

Technology Innovations by Patenting in the Electric Vehicles (EV) Automobile Industry Neutrality and Opportunities for EV Businesses in Growth by Strong Service Provisions, AI in Project Management and Client Relationships in Decarbonization

Pravin Sankhwar*

Abstract

The electric vehicle (EV) industry is growing at a rapid rate both in production and innovation because of strong decarbonization motivation from both government and private companies. The patents granted offer improved safeguarding commercializing of the invention and protecting the rights of the owner. With the growing EV industry, the patents have risen in number, and in India alone, there are more than 12,00 patents filed between 2017 and 2022. Although only a small number of patents are approved after stringent scrutiny when awarded offer protection of the right of the inventor to be reproduced by others without getting paid a royalty. Some major components of EVs include state-of-the-art batteries, power trains, smart controllers for driver assistance and traction controls, charging mechanisms with improved charging times, and so on. This paper is developed in a manner to determine the impacts of technology innovations by granting patents to revenue generation for the major companies. Additionally, how businesses draw inherent advantages of monopolizing their products in the EV industry was touched base along with the study of strong relationships between parties to drive a successful change in decarbonization efforts in this industry.

Keywords: Decarbonization, electric vehicles, project management, technology innovation

INTRODUCTION

A monopoly market is beneficial to existing businessmen as they can take advantage of this opportunity to gain profits for a long time until there is a new entry or new government regulation imposed, which eventually erodes the market [1, 2]. For instance, the distribution of cooking gas in India is regulated by the government, and no private players are competing with government-owned

*Author for Correspondence

Pravin Sankhwar

E-mail: pravin1989vision@gmail.com

Independent Researcher, Electrical Engineering Consultant,
WSP, US

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companies, giving rise to a monopoly market [3]. A change in government regulations would allow private companies to develop and obtain market share, which would eventually affect the sales of government-owned business organizations [4]. From an economist's perspective, there are several disadvantages of monopoly because of the higher prices paid by customers for services, lesser availability of incentives to cut down costs, and spending for innovations [4].

LITERATURE REVIEW

There are also significant diseconomies of scale that persist, which decrease profitability to some

extent [4]. Owing to the inelasticity in demand created by the monopolistic market, companies can increase prices, and customers must pay higher prices as they have no other choice [3]. For instance, Microsoft can increase the price of its MS Office software because of its monopoly [3]. There is a chance that monopolies gain power from government policies [4]. Some premium car manufacturers can increase the price of their cars because of a monopoly in the type of features offered, which makes it difficult for them to find products other than the brand. Therefore, such companies may be able to take undue advantages and control prices [4]. This means that the vehicle industry is a candidate for gaining market monopoly from major automobile companies [5].

However, from a businessman's perspective, a monopoly would be viewed as an advantage for them to grow businesses [6]. Greater control over the types of goods and services provided by one company dominates the market [6]. For instance, a businessman would look for ways to gain greater control over prices in the market by following malpractices and influencing government decisions by using money and eventually trying to gain power [6]. In addition, businessmen would try to develop a new product line that is again a monopolistic market because of the influence of government policies [6]. Moreover, having enough control over prices for another businessman may sometimes be challenging for their entry [4].

There will be advantages in gaining economies of scale by increasing production [6]. Moreover, the businessperson will be able to invest in research and development to further increase the quality of goods and services. This is because they have a surplus of funds available, are economically sound, can easily invest in new infrastructure, and will be able to hire the best talent in the market [6]. The businessman will be able to offer the best salary and benefits to its employees [6]. An example of a monopoly is a large retail store such as Walmart, which was able to shut down all small-scale retailers by the creation of a monopoly. This is because of their cheaper price offers due to the large distribution network worldwide [6]. There will be no substitutes for the product in the market developed by breakthrough technology [6]. For instance, Microsoft's MS Office product had a monopoly in a few years because of the non-availability of substitutes in the market for these services.

