AN AHP APPLICATION FOR FAILURE RISK-BASED RANKING OF ELECTRIC VEHICLE PROJECTS

Idriss Abdou
Laboratory of Applied Mathematical Studies and Research (LERMA),
Mohammadia School of Engineering (EMI), Mohammed V University,
Rabat, Morocco
idriss.abdou92@gmail.com

Mohamed Tkiouat
Laboratory of Applied Mathematical Studies and Research (LERMA),
Mohammadia School of Engineering (EMI), Mohammed V University,
Rabat, Morocco
mohamedtkiouat@gmail.com

ABSTRACT

In order to address challenges in the sustainable development of transportation, economy, and environment, governments along with conventional automobile manufacturers and consumers are extremely interested in the development of the electric vehicle (EV) manufacturing industry and market. However, many manufacturers are worried about entering the EV market because of some of the limitations of EVs and government economic policies. A framework for failure risk-based ranking of EV projects is proposed that applies the Analytic Hierarchy Process (AHP) as a method of ranking. The hierarchy structure of the AHP is created with the risk categories, risk factors, and EV project candidates at different levels of the decision. By specifying the failure risk categories and failure risk factors, the ranking of EV project failure risks and the EV projects are accomplished via the pairwise comparison in the AHP. The results from the ranking provide useful information for planning and decision making. In fact, the results of the proposed method make it possible to specify the EV projects that are feasible to carry out and to compare the various projects at the technical and economic level.

Keywords: failure risk-based ranking; EV projects; investment; multi-criteria decision making; Analytic Hierarchy Process (AHP)

1. Introduction

Electric mobility is understood to mean a transport or a moving performance which is intelligent, silent and has zero emission of gaseous pollutants. Electric mobility adapts perfectly to the needs and energetic, economic and ecological stakes required by the various treaties, in particular minimizing environmental pollution. Its use will enhance the national product in electric vehicle technology. A wide range of models and processes have been submitted by various international firms offering individual, common or goods transport in an efficient manner that partially meets the aforementioned requirements. An assessment of the overall energy consumption of the current traffic in the region encourages us to examine the interest in the integration of electric mobility, but at the same time it requires intelligent adaptation

ISSN 1936-6744
https://doi.org/10.13033/ijahp.v13i3.884

to an environment that is difficult to develop (Beeton & Mayer, 2014; Muller & Mayer, 2015; Hulsmann, 2016).

Given the current global trend towards environmental sustainability, EV has been recognized as a promising means to reduce dependence on petroleum fuel and carbon emissions in the transportation industry. For example, EVs can lower carbon emissions by 30-50% and improve fuel efficiency by 40-60% on the average. Scholars and environmentalists regard EVs as a generic cure for many environmental issues, such as urban smog and the energy crisis (Beeton & Mayer, 2014; Muller & Mayer 2015; Nikowitz, 2016; Corno et. al., 2017).

Previously, several EV projects have been proposed (Japanese EV Ecosystem, EV Demonstration Programme in China, Hawaii EV project, Charging up Chile, etc.). All of these EV initiatives have faced numerous problems in reality such as countervailing pressures for change in the automotive industry; social dilemma problems; diffusion of innovations; lack of infrastructure, especially charging stations; poor performances of the battery; and the eternal comeback of the fuel cell. Consequently, it will be very interesting to evaluate the risk of failure of EV projects. The EV project ranking based on failure risk becomes especially crucial when the investment decision needs to be selective and prudent (Beeton & Mayer, 2014; Nikowitz, 2016; Liebl, 2017). This ranking will help administrators identify the appropriate campaign book to make a successful EV project.

This paper proposes a framework for EV project ranking based on failure risk. Since the failure risk of an EV project is composed of different failure risk categories and failure risk factors which may not be mathematically defined in explicit formulas, the ranking based on the absolute measure of failure risk is not feasible. Thus, a ranking method that is based on the notion of relative contribution to failure risk is employed. The applied method is the called the Analytic Hierarchy Process (AHP). The AHP is one of the most widely used multi-criteria decision-making methods (Taylan et. al., 2014; Li & Zou, 2011; Hanin et. al., 2021). The method is simple and is able to combine both qualitative and quantitative criteria. The AHP has shown its applicability for ranking problems involving multiple criteria (Taylan et. al., 2014). The multi-criteria nature of multiple failure risk categories and failure risk factors makes the application of AHP very suitable. The proposed framework realizes the comparison of EV projects with respect to the failure risks and has significant implications for economic and political decision making (Li & Zou, 2011).

