialist chose four vehicle organizations in India for a time of a long time from 2001-02 to 2010-11. The determination of the organization was done based on their portion of the overall industry. The investigation discovered that the monetary execution of Mahindra and Mahindra Limited as well as Tata Motors was extremely acceptable as far as productivity as well as administrative proficiency to create deals from the utilization of resources. Be that as it may, their liquidity positions were not really sound. The liquidity position of business vehicle produces was superior to traveler vehicle makers. The monetary presentation of Ashok Leyland was similarly poor. A superior long haul dissolvability situation for traveler vehicle industry Maruti Suzuki and business.

Sharma and Reddy (1985) By performing an eight-year study on the liquidity condition of pharmaceutical businesses, they were able to identify the elements that influence liquidity. It was established that government policy on inputs and outputs had a major impact on the company's liquidity position.

Research Methodology

Research Statement

"A Study on Impact of Research and Development Cost on Selected Automobile Companies in India"

About the Research Problem

The car industry appeared to be going through one of its toughest moments during this pandemic's peak. Automakers were already dealing with a number of challenges, including as shifting consumer demands and environmental difficulties brought on by emissions; as COVID-19 expanded, they also had to contend with declining auto sales and unpredictability in the political landscape. Car sales in India were predicted by rating agency In-Ra to drop by 25% in 2020–2021. As a result, the pandemic's onslaught has made the car industry's current problems worse and created previously unheard-of levels of uncertainty among market participants. The auto industry also faces other issues, such as manufacturing stoppages, a decline in vehicle sales, and liquidity. For these reasons, research and development parameters are used to analyse the effects of R&D on the financial performance of Indian auto companies. As a result, the automobile industry benefits from these factors.

Research Design

Research design refers to the framework of market research methods and techniques that are chosen by a researcher. The design that is chosen by the researchers allow them to utilize the methods that are suitable for the study and to set up their studies successfully in the future as well. That effectively

presents the problem of the study moreover it constitutes the collection, measurement and analysis of the data in the systematic way. For this study, researcher had used Descriptive research and convivence sampling method. Motive behind choosing this tool is that this method is useful in describing the data that analyzed through study. Moreover, descriptive study can provide you the overall knowledge about the specific sector in an analytical way.

Objectives of the Study

- To identify R&D impact on financial performance of selected Automobile Companies.
- To examine the impact of R&D cost on PBT and its significance of selected Automobile Companies.
- To study the impact of R&D cost on net sales and its significance of selected Automobile Companies.

Hypothesis

Hypothesis 1

H_0: There is no significant relationship between R&D cost and PBT of selected Automobile company of India.

H_1: There is significant relationship between R&D cost and PBT of selected Automobile company of India.

Hypothesis 2

H_0: There is no significant relationship between R&D cost and Sales of selected Automobile company of India.

H_1: There is significant relationship between R&D cost and Sales of selected Automobile company of India.

Sources of Data

This study is based on the secondary data. The data have been obtained from the annual reports of the selected automobile companies.

Sample Size

The research has been focused on top three companies on the basis of market capital.

Following companies were selected of Financial Year 2020-21

Rank	Company	Market Capitalization (In Crore)
1	Tata Motors	2,49,795
2	Mahindra & Mahindra	75,311
3	Maruti Suzuki	73,308

Tools and Techniques

Statistical tools have been used. In statistical tools, descriptive statistics, correlation, regression, hypothesis testing, etc. have been adopted for the present study.

Period of Study

Present study is taken for the period of four year commencing from 2017-18 to 2020-21

Limitation of Study

The study has been conducted on a single industry. Therefore, the outcome of the present study may not be applicable to the all industries.

Research Variables

The main variable used in the study is R&D spent by selected Automobile companies during the period of the study. To measure impact of financial performance of automobile companies on R&D below mentioned variables have been used.

- PBT (Profit Before Tax)
- Net Sales

Data Analysis and Finding

- **Regression Analysis**

Tata Motors

Table 1: Summary Output

Multiple R	R Square	Adjusted R Square	Standard Error	Observations
0.9875469	0.975248879	0.925746637	316.8475426	4

Multiple R is the 'multiple correlation coefficient". It is a measure of the goodness of fit of the regression model. The Multiple R indicates a strong correlation amongst R&D, Profit Before Tax and Sales. Multiple R- Squared indicates how clearly the model or regression line "set" the data. It indicates the proportion of variance in the independent variable (R&D) explained by the dependent variables (PBT and Sales). In this model of Tata Motors Multiple R is 98%. R-Squared indicates 97% of variation in the dependent variable explained by the independent variables. Adjusted R-Squared is 92%.