Service Providers

The service industry has been rising and has supposedly contributed to a significant portion of companies becoming part of consulting and IT support services [7]. The idea behind many companies' use of service providers is to reduce costs and allow the inflow of technology, which would otherwise be difficult to cater to the current organizational structure. Many larger firms in the electric vehicle industry rely on outsourcing several divisions of business to companies located in developing countries to gain cheap infrastructure costs. For instance, many chat support and phone support agents are directed to Business Process Outsourcing (BPO) companies that handle a large volume of customer calls [8]. Thus, it becomes evident that service providers are defined as companies or individual entities that provide services to other companies, such as IT services, consulting services, and handling large customer calls. However, there is a service agreement in place between both the service provider and the party that is legally abiding by any issues related to compensation for services, intellectual property exchanges, and so on. When such transactions occur, many businesses prefer to rely on market leaders who offer uninterrupted services within the agreement. Figure 1 shows the exchange of services between service providers and parties using an agreement.

The purpose of this research is to understand the advantages of service providers in the EV automobile sector and other sectors. The idea of hiring a service provider with a party is to take advantage of the improved technology and services that are difficult to find within the organization with available budgets and resources. Moreover, for a global firm, there are advantages in including diversity and knowledge from other entities that are deemed service providers.

Researchers have found that there are challenges to the separation of the service provider from the customer in healthcare where the appointments are held using teleconferencing [9]. Service separation

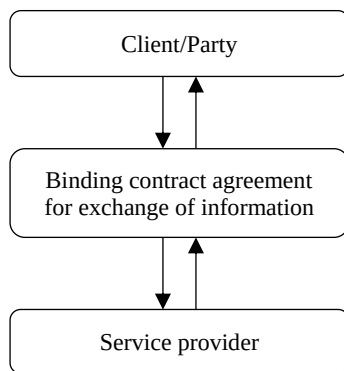


Figure 1. Service providers.

has been studied by researchers, as this often contributes to the lack of engagement with the customer to an extent that otherwise would have been possible with direct interaction. The same thing could be analogous to service providers being located remotely and having limited assistance with online chat or telephonic support. Researchers have found that outsourcing is one of the areas that businesses focus on to meet the needs of the industry [10].

There is a traditional belief in using outsourcing for tasks that are less critical and less skilled. However, with some of the opportunities seen in the increase in profits for companies with cost cutdowns, there has been a shift to some of the specialized areas being outsourced. For instance, the design of product manufacturing is outsourced to third-party service provider companies located in developing countries. Other researchers have also found that service providers are climbing the value chain and shifting towards value-added services, rather than engaging in mundane activities that are often considered less beneficial [8]. Additionally, some companies have utilized service providers to enhance logistics operations.

In real-world applications, let us consider a manufacturing company that needs design work for materials crafted at the flow line. Owing to the increased cost of having a design team within the company, there is a need for higher management to seek help from the service providers to help with design works and other documentation works, which could be expensive to handle both in terms of resources and infrastructure in manpower. Therefore, a strategic decision to hire service provider companies with an agreement in place for the exchange of intellectual property and the flow of information would encourage increased productivity of the materials at the flow line. For instance, design works are often computer-based and require higher skills than labor work involved in manufacturing the products at the flow line. In the local area, there could be a scarcity of skilled personnel, which can easily be obtained from a service provider that has remote staff available.

Project Management

Project management in business studies is a crucial aspect that encompasses all phases of a project, including initiation, planning, execution, monitoring, control, and closure [11, 12]. During these phases, the project is assessed from a scoping perspective to determine whether it is feasible to pursue. Some stakeholders would likely request detailed reports to determine whether the project made sense in terms of capital budgeting and other operational budgeting plans for the company. For example, a project that is planned to be pursued in the next five years must be planned for time so that there is a budget allocation performed after all necessary approvals from stakeholders. Once project funds are allocated, there are stages in planning the project to determine what exact plans should be in place to ensure that execution is performed properly. Finally, monitoring and control ensure the quality of the outcomes, which eventually results in the final closure of the project to ensure that it is ready to close. Thus, the project is not permanent and has a fixed beginning and end. In this study, the aspects of artificial intelligence in project management phases were studied using both quantitative and qualitative approaches.