The structure of the paper is as follows. Section 2 presents an overview of electric mobility in the world. Section 3 describes the proposed framework. In Section 4, the framework implementation is shown through an illustrative example. We conclude with some remarks in Section 5.

2. Overview of electric mobility in the world

Today, among the many solutions developed to promote the use of energy-efficient and clean modes of transport, electromobility offers interesting alternatives. Indeed, in this environmental context favorable to renewable energies, electric mobility which represents an environmental, climatic, technological and societal stake has its role to play. Despite some reservations about current electricity production, the expected benefits of this mobility, in terms of improving public health, air quality and reducing greenhouse gases and fine particles in the region and atmosphere, are clearly strong.

The goal of electromobility is to offer a new service, including various uses (car sharing, public transport, merchandise, individual, etc.) that are complementary to the current mobility system, particularly in urban areas. However, the development of electromobility is recent, and many aspects require significant improvements (low battery life of electric vehicles, insufficient and unequal deployment of charging stations in the territory, lack of real standards and regulatory frameworks, low acceptance of this new form of mobility by consumers, etc.). For more details, see Leal and Kotter (2015) and Leal (2015).

Electric mobility has reached an advanced stage and is benefitting from various developments whose influence can be expected to become more and more important. These developments include high oil prices, carbon constraints, intermodality and the rise of organized car sharing. In fact, the development of vehicle engine technology depends on changes in infrastructure, mobility, the electricity sector and the global car market, evolution of energy prices, and climate policy (Dijk et. al., 2013). Also, recently several works have discussed the alternatives and barriers for an efficient logistics chain in the manufacturing industry, including the automotive sector, in the context of Covid-19 (Biswas et. al., 2020; Biswas & Das, 2020).

Electric mobility is not intended to replace thermal vehicles in view of the predominance of these vehicles in urban areas. However, it can be a good excuse for a gradual change in behavior. The development of electric mobility and alternative modes of transportation will only be possible with changes in the population's travel habits. For all these reasons, local authorities, through their strategies and actions, are at the forefront of promoting the development of energy efficient and clean modes of transport. Through initiatives at the local level, communities can allow a gradual change in the travel habits of citizens and strategies of private actors, through numerous calls for projects. Supported by the State, all these actors will be able to act together and create synergy in order to favor this type of mobility in the present and future. In Table 1, we present some case studies of EV projects developed in Norway, France, Germany, China, Japan, Chile and United States with the problems experienced.

Table 1
Case studies of EV

Case study	Principle and objective of the study	Challenges and barriers
China (Beeton & Mayer, 2014; Tagscherer, 2012; Zheng el. al., 2018; Bresser el. al., 2018).	China is the world's largest car market and showcases its products at a biennial fair in Beijing. In 2015, China became the first outlet for electric vehicles; 247,000 "zero emission" passenger cars and utilities were registered this year, which was a 300% increase from 2014 according to the Federation of Chinese Manufacturers.	Inadequate infrastructure. Battery replacement and recycling. Low willingness to pay by the consumer.
Norway (Biresselioglu et. al., 2018; Leurent & Windisch, 2011).	Last September, 60% of car sales in Norway were electric or hybrid cars. This small country of 5 million inhabitants aims to ban the sale of gasoline cars in 2025. Norway has 215 clean cars per 10,000 inhabitants, which is the highest in the world. Norwegians have even developed a production line for specific cars.	The capacity of the electrical system to individually recharge each vehicle with economic conditions that are most adapted to the needs of the user. The adequate size of charging points for users connected.
France (Bresser et. al., 2018; Biresselioglu et. al., 2018; Leurent & Windisch, 2011)	The state has set up an ecological bonus along with other financial incentives to purchase an electric vehicle. These aids are available for both individuals and professionals. They are supplemented by other benefits such as exemption from taxes on company vehicles or the gray card tax. Since 2008, the government has introduced an ecological bonus that encourages buyers to move towards new models with low CO_2 emissions for individuals and professionals.	The capacity of the electrical system to individually recharge each vehicle with economic conditions that are most adapted to the needs of the user. Optimizing the connection of these installations to the electricity networks.
Germany (Biresselioglu et. al., 2018; Leurent & Windisch, 2011).	In order to develop electromobility, the German government has granted an environmental bonus of up to € 4,000 for the purchase of an electric vehicle and € 3,000 on a rechargeable hybrid retroactive from January 1, 2016. This long-term financial incentive that was asked for by the German manufacturers could finally make sales in Germany increase.	The development of load control to minimize network needs and optimize the electrical demand. Development of a charging infrastructure for electric vehicles.
Japan (Beeton & Mayer, 2014; Bresser et. al., 2018)	The Japanese EV market is one of the earliest and strongest ones worldwide in terms of sales and industry entry. Since 2005, a combination of factors in Japan has led to the second highest levels of EV sales globally. Innovative OEMs (Nissan, Mitsubishi, Toyota), a proactive electric utility (TEPCO), and leading battery and energy companies (NEC, Hitachi, Mitsubishi, Sumitomo) headquartered in Japan have entered the EV market.	Inadequate infrastructure for battery replacement and recycling. Low willingness to pay by the consumer.

