

**Market opportunity analyses and
technical requirements for electric
kick scooters in Finland**

Algorithm of selection the best electric kick scooter

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Abstract <p>The modern world and society more and more question the common statements in different spheres of life. Two of the most discussed ones are the transportation modes and the rise of alternative individual transport. Plus, the environmental concern during the last years has risen significantly. Thus, the concept of electric kick scooters is at the centre of the modern transport revolution. This industry originated in the early 2000s and had significant growth during the previous years.</p> <p>The research objective was to analyze the Finnish market of an electric kick scooter and its potential development. Also, the basement for the future development of the market was established through the analysis of the best suitable type of electric kick-scooter for the Finnish market and its environment. The list of scooters was prepared using technical and customer requirements and demands.</p> <p>The research was conducted using a mixed-methods approach, meaning that qualitative and quantitative data was used as the basis for the study. The theoretical part and the research analysis were based on the literature review, which helped determine the technical requirements, hence, one of the research questions. Also, the survey was used to analyze the customer perception of the market on a par with customers' attitudes and thoughts. The researcher analyzed the market and built a define the best types of electric kick-scooters for the researched market based on the collected information.</p> <p>The analysis results helped build the table of the suitable types of e-scooters and determine the best one. Plus, the statement was made about the possible future implementations of the research for establishing a retail company, the main product of which would be electric kick-scooters. Also, the most important technical and customer requirements were determined on a par with a projection of the market.</p>		
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1 Introduction

"Unsuccessful entrepreneurs usually equate an idea with an opportunity; successful entrepreneurs know the difference!" –

Jeffry A. Timmons

Numerous actions and problems influence the current global situation. Those problems are strictly observed and maintained by many international organizations. In 2015 United Nations and all the member states adopted a particular program called The 2020 Agenda For Sustainable Development, which *"provides a shared blueprint for peace and prosperity for people and the planet, now and into the future."* One of those goals is about the preservation of the ecosystem and nature. (The 17 Goals 2021.) Besides the development of electric cars, sustainable energy, natural plastics, and sustainable fuel, there is a product, which contributes a lot to problem-solving. Electro scooters have no direct environmental harm, produce no CO₂, and the longer they serve, the more ecological advantages they get (Fournier 2019.) Nowadays, the global market of individual electric vehicles is proliferating. According to Grand View Research, the global market of electric scooters is expected to expand at a compound annual growth rate of 10.3 % from 2021 to 2028 (Global Electric Kick Scooters Market Size Research 2020). At that time, the Finnish market is represented only by rental companies in big cities, while small towns have little representation or do not represent the market at all (Yle 2021).

1.1 Background of the research

The aim of this work is analyzing of a growing market of electric kick-scooters, finding opportunities, determining requirements, which will provide the best riding experience in a complex Finnish environment.

The growing market, like a wave, becomes more and more potent over time. For example, the first television was shipped to the U.S. in 1925, and it took twenty-six years to reach 25% of the country (Thompson 2006). In other words, the time for new technologies to reach the population is quite a long time. Therefore, market analyses and determining a real demand led to the success and the top of the new coming wave.

Jeffrey O. Grady wrote that Systems Requirement Analysis gives the professional systems engineer the tools to set up a proper and helpful analysis of the resources, schedules, and parts needed to undertake and complete any large, complex project successfully. Moreover, this utterance could be applied to any project, business, or start-up. (Grady 2005.)

The product's requirements in a growing market should cover all the customer's needs, performance expectations, design trends, and many other nuances such as law restrictions, environmental features, and adjusting to customers' habits. However, more nuances could be predicted before starting the business, better odds this start-up has.

Nevertheless, a successful start-up needs to meet market penetration, fast SKU growth, budget backups, and other business-oriented features, which would not be covered in this thesis.

1.2 The motivation of the research

As it was said above, the ecological problem is a worldwide question, which new coming generations must solve. New technologies must be environmentally friendly and have a high rate of sustainability. From the researcher's point of view, one possible solution could be sustainable vehicles and transportation modes.

The particular example of the electric kick scooters, which can be used on the city center's busy roads, can significantly affect the global pollution situation and reduce car traffic jams on the city center streets. Moreover, the scooter's battery capacity is enough to cover distances up to 30 kilometers with a speed of 25 kilometers per hour (Chang Ma & Darsi 2020).

From a business point of view, the opportunity to create a new sustainable transportation mode, which would be an alternative for public transport and not so expensive as a private car, is a global-wide solution to the environmental and urbanization problems. The business would be supported both by the government and society. The need for alternative vehicles should increase the electric kick scooter market and each company's shares in the industry.