Artificial intelligence is a tool that helps drive projects within set schedules and desired quality without much human interference. For example, a construction project management schedule and budgeting when run via an AI model aimed at reducing construction costs and time would become a promising solution for project managers working hard to save costs and maintain a strict schedule to keep things moving. AI can ensure improved project management efficiency through an automated mechanism for the entire life cycle of the project. Some managerial positions can be compensated with AI tools and techniques, and many process-related manpower may be replaced with AI tools and techniques to increase the productivity and efficiency of the services. Many times, AI tools can improve the decision-making ability of top management when taking key measures to improve the industry practices followed by their company.

It has been studied that the majority of the projects are not successful even though a huge amount of money is spent on them every year [13], which results in the modernization of the way project management is done these days. For example, AI is not known or has not been explored in the past few years. Machine learning and the training of machines using several techniques have resulted in AI products with cognitive abilities similar to those of humans, which drives research in the direction of modernization of project management. Given that the success rates of a project are highly limited with traditional methods of project management, AI can model to understand what we are lacking in the past so that a successful project is delivered.

Some researchers have studied AI support when delivering project management [14]. This begins with a descriptive statistical analysis and a factor analysis to ensure that a logical approach is followed, and problems are solved using the proposed methodology. Therefore, when the authors performed the statistical analysis, they found that there was a high level of engagement of AI in project management when concerning activities in professional, scientific, and technological fields [14], because there are significant achievements from AI applications in project management processes.

METHODOLOGY

A literature review was conducted to understand the impact of service providers on the global operation of businesses. The impact of monopoly in the industry on advantages to businesses and economists was compared. Whether or not technology improved the revenue for the business was compared using data available for Tata Motors and Mahindra & Mahindra in India for patents granted and revenue generated from 2015 to 2021 and 2017 to 2022, respectively (data were based on statistics and other open-source information available on Google). Based on correlation analysis using JASP, the p-value was obtained for the linear regression results and ANOVA. The p-value of these test results was used to determine whether the relationship between patents granted and revenue for the firms had a statistically significant relationship.

The methodology used here is to document some peer-reviewed research papers to document what artificial intelligence means for project management. There is a need to establish from available research to determine the exact impact on the project life cycle. Because AI is intelligent enough to interpolate and extrapolate the results with reasoning and analysis of similar cognitive strengths as humans, the areas that can be optimized in projects must be documented based on both qualitative and quantitative methods. For example, the number of projects benefiting from AI and the positive outcome of certain processes that implemented AI is something that needs to be explored within the scope of this paper.

For qualitative analysis, the fuzzy risk membership vector was used from research by authors [15]. The risk was compared to political, policy, and legislation to see whether there was a correlation using the JASP program. Table 1 lists the data available from the study done by Xu and Lin [15]. The purpose of establishing a relationship between politics, policy, and legislation is to determine whether both variables have a significant relationship. This is based on an analysis of the results from the correlations.

Table 1. Fuzzy risk membership vector by zones [15].

Zone	Political	Policy and legislation
NG Zone	0.103	0.442
SE Zone	0.123	0.100
RE Zone	0.330	0.158
VE Zone	0.443	0.300

An AI model was trained to decipher the meaning of the p-values and Pearson's R-values and significantly improve the project managers' experience when trying to study the relationships between risks from different categories for a given project.

RESULTS

From Figures 2 and 3, there is steady growth in the revenue of each automobile company, but there is no statistical correlation between the number of patents granted during a year and the revenue for that year. Tables 2–5 document the linear regression and ANOVA results for Tata Motors, Mahindra & Mahindra. This proves that there are no significant disadvantages to patenting technological innovations in the electric vehicle industry when several open-source proponents, such as more open-source projects, ensure that there is no lack of public interest in the same.

