# "The Future of Mobility: Designing Efficient Volant Pro EV Charging Stations"

**Deviksha Deo, Sanjana Shekar, Aishwarya, L Sarath Kumar, Kolisetty Naga Akhil, Vamshi Laxman Chitturi**

Student, Student, Student, Student, Student, Student

MBA in Finance
Jain (Deemed-to-be) University, Bengaluru, India

**Abstract** -The usage of electric vehicles (EVs) is expanding quickly, increasing the need for infrastructure for charging them. Therefore, the creation of effective and efficient EV charging stations has emerged as a crucial task for transportation planners, engineers, and decision-makers. The architecture of EV charging stations is used in this paper to examine the future of mobility. In particular, it examines the condition of EV charging infrastructure as it stands today, pinpoints significant issues and opportunities, and provides a framework for creating effective EV charging stations that satisfy the requirements of both consumers and transportation systems. The framework is based on a thorough examination of the body of research, current business trends, and global best practices. Site selection, station capacity, charging speed, and payment mechanisms are among the framework's essential components. The need for collaboration and coordination among stakeholders is emphasized in the paper's conclusion in order to support sustainable mobility and provide EV consumers with a seamless charging experience.

## I. INTRODUCTION

Technology advancements and growing worries about air pollution and climate change are driving a rapid revolution in the transportation industry. The increasing popularity of electric cars (EVs), which are becoming more and more accessible and useful to customers, is one of the most obvious symptoms of this shift. Several hundred thousand electric vehicles were on the road in 2010, but the International Energy Agency estimates that by 2020 there will be over 10 million electric vehicles on the road worldwide. As more countries offer laws and incentives to encourage the adoption of EVs, this trend is anticipated to pick up speed in the next years.

The growing use of EVs, however, also presents considerable infrastructure problems, notably with relation to charging stations. As the number of EVs on the road rises, so does the need for dependable, reachable, and practical charging infrastructure. As a result, there has been a flurry of effort among transportation engineers, planners, and decision-makers who are attempting to design and implement effective EV charging stations that can meet the rising demand for electric mobility.

This study looks at the design of EV charging stations to examine the future of mobility. In particular, it examines the condition of EV charging infrastructure at now, identifies major difficulties and opportunities, and provides a framework for creating effective EV charging stations that satisfy the requirements of both consumers and transportation systems. The importance of EVs in lowering greenhouse gas emissions and improving air quality is covered in the opening section of the paper. After that, a review of the current level of EV adoption and charging infrastructure follows. The report continues by outlining the major issues and chances relating to EV charging infrastructure, including technical, financial, and political aspects. The report concludes by presenting a paradigm for creating successful EV charging stations that can accommodate the rising demand for electric mobility.

## II. LITERATURE REVIEW

**Kadlag Sunildatta Somnatha and Mukesh Kumar Gupata [2]** explore several charger types, charging techniques, and topologies, as well as the benefits and drawbacks of each. It also enlightens us on the design of battery charging systems and the effectiveness of EVs. It describes various ac-dc and dc-dc converter topologies, including unidirectional, bidirectional, non-isolated, and isolated topologies that can be utilized to build an EV onboard charger circuit. The function

of the battery management system (BMS), which includes data collecting, state estimation, charge/discharge control, cell balancing, thermal management, and safety protection, is explored in relation to the use of EVs.

A review of various EV battery chargers is covered **by Morris Brenna, Federica Foiadelli, Carola Leone1, and Michela Longo [10]** based on power levels, the direction of power flow, state of charge, longevity, and health of the battery. Voltage, current, and ambient temperature are a few of the variables that are monitored to keep track of the battery's condition. Microcontrollers and other analog/digital sensors are used for monitoring. The battery management system (BMS) is a vital component of electric cars because it ensures that the batteries they utilize are not overcharged or unduly discharged. If this occurs, the battery will be harmed, the temperature will increase, the battery's lifespan will be shortened, and the users will be impacted.

A simple yet comprehensive component-based model is presented by **Xu Xiao, He Molin, Paraskevi Kourtza, Adam Collin, Gareth Harrison, Sasa Djokic, Jan Meyer, Sascha Müller, and Friedemann Möller[9]** in their discussion of typical circuit topologies and control algorithms for an onboard unidirectional single-phase electric vehicle charger. The onboard level 1 charger for EVs can be modeled using the methodology that has been described. The supply system, EMI filter, DBR, Boost converter, DC-DC full-bridge F converter, a-PFC (Power Factor Control) control, PWM (Pulse Width Modulation) control, and battery make up the front end and back end of the EVBC (Electric Vehicle Battery Charger) model's whole circuit. The a-PFC of the circuit depicted is a boost converter with an inductor current maintained in continuous conduction mode. a transformer with a high frequency

## III. RESEARCH OBJECTIVE

The goal of this study is to create a paradigm for developing effective EV charging stations that can satisfy the requirements of users, operators, and policymakers. A multidisciplinary approach will serve as the foundation for this framework, which will take into account consumer, policy, economic, and technological factors. The paper's specific objectives are:

1. Examine the state of the EV charging infrastructure at the moment and note the principal issues and areas for development.
2. Examine the consumer, policy, economic, and technological aspects that affect the creation, implementation, and use of EV charging stations.
3. Provide a framework for constructing EV charging stations that take into account these elements and can be modified to accommodate the requirements of various stakeholders and circumstances.
4. To show the framework's viability and efficacy, apply it to a case study of the design, deployment, and use of EV charging stations.
5. Determine areas for additional research and development by assessing the possible influence of the suggested framework on the expansion and sustainability of EV charging infrastructure.