The industry of electric kick scooters is growing rapidly, with a growth rate of 10.3% from 2021 to 2028 (Global electric kick scooters market size report, 2021-2028, 2021). The industry growth moment is the best occasion to penetrate the market and capture the market share.

1.3 The background of the research

1.3.1 History

Baron Karl von Grais de Sauerbrun invented the first kick scooter in Germany in 1817. Almost at the same time, in 1821, the first electric motor was invented. (Faraday 1822. It took less than one hundred years till someone could assemble them. Arthur Hugo Cecil Gibson patented self-Propelled Vehicles in July 1916 (Mansky 2019).

A. H. C. GIBSON.
 SELF PROPELLED VEHICLE.
 APPLICATION FILED JULY 26, 1913. RENEWED SEPT. 28, 1915.
1,192,514. **Patented July 25, 1916.**
 2 SHEETS—SHEET 1.

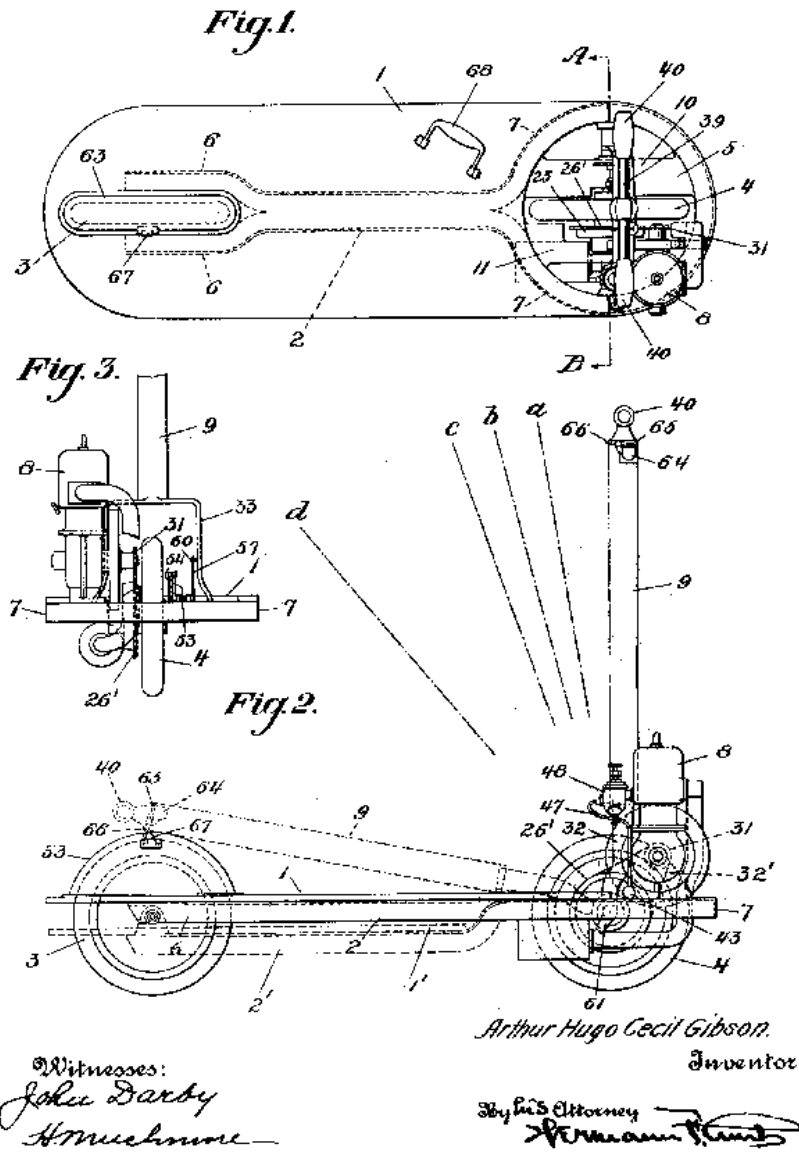


Figure 1 Arthur Hugo Cecil Gibson's "Self Propelled Vehicle," patented July 25, 1916 (Mansky 2019)

The first model based on the patent was produced by an American factory in New York and named Autoped. Big state companies and the army used self-propelled

vehicles since they penetrated the market. The vehicle's primary usage was fast delivery of mail and army commands on short distances.

This invention was not met warmly by society. It was an expensive entertainment mainly for the wealthy elite. The cycling press of the day wrote it off as "a freak vehicle," which had a significant influence on the development of the product. Nevertheless, the Autoped was broadly promoted in the news for people of different incomes.