Case study	Principle and objective of the study	Challenges and barriers
United States **(**Bresser et. al., 2018)	In the United States, there are several EV support policies to make EVs more attractive and accessible including, Purchase or lease purchase tax credits (long-term lease with option to purchase) for EVs. Discounts on the electricity bill: this offer applies most often for recharging vehicles outside peak hours (off peak-hours). Easy access to parking points: parking spaces are free. Some even offer free refill possibilities (i.e., Tesla superchargers). The parking time may be limited. Reduction of registration fees: the registration card must be renewed every year or every two years in the United States. Some states offer discounts on these fees. Insurance reductions: In California, discounts are 10% on most insurance contracts.	The consumer's acceptance of EVs. The proper functioning of the electrical system. Development of charging infrastructure for electric vehicles.
Chile (Beeton & Mayer, 2014)	Multiple governmental agencies in Chile have recognized the potential of electric vehicles (EVs) to contribute to air pollution mitigation and reduction of net energy consumption. To achieve these goals, a target of 70,000 EVs by 2020 was established by a Nationally Appropriate Mitigation Plan (NAMA) and e-Mobility Readiness Plan commissioned by the Ministerio del Medio Ambiente (MMA) and the Ministry of Transport and Telecommunication (MTT) in 2012.	The high cost of electric vehicle (EV) ownership is far out of reach for the typical Chilean family. Limited policy incentives for electric mobility.

Table 1 shows that the incentives for electric mobility face several problems to achieve the planned objective. Consequently, it will be important to assess the risk of failure of future EV projects and their corresponding ranking. For this purpose, we applied a multi-criteria decision method called the Analytical Hierarchy Process. Since it is classified as a developing country, Chile is a model for each country that wants to rely on electric mobility. A number of important economic, technological and environmental factors combine to make Chile a particularly compelling candidate for the expansion of hybrid and battery (H/B) EVs in the Latin American market, including the presence of an existing EV charging infrastructure (including Latin America's first EV charging station). However, the weak purchasing power of Chilean citizens and lack of stakeholder's involvement remains a real obstacle. Therefore, mobilization of all parties for electric mobility integration is an important key for a successful EV project (Beeton & Mayer, 2014).

3. Description of framework

The framework proposed in this paper applies the Analytic Hierarchy Process (AHP) as a method of ranking. The AHP was proposed by Saaty (1980) for solving multi-criteria decision-making problems. The decision problems are structured in a hierarchical form which includes a goal, criteria, sub-criteria, and alternatives. The comparison is carried out in a pairwise manner for each level: criteria, sub-criteria, and alternatives. Saaty and McFarlan presented the AHP method in detail in Saaty (1980) and McFarlan (1981).

The ranking score of the p-th alternative is obtained from:

$$S_p = \sum_{r=1}^{G} \sum_{q=1}^{N_{Cr}} W_{C_r} W_{S_{rq}} W_{A_{rqp}} \;\; ; p = 1, \dots, M$$

where W_{C_r} is the priority weight for the r-th criterion, $W_{S_{rq}}$ is the priority weight of the q-th sub-criteria under the criterion r, and $W_{A_{rqp}}$ is the priority weight for the p-th alternative under the sub-criterion S_{rq}. Note that under the goal there are G criteria, each of which is denoted by C_r. There are N_{Cr} sub-criteria under the criteria C_r, each of which is represented by S_{rq}. M is the total number of alternatives. The alternatives with higher ranking scores have a higher priority or rank (McFarlan, 1981).

