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Risk Assessment and Reliability in the implementation of Urban Electric Mobility Projects

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The study's objective is to conduct a risk assessment to identify opportunities, risks, and impacts in implementing urban electric mobility projects and evaluate the perceptions of state secretaries and government, Mayors, Manufacturers, service providers, and other stakeholders on the risks. As part of the study, it was necessary to identify technical barrier and/or financial barriers worldwide, define how to use the advantage of renewable energy technologies to bring more reliability to the project, and categorize the risks considering hardware (buses, batteries, material national vs. imported, chargers, electrical centers).

Currently, it is observed an increase in pollution, the emergence of the pandemic scenario covid-19, the opportunity for the emergence of new technologies, the ever-increasing application of the concept of recycling/reusing, the need to contribute to reducing emissions of CO2, the need to optimize costs and resources, the increased reliability, the need for resilience and the need for integration. This scenario shows it is necessary to administer and manage the risks in implementing a project that involves using renewable technologies for mobility as a solution in urban areas, such as electric buses with energy supplied from renewable sources. The study focus on the identification of these risks.

As a methodological approach, qualitative and quantitative data will be obtained from an in-depth literature review on the topic and from stakeholders, such as secretaries and government, Mayors, Manufacturers, service providers, and other stakeholders. FMEA will be used to identify risks and barriers. It will consider the vision of the main stakeholders in the Brazilian market, which can be expanded to the world scenario.

As a result, the authors propose a matrix with opportunities, risks, and impacts and a model that can be implemented to meet current regulations. The model brings the whole concept of sustainability to the center of the solution.

The conclusion is that by working proactively on risks to meeting regulations, digitalization concepts associated with using renewable sources and solutions that contribute to decarbonization can be effective, and cities can be transformed and have a promising future for future generations.

As a contribution, the proposed analysis will demonstrate the existing risks and some of the best responses and possibilities to make this transition contribute to decarbonization and transforming the planet in a better way. The present study augments the knowledge of the engineers/managers and professionals involved with Urban Electric Mobility Projects. Although conducted in Brazil, it can be generalized to other projects, whose safety is affected by lack of risk assessment. The study can change the practice and thoughts of professionals dealing with Mobility Projects.

Keywords: Smart city, resilient cities, net zero, , risk assessment, risk management urban electric mobiliy

1. Introduction

With time, with the increase in pollution, with the emergence of the pandemic scenario covid-19, with the opportunity for the emergence of new technologies, with the ever-increasing application of the concept of recycling/reusing, with the need to contribute to reducing emissions of CO2, with the need to optimize costs and resources, increase reliability, the need for resilience and the need for integration, it is necessary to administer and manage the risks in the implementation of a project that involves the use of renewable technologies for Mobility as a solution urban areas, such as electric buses with energy supplied from a renewable source. By bringing digitalization concepts associated with the use of renewable sources and solutions that contribute to decarbonization, we can transform cities and have a promising future for future generations.

Currently, one of the biggest offenders in the effects is CO2 emissions and when we analyze a city, we can highlight that one of the biggest offenders are diesel-powered buses and trucks that, even with the evolution of technologies over time, still represent more 70% of CO2 emissions. When we talk about a resilient smart city, we can bring the pillar of urban mobility as fundamental and when we apply the transformation to an electric technology with the use of renewable sources, we have the way to start the scenario of this scenario reversal. Another point to highlight is that research related to the subject shows that 60% of people will live in cities and it is increasingly important to change the current scenario.

Thinking of an energy matrix migration methodology for urban electric mobility, we can consider an assessment of the main risks and mitigation actions that can be explored in this process, where throughout this work we hope to demonstrate through risk management and FMEA methodologies: 1- Matrix based on the main points of risks and barriers considering the vision of the main stakeholders in the Brazilian market and which can be expanded to the world scenario. The proposal is to evaluate the perceptions with state secretaries and government, Mayors, Manufacturers, service providers, in addition to the teams responsible for implementing this process. 2 Identification and direction of the main points raised worldwide as a technical barrier and/or financial barrier, 3- How to use the advantage of

renewable energy technologies to bring more reliability to the project, 4- Categorization of risks considering hardware (buses, batteries, material national vs imported, chargers, electrical centers), risks and management of guarantees, cyber security risks since it is necessary to make the best use of platforms and connectivity, quality risks in the provision of services and operation where we must have a very strong focus on management of the people responsible for the execution and implementation of the project in addition to the people who will take care of the day-to-day, risks of changing legislation and regulation, risks in quality and cost of the necessary inputs, in addition to the risk of demand and/or revenue adequate to profitability minimum to investors, cost reduction and benefits to citizens.