The most prominent disadvantages were the weight of around 110 kilograms and the high production cost. These two factors played a significant role in this technology's forgotten until the innovative breakthrough of battery technologies.

1.3.2 Technology breakthrough

Akira Yoshino invented the first Lithium-ion battery in 1985, and then a commercial Li-ion battery was developed by a Sony Group Corporation in 1991. Since that time, Li-ion batteries were spread worldwide. They energize devices from smartphones to electric vehicles. (National academy of engineering n.d.)

Most of the electric kick scooters have some type of lithium-ion – Li-ion – based battery pack due to their excellent energy density and longevity. Batteries are one of the most expensive components of the scooter, and overall cost increases accordingly. (Technical guide: electric scooter batteries n.d.)

BloombergNEF's annual battery price survey finds prices fell 13% from 2019. Lithium-ion battery pack prices, which were above \$1,100 per kilowatt-hour in 2010, have fallen 89% in real terms to \$137/kWh in 2020. By 2023, average prices will be close to \$100/kWh, according to the latest forecast from research company BloombergNEF (Henze 2020.)

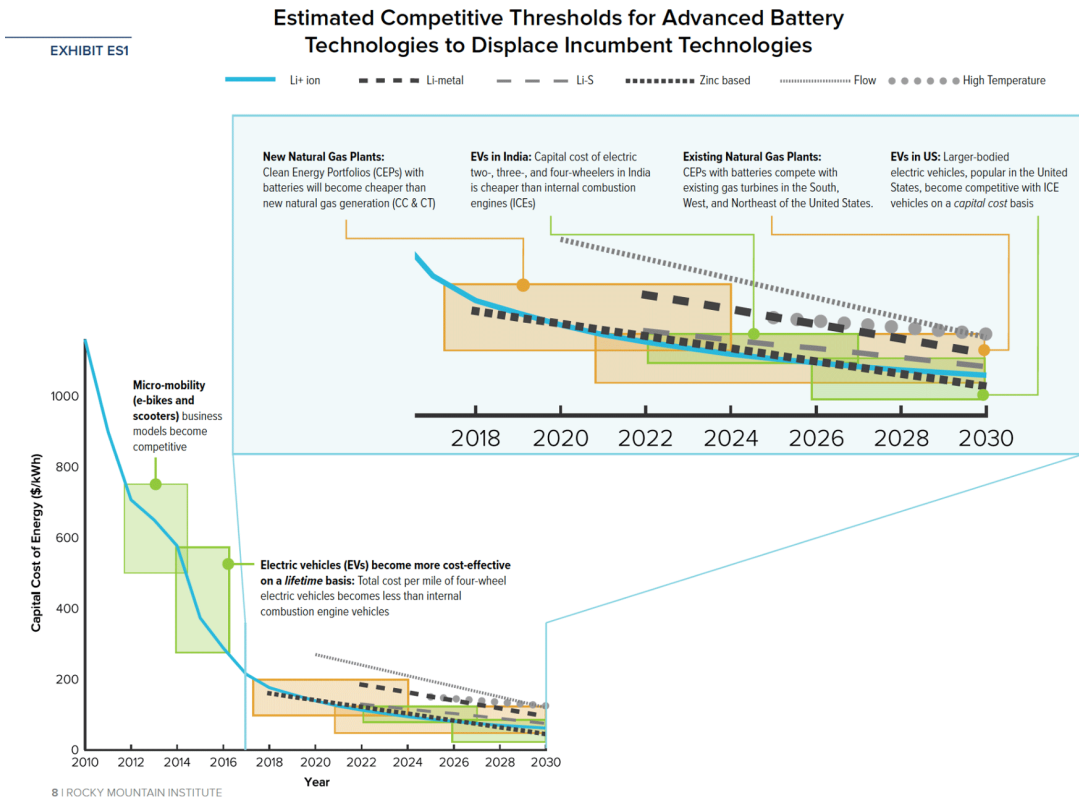


Figure 2 Estimated competitive thresholds for advanced battery technologies to displace incumbent technologies (Hall 2021)

Nowadays, a lot of new battery inventions are announced. Universities worldwide are researching batteries, their capacity, charging time, safety, and other characteristics. Top companies are developing and testing new materials for battery components and the types of assembling them. (Hall 2021.)

1.4 Research question

1.4.1 Research problem

As it was said above, the current situation with kick-scooters is about to be changed. The market is still pretty unknown. It will continue to grow during the present and the next decade (Global electric kick scooters market research report, 2021-2028 2021). The Finnish market of the product is poorly represented by several companies, which main product is a provision of rental services of e-kick scooters in large cities.