The framework for failure risk-based ranking of EV projects has the following steps:

1. Create the decision model in a hierarchy form as shown in Figure 1. The model is decomposed into the goal, criteria, sub-criteria, and alternatives levels. The goal is EV project ranking based on failure risk. The failure risk of an EV project is attributed to the failure risk categories each of which includes its relevant failure risk factors (McFarlan, 1981). The criteria level thus contains all failure risk categories whereas the sub-criteria level consists of a number of failure risk factors. The alternative level is at the bottom of the hierarchy structure and has all candidates of EV projects.

2. Following the AHP method as described, perform the pair-wise comparisons for the failure risk categories, failure risk factors, and EV project candidates. Compute the priority vectors as well as their corresponding CR's.

3. Determine the priority score of each EV project.

4. Rank the EV projects according to their priority scores.

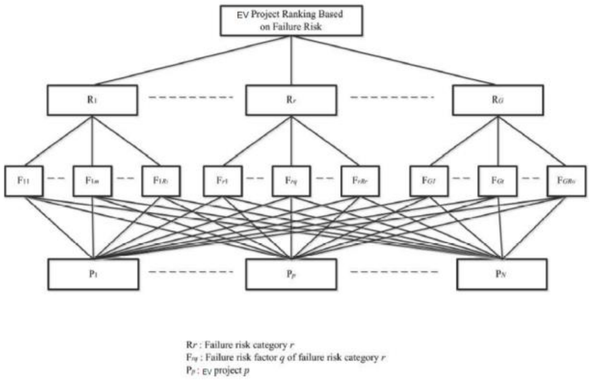

Figure 1 Hierarchy structure of AHP

ISSN 1936-6744
https://doi.org/10.13033/ijahp.v13i3.884

According to the first step in the framework, it is essential to specify the failure risk categories and failure risk factors. There is a series of identified failure risk categories and failure risk factors. However, they can be structured into similar groups. We have determined the failure risk categories and failure risk factors based on the types of problems that have been noted in some previous EV projects all over the world. The resulting failure risk factors were classified into three categories, namely, strategic, process-related and technical. The obtained failure risk categories and factors are shown in Table 2 in accordance with the hierarchy structure in Figure 1.

Table 2
Failure risk

$\boldsymbol{R_1}$: **Strategic risk category**	$\boldsymbol{R_{11}}$: Inexperienced consumers
	R_{12}: Lack of stakeholders' involvement
	R_{13}: Support given by government
$\boldsymbol{R_2}$: **Process-related risk category**	R_{21}: Unclear scope and requirements
	R_{22}: Unrealistic schedule
	R_{23}: Poor budgetary control
$\boldsymbol{R_3}$: **Technical risk category**	R_{31}: Poor performance of the battery
	R_{32}: Inappropriate project development
	R_{33}: Lack of infrastructures

4. Case study

In this case, we consider 4 EV projects that need to be ranked according to their respective failure risks (Table 3). The details of 4 EV projects are presented in Beeton and Mayer (2014). The study was carried out under the supervision of three university professors who have specialized in the field of electric mobility (Mohamed Tkiouat, Mohamed Maaroufi and Mohamed Cherkaoui, professors in Engineers' Mohammadia School, EMI, UMV Rabat). The results are taken from experts after receiving the pairwise judgments as a group with consensus on each judgment.

The failure risk categories and failure risk factors according to Chua (2009), presented in Table 2, are employed for the purpose of method demonstration. Following the AHP, the decision maker evaluates the pairwise comparison matrix of each comparison from which the associated priority vector and consistency ratio CR are computed (Chua, 2009; Sardi & Bona, 2021). In each pairwise comparison, we ask the experts which option is riskier, so that the riskiest factor receives the highest priority.

Table 3
Presentation of the 4 EV

EV Project	Title
EV1	Free-floating all-electric city cars
EV2	Plug-in cars as company cars
EV3	All-electric car subscription
EV4	Leasing chain for all-electric cars

Tables 4-16 present the pairwise comparison with its associated priority vector and consistency ratio CR for the goal, R_1, R_2, R_3,R_{11}, R_{12} , R_{13}, R_{21}, R_{22}, R_{23}, R_{31}, R_{32} and R_{33}, consecutively.

The results from all analyses are summarized in Table 7. Note that the partial score corresponds to the term $W_{C_r} W_{S_{rq}} W_{A_{rqp}}$ in the equation of ranking score.