The null hypothesis is defined as there is no significant difference between the two variables, and the alternate hypothesis is there is a significant difference between them. They were written as below:

- *Null hypothesis:* $H_0: U1 = U2$: Two variables have no statistical significance differences
- *Alternative hypothesis:* $H_0: U1 \neq U2$: Two variables have a statistical significance difference.

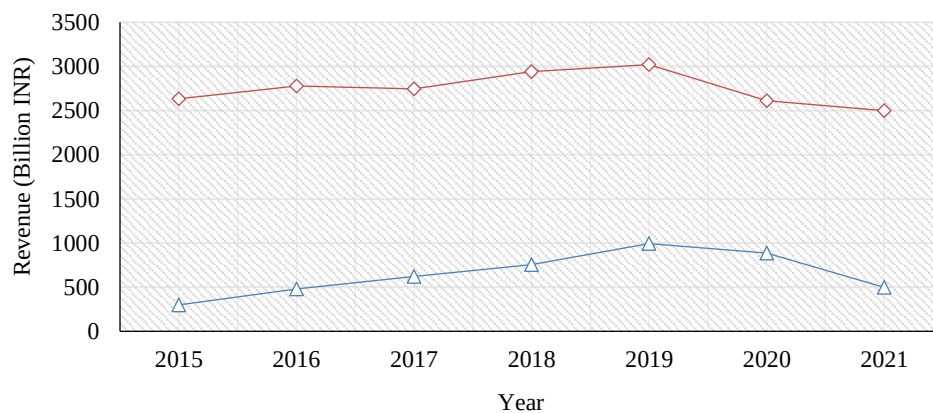


Figure 2. Tata Motors.

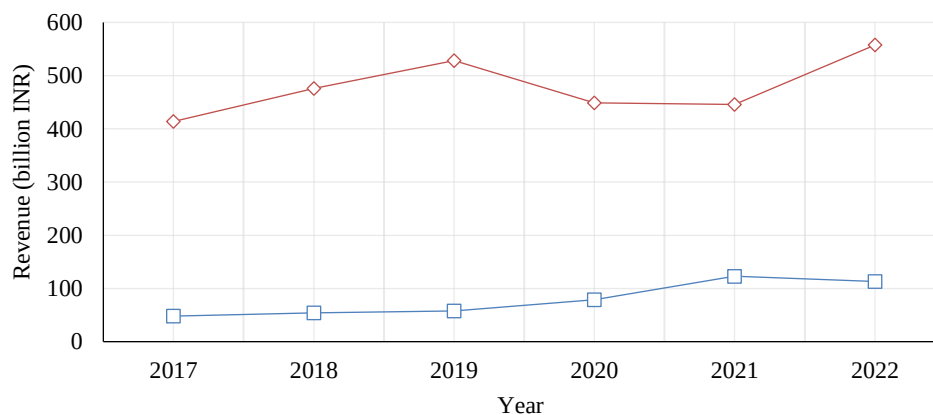


Figure 3. Mahindra & Mahindra.

Table 2. Model summary—Revenue in billion INR for Tata Motors [16].

Model	R	R ²	Adjusted R ²	RMSE
M ₀	0.000	0.000	0.000	185.835
M ₁	0.566	0.321	0.185	167.802

Note: M₁ includes Approved Patents

Table 3. ANOVA for Tata Motors [16].

Model		Sum of Squares	df	Mean Square	F	p
M ₁	Regression	66420.144	1	66420.144	2.359	0.185
	Residual	140787.316	5	28157.463		
	Total	207207.460	6			

Note. The intercept model is omitted, as no meaningful information can be shown.

Table 4. Model Summary—Total revenue in billion INR for Mahindra & Mahindra [16].

Model	R	R ²	Adjusted R ²	RMSE
M ₀	0.000	0.000	0.000	54.572
M ₁	0.260	0.067	-0.166	58.919

Note. M₁ includes Granted Patents.

Table 5. ANOVA for Mahindra & Mahindra [16].

Model		Sum of squares	df	Mean square	F	p
M ₁	Regression	1004.915	1	1004.915	0.289	0.619
	Residual	13885.754	4	3471.438		
	Total	14890.668	5			

Note. M₁ includes Granted Patents.