One of the most famous parts of Finnish culture is bicycles. The country differs from other countries, where this mode of transportation is popular not only for its convenience and low price but also because of its warm climate. Nevertheless, Finland is one of the most cycling countries in the world. (Wood 2018.) While the culture of bicycles is an unbreakable part of the country, the electric kick-scooters have limited visibility in Finland.

Despite the global tendencies on environment and sustainability, the Finnish electric kick-scooters market is latent and minor growing. In 2020 the market representation of electric scooters on Finnish streets was shrinking. Several major companies went out of the market. Only a few powerful companies left their representation in big cities offering rental services for pedestrians. (Yle 2020.) The first services of rental electric scooters appeared in Finland in 2019 with great acknowledgment in the media. In small cities, the services started to appear only in 2020. (SmartCitiesWorld 2019.)

Thus, the market of electric kick-scooters in Finland is relatively unknown since it is represented only by rental services. That is why the contradiction arises- if the country has adopted the culture of bicycles, despite its severe climate, why electric kick-scooters have such a little representation on the local market, and what can one do with this problem?

1.4.2 Research question and approach

The thesis work should consist of the theoretical part and practical application of knowledge with real-life examples (Zubova 2020, 22).

The first and the main aim of the thesis is to define

- What is the best electric kick scooter for the Finnish market?

By answering this question, the business' competitive advantage can be found in developing a new start-up. The aim is to develop a tool, an excel database, which would provide a rating of the electric kick scooters.

This topic is a wide field of studies, and it would be wise to split the topic and create minor range questions. The first part of the thesis would consist of the opportunities of the electric kick scooters in general. Therefore, the pertinent question can be

- What are electric kick scooter's perspectives on the Finnish market?

This question would be covered by the SWOT analyses of the electric kick scooter's concept.

The next part would be about electric kick scooters' technical requirements, which are needed for comfortable riding and the scooter's long lifecycle in a harsh environment. Thus, the sub-question could be:

- Which requirements have more value on the Finnish market?

This section would cover all types of requirements and consist of some examples best suited for this particular requirement. The requirement prioritization would be summarized according to the survey's responses, which potential customers answered.

Based on the research question, the study would be conducted using cross-sectional analysis since the scooter requirement and technical compositions are analyzed according to the current specifics. Also, the analysis would be done by using a qualitative method. The methods were selected regarding the research questions and their goal.

1.5 Structure of the thesis

The research is written in a logical and wise manner and contains five chapters. The chapters are going through the actual research steps. These chapters represent how the research was implemented, what methods were used, what literature and theory the research were based on, and what results were made by the researcher in the end.

The following chapter - introduction, and the third chapter - literature review, would be the relevant literature-based part of the research. The information would be

analyzed using different academic sources and other reliable data. This information will be critically analyzed. A comprehensive conclusion about the market analysis, opportunity, and preparation of the database on the best suitable electric kick scooters for the selected market will be made. The "Research methods" chapter will include a detailed explanation of the research process and methods that have been used during the research process. The arguments for data collection techniques and data analysis process will be presented in this chapter. The next chapter is number 4, "The study," where the research questions will be answered completely with a detailed explanation of each step. The last chapter, "Discussion," will include the research conclusion, the analysis of the previous chapter, and suggestions for future research.

2 Research methods

In order to solve the research problem and answer the research questions stated above, a study is needed to be implemented. The research itself is a way of finding answers and getting to know the truth about the phenomenon (Kananen 2011). In order to do so, a researcher needs to use special research methods. According to the library of the University of Newcastle, research methods "are the strategies, processes or techniques utilized in the collection of data or evidence for analysis in order to uncover new information or create a better understanding of a topic" (University of Newcastle Library guide 2020).

There is no doubt that it is essential to select the right research methods before the study since it can influence the whole process on a par with the validity of the results. Collection of the needed information from various sources using this or that research methods is included in the data triangulation process. It is required for all researchers to ensure the reliability and validity of their findings.

Another important dimension of research methodology is the objectivity of the research. It is a standard belief that a researcher presents objective and truthful information about the investigated matter. (Dahlberg & McCaig 2010, 14.) Thus, the

research methods help provide a researcher with different tools and techniques to fulfill the requirements.

2.1 Qualitative research

When the research problem and the research questions are defined, the research methods can be determined. There are three research methods: qualitative, quantitative, and mixed research. If the determination of the last-mentioned methods is more or less clear, the meaning of the first and the second one must be given.