Table 2: ANOVA Analysis

	df	SS	MS	F	Significance F
Regression	2	3955681.118	1977840.559	19.7011053	0.15732489
Residual	1	100392.3652	100392.3652		
Total	3	4056073.483			

From Table 2, it can be seen that the relation between R&D and PBT, Sales. However, considering 5% level of significance, p-value of multiple regression model is greater than 0.05 i.e., 0.15. It indicates that multiple regression model does not hold good. Alternative hypothesis is rejected. Null hypothesis is failed to rejected that there is no significant relationship between dependent & independent variables. P-values of T-statistics are also greater than 0.05 which indicates there is no relationship between R&D and PBT, Sales.

Mahindra & Mahindra

Table 1: Summary Output

Multiple R	R Square	Adjusted R Square	Standard Error	Observations
0.821206892	0.67438076	0.023142281	444.2410622	4

Multiple R is the 'multiple correlation coefficient". It is a measure of the goodness of fit of the regression model. The Multiple R indicates a strong correlation amongst R&D, PBT and Sales. Multiple R- Squared indicates how clearly the model or regression line "sets" the data. It indicates the proportion of variance in the independent variable (R&D) explained by the dependent variables (PBT and Sales). In this model of Mahindra & Mahindra Multiple R is 82%. R-Squared indicates 67% of variation in the dependent variable explained by the independent variables. Adjusted R-Squared is 2.3%.

Table 2: ANOVA Analysis

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	408726.2317	204363.1159	1.0355358	0.570630563
Residual	1	197350.1214	197350.1214		
Total	3	606076.3531			

From Table 2, it can be seen that the relation between R&D and PBT, Sales. However, considering 5% level of significance, p-value of multiple regression model is greater than 0.05 i.e., 0.57. It indicates that multiple regression model does not hold good. Alternative hypothesis is rejected. Null hypothesis is failed to rejected that there is no significant relationship between dependent & independent variables. P-values of T-statistics are also greater than 0.05 which indicates there is no relationship between R&D and PBT, Sales.

Maruti Suzuki

Table 1: Summary Output

Multiple R	R Square	Adjusted R Square	Standard Error	Observations
0.785410619	0.61686984	-0.14939048	92.95763261	4

Multiple R is the 'multiple correlation coefficient". It is a measure of the goodness of fit of the regression model. The Multiple R indicates a strong correlation amongst R&D, PBT and Sales. Multiple R- Squared indicates how clearly the model or regression line "fits" the data. It indicates the proportion of variance in the independent variable (R&D) explained by the dependent variables (PBT and Sales). In this model of Maruti Suzuki Multiple R is 78%. R-Squared indicates 61% of variation in the dependent variable explained by the independent variables. Adjusted R-Squared is -14%.

Table 2: ANOVA Analysis

	df	SS	MS	F	Significance F
Regression	2	13912.88854	6956.44427	0.80503952	0.618975088
Residual	1	8641.12146	8641.12146		
Total	3	22554.01			

From Table 2, it can be seen that the relation between R&D and PBT, Sales. However, considering 5% level of significance, p-value of multiple regression model is greater than 0.05 i.e., 0.61. It indicates that multiple regression model does not hold good. Alternative hypothesis is rejected. Null hypothesis is failed to rejected that there is no significant relationship between dependent & independent variables. P-values of T-statistics are also greater than 0.05 which indicates there is no relationship between R&D and PBT, Sales.

- **Correlation Analysis**

	R&D	PBT	Sales
R&D	1		
PBT	0.91415139	1	
Sales	0.263077221	0.077302124	1

Profit before Tax of Automobile companies has highest positive correlation with R&D activities.i.e.,91% Meanwhile, when Automobile companies give more attention to R&D activities, then automatically their Sales is increase. Net sales of Automobile companies also has positive correlation with R&D.

Conclusion and Finding

The research ecosystem in India presents a significant opportunity for multinational corporations across the world due to its intellectual capital available in the country. The main purpose of the study is to analysis the impact of R&D on net sales & profit before tax of selected auto mobile companies' financial performance. Researchers found that there is no significant relationship between R&D and Profit Before Tax and Sales However there are multiple factors affecting the relationship of R&D with Profit Before Tax and Sales like Covid 19 which affected the sales of selected Automobile companies.

R&D has been regarded as a significant factor in enhancing the specialization patterns of an Automobile company's competitive advantage internationally, helps in the maintenance or improvement of existing products, creation of new products and innovation of the production processes of companies thereby improving firm´s financial performance. These results suggest that R&D intensity, the investment in knowledge generation and innovation makes a strong contribution to financial performance.

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