Note. The intercept model is omitted, as no meaningful information can be shown.

Table 6. Correlation analysis [16].

		Pearson's r	p	VS-MPR+	Lower 95% CI	Upper 95% CI
Political	Policy and legislation	-0.091	0.909	1.000	-0.967	0.953

* $p < .05$, ** $p < .01$, *** $p < .001$

Using JASP [16], the correlation results are documented in Table 6 and Figure 1. Pearson's r-value was obtained which was -0.091 and the p-value was 0.909. Each of these values is statistically significant for determining the correlation between the two variables under study.

Scatter Plots [16] shown in the presented in Figure 4. Based on the results documented for the correlation analysis and the scatter plot, we performed a null hypothesis test to determine the correlation. The p-value was greater than 0.05, which means that the null hypothesis cannot be rejected as the values are not statistically significant. Thus, there is a significant relationship between the political, policy, and legislative variables. Furthermore, when the revalue is analyzed, its negative value shows cases of a negative correlation; with an increase in one, there is a reduction in the other. Thus, politics, policy, and legislation have negative effects on each other.

The graph in Figure 4 indicates the negative correlation curve and becomes a guided path for the AI model when analyzing the data for risks and their correlation for any project. The major limitation of this analysis is that the data were selected from a given paper and may not be generalized for relationships between the political, policy, and legislation risk categories. Fuzzy logic, as presented in the literature, is a great tool in decision-making, but there may be other methods and logical reasoning available to ensure that more human-like cognition is available with AI.

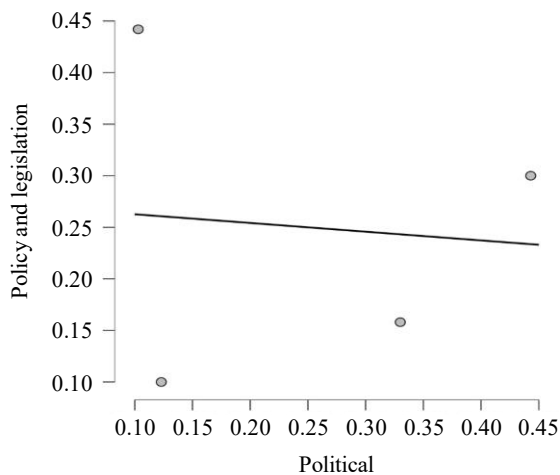


Figure 4. Scatter plot.

CONCLUSION, DISCUSSION AND LIMITATIONS

Technology patenting in the EV industry safeguards the interests of companies but has no significant impact on revenue from the analysis presented in this paper. The results were analyzed based on statistical analysis and comparison of p-values. However, the major limitations are the source of data and the type of statistical analysis tools. Other market-driven factors of supply chain issues for EV and spare parts, and government policies were ignored, and the results were based only on granted patents vs. revenue generation.

In conclusion, a literature review was conducted to understand the significance of service providers and the advantages of improving value-added services for EV industry companies. A practical application was studied for the manufacturing industry to increase production with the use of outsourcing or service providers for design work. The future seems to include more value-added services being used by service providers and opening an excellent scope of their business globally.

The advantages of monopolistic markets were compared between businessmen and economists. From an economist's perspective, it is observed that there are fewer advantages but greater disadvantages. For instance, companies can take an undue advantage and would hamper the growth of other related businesses. However, an established businessman monopoly would help the company prosper and stay at the top of all market players.

Based on the results documented in the research, the risks have a negative correlation, are statistically significant, and null hypotheses are not rejected. Based on the available literature, it has been determined that AI has great potential for improving the success rates of projects through efficient project management. When studying the various processes of a project, such as initiation, planning, execution, monitoring and control, and closure, there were many excellent areas where AI would have great applications to streamline the processes. Although the data used here were dependent on the type of project chosen by the researchers, the results and analysis presented in this paper provide a foundation for AI modeling and training.

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