The proposed analysis will demonstrate the existing risks and some of the best possibilities to make this transition contributing to decarbonization and transforming the planet in a better way. As expected results, we have the proposal of a matrix with the identification of opportunities, risks and impacts with the proposal of a model that can be implemented in the light of current regulations and bringing the whole concept of sustainability to the center of the solution, contributing with the other benefits already highlighted and financially viable in a replicable model.

Preliminary Risk Analysis and Mitigation Actions

We can highlight that one of the main risk points in the implementation of an intelligent city concept with the implementation of urban electric mobility technologies is the clear mapping of the needs and opportunities of each project. We can highlight: 1- Business Model: Where the best business model should be sought to be implemented, whether it is in an integral solution that includes electric bus technology, recharge infrastructure, substations, systems to manage design, maintenance and power solution in a single scope. Based on the integral solution, we may have variations that fragment scopes to enhance the final solution to the customer. 2- Preliminary Mapping of the necessary technology, such as vehicle size, quantity of passengers, time availability for recharge during the day or consider the concept of night recharge. 3- Recharge infrastructure at storage sites, whether in garages, terminals or specific locations. 4- Reliability in batteries considering performance, minimal autonomy with a complete recharge cycle and technology availability after the manufacturer guaranteed cycle (currently around 8 years with a maximum depreciation of 20% of battery performance). 5- Solution for battery use in projects that may integrate Storage Solutions or that can be reused battery banks in the application of a second cycle in part with manufacturers. 6- Clear definition of the scope of technical assistance, preventive, predictive and corrective maintenance, aiming at agility in maintenance making the vehicles stop as little as possible, in addition to the maintenance of the warranty provided by the manufacturers.

Considering the preliminary points explored, the vast experience in the management of the largest fleet of urban vehicles outside China, the methodology provides for work with specific groups involving bus operators representatives, manufacturers representing both domestic and international manufacturers, involvement of the municipalities and/or states responsible for the granting of services, investors and financing agents and class entities that act as ambassadors of urban electromobility.

Detailing a little more about the methodology, the proposal is at first to evaluate the risks, barriers and opportunities found through the evaluation of the project to implement a new electric bus technology considering the expert groups of the main stakeholders. The proposed groups are: 1- Specialists in Diesel Bus Operation; 2- Experts who work in the manufacture of electric buses, both being manufactured in Brazil and imported; 3- Experts in the Public Power Optics considering the main projects in progress in Brazil; 4- Experts from leading investors and business models developers. Based on the analysis of the sessions of the sessions with these 4 groups, using the risk management methodology, the proposal is the consolidation of the points of attention found, creation of a prioritization matrix considering the relevance score of each of the items worked. From this priority, we return to the groups formed and validate the results of prioritization and worked with the proposal of mitigating the risks found and documentation and registration of steps made to contribute to the success in the implementation of an urban electric mobility project.

In preliminary analyzes we can highlight: A- Risks related to the technical part, such as maximum route, amount of routes, type of pavement, slope of the route, availability of hours for refilling, preventive maintenance, predictive maintenance, corrective maintenance time, availability of Infrastructure in both garage or terminals, in the distribution system; B- Hardware risks: availability of spare parts over vehicle life, battery technology to maintain or optimize vehicle autonomy, type of bus considering maximum size and autonomy with a single recharge cycle; C- Software Risks: Ensure the efficiency of the entire system monitoring software considering vehicles and porters, as well as ensuring proper and safe communication against possible cyber attacks that compromise the operation; D- Power supply-related risks: availability of redundancy in the different feeder and substitution distribution system, renewable energy generation assessment with solar panels in conjunction with storage systems; E- Business Model Risks: Use and apply business models appropriate to each location considering fees received from users, financial subsidies applied by the municipalities and states, 100% integrated business model or made by strategic blocks, duration time of contract and financing origin, besides highlighting the encouraged lines.

Considering the proposed scope and defined steps, we hope to answer the questions described in this paper, as well as generate documentation that can be used for success in the implementation of urban electromobility projects.