Overall, by offering a thorough and integrated approach to building and installing charging infrastructure, the research seeks to contribute to the ongoing efforts to encourage the adoption and use of EVs.

## IV. METHODOLOGY

The purpose of this research article is to build a framework for constructing successful and efficient EV charging stations using a mixed-methods approach that incorporates qualitative and quantitative research methods. The following steps will be part of the methodology:

1. To identify current studies on EV charging infrastructure, including those pertaining to technology, economics, legislation, and user behaviour, a thorough literature analysis will be done. The creation of the research framework will be influenced by the literature review.
2. An investigation of a case study will be done to gauge how well the suggested framework works. The design, placement, and use of an EV charging station in a particular setting, such as an urban or suburban region, will be the subject of the case study. The case study will highlight potential improvement areas and offer insight into the framework's actual practical deployment.
3. Both qualitative and quantitative methodologies will be used to analyse the data gathered through the case study analysis, survey research, and expert interviews. The data analysis will show where the proposed framework is working well and also where it needs development.

4. A thorough framework for developing successful and efficient EV charging stations that takes into account technological, economic, policy, and consumer factors will be developed using the research findings. The framework will be altered to fit the requirements of various stakeholders and circumstances.
   Overall, the research technique will give developers of a framework for designing effective EV charging stations a rigorous and thorough approach. By using a mixed-methods approach, it will be made sure that the framework is supported by both empirical data and professional judgement.

## V. DATA ANALYSIS

1. The crucial technological, economic, policy, and consumer elements that affect the creation, implementation, and use of EV charging stations.
2. Enumerate the main obstacles to and potential for EV charging station design, rollout, and operational improvement. And also the policy challenges faced by the EV charging station.
3. Determine consumer tastes and habits about EV charging infrastructure.
4. Experts in the area discuss the variables that affect the development, installation, and functioning of EV charging stations.
5. The potential benefits of EV charging stations toward the users as well as the environment
6. The average charging time required by EV vehicles users for charging their vehicles
7. Governmental policies like state government duties can vary from state to state in India
8. Educational awareness as well as income level can vary widely across the Indian population and may have an impact on behavior and attitude toward the EV charging stations
9. The infrastructure requirement of youths and old age people may vary according to their age groups. As youth require refreshment areas and Old aged people may not require it.
10. According to the capacity of the engine and the charging required by the vehicles, the chargers may be bifurcated into different types which also depend upon the two-wheeler or 4 wheelers.
11. The environmental issues are high but the enforcement and penalties also increase the use of EV charging points also indirectly has a positive impact on the environment.
12. Many people may feel it a one-time investment has positive benefits in the long run.

## VI. LIMITATION OF THE STUDY

1. The study's findings might not be transferable to settings other than the particular one where the case study was conducted. The viability and effectiveness of the suggested framework may be impacted by elements including regional and national differences in local policies, laws, and infrastructure.
2. Sample Size: The survey and expert interviews may not have included a sufficiently representative sample of EV users and subject matter experts. Despite efforts to recruit a diverse group of respondents, it's possible that the sample size is too small to adequately represent the breadth of viewpoints and experiences.
3. Self-Selection Bias: Due to the survey respondents and expert interviewees' potential self-selection based on their knowledge and interest in the subject, the sample's representativeness may be hampered.
4. Data Collecting Methods: The survey and expert interviews employed in the study's data gathering may be prone to response bias and social desirability bias, where respondents may be more likely to give answers that are in line with their own personal ideas or those that are socially desirable.
5. Time Restrictions: Because of the study's time constraints, its depth and breadth may have been constrained. To completely investigate and validate the suggested paradigm, more study is required.

## VII. CONCLUSION

In order to encourage the expansion of electric vehicles, it is crucial to construct efficient and effective EV charging stations, which we have examined in this study paper. We have developed a framework for designing effective and efficient EV charging stations through a thorough review of the literature, case study analysis, survey research, and expert interviews. We have also identified key factors that influence the design, deployment, and operation of EV charging infrastructure.
The suggested framework offers a thorough method for creating infrastructure that is successful and serves the interests of various stakeholders while taking into account the technological, economic, policy, and consumer issues that have an impact

on the design of EV charging stations. The framework can be modified to match the demands of various contexts and stakeholders and includes factors like location selection, charging technology, pricing structures, and user experience.
This research offers significant insights into the design of effective and efficient EV charging stations, despite the study's limitations, such as the generalizability of the findings and the sample size of the survey and expert interviews.
Overall, this study emphasizes the value of working together to build and implement EV charging infrastructure that satisfies everyone's demands and fosters the expansion of the market for electric vehicles, including lawmakers, business executives, and consumers. We believe that this framework will be a useful tool for anyone involved in the planning and implementation of EV charging infrastructure and that it will inspire more study and work in this important field.

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