Table 4
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for the goal

EV Project ranking based on failure risk	$\boldsymbol{R_1}$	$\boldsymbol{R_2}$	$\boldsymbol{R_3}$	Priority vector
$\boldsymbol{R_1}$	1	5	2	0.581
$\boldsymbol{R_2}$	1/5	1	1/3	0.109
$\boldsymbol{R_3}$	½	3	1	0.309
CR=0				

Table 5
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_1

Strategic risk category	$\boldsymbol{R_{11}}$	$\boldsymbol{R_{12}}$	$\boldsymbol{R_{13}}$	Priority vector
$\boldsymbol{R_{11}}$	1	1/6	1/5	0.081
$\boldsymbol{R_{12}}$	6	1	2	0.575
$\boldsymbol{R_{13}}$	5	1/2	1	0.343
CR=0.024				

Table 6
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_2

Process-related risk category	R_{21}	R_{22}	R_{23}	**Priority vector**
R_{21}	1	1/3	1/5	0.106
R_{22}	3	1	1/3	0.260
R_{23}	5	3	1	0.633
CR=0.044				

Table 7
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_3

Technical risk category	R_{31}	R_{32}	R_{33}	**Priority vector**
R_{31}	1	3	1/2	0.309
R_{32}	1/3	1	1/5	0.109
R_{33}	2	5	1	0.581
CR=0				

Table 8
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{11}

Inexperienced consumers	**EV1**	**EV2**	**EV3**	**EV4**	**Priority vector**
EV1	1	5	3	1/2	0.308
EV2	1/5	1	1/2	1/7	0.064
EV3	1/3	2	1	1/4	0.119
EV4	2	7	4	1	0.507
CR=0.007					

Table 9

Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{12}

Lack of stakeholders' involvement	EV1	EV2	EV3	EV4	Priority vector
EV1	1	1/4	2	1/5	0.112
EV2	4	1	5	2	0.472
EV3	1/2	1/5	1	1/4	0.076
EV4	5	1/2	4	1	0.338
CR=0.064					

Table 10

Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{13}

Subsidies given by government	EV1	EV2	EV3	EV4	Priority vector
EV1	1	1/3	1/2	1/4	0.095
EV2	3	1	2	1/2	0.277
EV3	2	1/2	1	1/3	0.161
EV4	4	2	3	1	0.465
CR=0.010					

Table 11

Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{21}

Unclear scope and requirements	EV1	EV2	EV3	EV4	Priority vector
EV1	1	3	5	2	0.470
EV2	1/3	1	3	1/2	0.171
EV3	1/5	1/3	1	1/4	0.073
EV4	1/2	2	4	1	0.284
CR=0.019					

Table 12
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{22}

Unrealistic schedule	EV1	EV2	EV3	EV4	Priority vector
EV1	1	2	5	3	0.470
EV2	1/2	1	4	2	0.284
EV3	1/5	1/4	1	1/3	0.073
EV4	1/3	1/2	3	1	0.171
CR=0.019					

Table 13
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{23}

Poor budgetary control	EV1	EV2	EV3	EV4	Priority vector
EV1	1	3	4	2	0.465
EV2	1/3	1	2	1/2	0.161
EV3	1/4	1/2	1	1/3	0.095
EV4	1/2	2	3	1	0.277
CR=0.010					

Table 14
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{31}

Poor performance of the battery	EV1	EV2	EV3	EV4	Priority vector
EV1	1	3	5	6	0.546
EV2	1/3	1	3	5	0.267
EV3	1/5	1/3	1	3	0.124
EV4	1/6	1/5	1/3	1	0.061
CR=0.078					

Table 15
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{32}

Inappropriate project development	**EV1**	**EV2**	**EV3**	**EV4**	**Priority vector**
EV1	1	1/2	1/3	1/5	0.088
EV2	2	1	1/2	1/3	0.190
EV3	3	2	1	1/2	0.271
EV4	5	3	2	1	0.482
CR=0.082					

Table 16
Matrix of pairwise comparison with its associated priority vector and consistency ratio CR for R_{33}

Lack of infrastructure	**EV1**	**EV2**	**EV3**	**EV4**	**Priority vector**
EV1	1	3	5	6	0.551
EV2	1/3	1	3	4	0.255
EV3	1/5	1/3	1	3	0.127
EV4	1/6	1/4	1/3	1	0.064
CR=0.069					

The ranking score S_p (described in section 3) for an EV project is the summation of all values of the partial score (according to failure risk factors) for that EV project. Applying the equation, the ranking score of EV1 is:

$$S = 0.014 + 0.040 + 0.020 + 0.005 + 0.013 + 0.032 + 0.052 + 0.002 + 0.100 = 0.280$$

The values of the ranking score for the other projects are obtained in the same manner. Based on the ranking score in Table 17, the EV projects in descending order of failure risk are EV2, EV4, EV1, and EV3, respectively. According to R_1 (strategic risk category), EV3 has the lowest failure risk, according to R_2 (process-related risk category), EV3 either has the lowest failure risk and according to R_3 (technical risk category), EV4 is the least risky.

EV3 has the lowest failure risk, which means that the investor can place more investment in EV3 than the other EV projects. Indeed, the EV3 project has a high chance of success because it does not require a large investment in infrastructure. Also, it is beneficial for the consumer to buy an EV in common because he shares the costs with other consumers. We notice that the failure risk of EV1, EV2 and EV4 are convergent which shows the complexity of an EV project. The results also show that the EV1 project is technically difficult to set up and requires a large budget and developed infrastructure (especially the implementation of recharging stations) which is not available in underdeveloped countries. It also requires the determination of consumers to move towards the acquisition of electric vehicles.

EV3 is the least risky project among the four EV projects proposed. As for any EV project, installing the necessary infrastructure is the most important task. When we talk about infrastructure, we are mainly talking about the installation of charging stations for electric vehicles. For this, we have started a technical study of the installation of charging stations for electric vehicles looking at the case of Morocco. To do this, we will first establish the different scenarios for the location of charging stations on the motorway section linking Tanger Med to Rabat in order to choose the most optimal scenario that best meets the various requirements. The results of this study will be the subject of another article.

Table 17
Results summarized

Goal		**Criteria**		**Alternatives**				**Partial score**			
Failure Risk Category	Priority Vector	Failure Risk Factor	Priority Vector	EV1	EV2	EV3	EV4	EV1	EV2	EV3	EV4
$\mathbf{R_1}$	0.581	R_{11}	0.081	0.308	0.064	0.119	0.507	0.014	0.003	0.005	0.023
		R_{12}	0.575	0.112	0.472	0.076	0.338	0.040	0.160	0.025	0.112
		R_{13}	0.343	0.095	0.277	0.161	0.465	0.020	0.055	0.032	0.092
Summation								**0.074**	**0.218**	**0.062**	**0.227**
$\mathbf{R_2}$	0.109	R_{21}	0.106	0.470	0.171	0.073	0.284	0.005	0.001	0.001	0.003
		R_{22}	0.260	0.470	0.284	0.073	0.171	0.013	0.010	0.002	0.004
		R_{123}	0.633	0.465	0.161	0.095	0.277	0.032	0.011	0.006	0.020
Summation								**0.05**	**0.022**	**0.009**	**0.027**
$\mathbf{R_3}$	0.309	R_{31}	0.309	0.546	0.267	0.124	0.061	0.052	0.025	0.011	0.005
		R_{32}	0.109	0.088	0.190	0.271	0.482	0.002	0.006	0.010	0.016
		R_{33}	0.581	0.551	0.255	0.127	0.064	0.100	0.045	0.022	0.011
Summation								**0.154**	**0.076**	**0.043**	**0.032**
Ranking Score								**0.280**	**0.316**	**0.114**	**0.290**

5. Conclusion

EV projects have high rates of failure which lead to devastating economic consequences. A framework for EV project ranking based on failure risk is described. The Analytic Hierarchy Process (AHP) is employed as a ranking method. A hierarchy structure which consists of levels including EV project ranking, failure risk categories, failure risk factors, and candidates of EV projects is defined. These levels correspond to the goal, criteria, sub-criteria, and alternatives in the standard AHP structure, respectively. By specifying the failure risk categories and failure risk factors, the ranking of EV project failure risks and thus of EV projects is accomplished via the pairwise comparison in the AHP. The proposed framework realizes the ranking of failure risks even if the risks are characterized in terms of multiple qualitative attributes. The purpose of this study was to select the EV project with a low failure risk taking into account strategic, technical and operational considerations. This is a reference for all who stakeholders intend to invest in this field.

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