Qualitative and quantitative research methods provide a compromise between wide and depth and generalizability and targeting to a specific population (Westat 2002). The qualitative research aims to analyze and describe data in words, meaning that the data collected using this method would be written or said through meanings, concepts, definitions, and metaphors. The qualitative method uses observations, open-ended questions, and interviews in order to collect the needed information. Using different tools mentioned above, the qualitative method of analysis creates a broader understanding of behavior. That is why this method provides broader data about real life and situations. (Eyesi 2016.)

Concluding facts and definitions mentioned above, one can state that qualitative methods of research make it possible to understand attitudes using interviews and open-ended question, it can provide insights that are specific to an industry, it allows using of creativity and giving it a leading role, it incorporates human experience and allows flexibility (Gaille 2018).

Nevertheless, despite the mentioned above advantages of qualitative research methods, there are as many disadvantages of using it. Since there are many secondary data resources, qualitative research may be more time-consuming and more expensive than a quantitative one. Also, the research findings' validity and results can be subjective, affected by the researcher's own experience and beliefs. (Westat 2002.) Thus, when talking about the interview process, a professional person needs to

implement the process, and an even more experienced one to implement the correction and editing.

Another critical point here is that the observation process of a social group of people is something that cannot be fully analyzed and implemented. When talking about society, a researcher must know that there is no subjective way of analyzing it. Also, allowed social experiments might vary from country to country regarding local laws and customs. Plus, the results of such an experiment will always be dependent on participants and their background. (Bogolyubova et al., 2011).

2.2 Quantitative research

On the contrary, there is a quantitative method of research. According to the University of Southern California library, “quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques” (Research guides 2021). Simply put, qualitative research focuses on gathering and analyzing numerical data, centralized statistical methods and mathematical calculation in a theory-building process (Newman & Benz 1998).

The main characteristics of quantitative research are using structured research methods when gathering the data; the research can be replicated and repeated; presented data are in the form of statistical information, arranged in tables, graphs or figures; the usage of questionnaire and computer technologies for data collection and analysis (Research guides 2021).

Based on the presented above facts, the advantages of quantitative methods arise. Often, this research is faster to implement due to the clarity of numerical data and the ability to translate it via modern technologies. Plus, the generalization is more accessible because of the statistical methods. Also, due to the

ability of another researcher to replicate the quantitative study, the greater values of a paper arise. (Eyisi 2016.)

Quantitative research tends to be objective. The data in this research is controlled and measure to address the accumulation of facts. As a result, quantitative research conclusions may be statistically and mathematically significant, but vice-versa humanly. (Research guides 2021).

However, there are some limitations to this approach. Quantitative research requires a more incredible amount of analyzed data since the research is dependent on the overall quality of the collected data (Eyisi 2016). Another drawback is that quantitative research is often implemented through computer software and other tools, which subject to errors and mistakes in measurement. Thus, this kind of research results can be wrong and reliable for the future. (Dowd n.d.)

Also, the disadvantages of quantitative research are: it may miss some contextual details; inflexibility process of discovery; the subjectivity of research appears when preparing questions; results of this study does not reflect behavior, motives and attitudes; unnatural and artificial environment of research (Research guides 2021).

2.3 Mixed method

The term mixed method refers to the process of mixing quantitative and qualitative methods within a single investigation. Such integration allows the performance of biliteral and more complete data than two different data collection methods and analysis (Wisdom & Creswell 2013).

Mixed-methods research can be implemented in a manner that a qualitative approach starts a study, stating a theory or a hypothesis, and be continued with a quantitative approach, validating this earlier stated hypothesis by mathematical data (Newman & Benz 1998).

A mixed-method design is better suitable for investigating questions that cannot be answered using only quantitative or qualitative methods. This method can be used to obtain a better understating of connections of connection between quantitative and qualitative methods; it can provide an opportunity for participants to express their opinions broader and even influence the research. Also, this method provides a researcher with more extensive available data and its collection techniques to build results using different tools and perspectives. (Shorten & Smith 2017.) However, the main disadvantage of mixed methods is the cost and time-consuming process of collecting and analyzing data on different grounds (Newman & Benz 1998).

Considering the specifications of the research question of this study, it was considered to use mixed methods research. This decision was taken regarding collecting qualitative data through articles, course books, academic research, and quantitative data through mathematical analysis and surveys.

2.4 Data collection

There would no research without data, the one collecting to build a conclusion and find results. The data collected for research can be classified into two major types- primary and secondary. Regarding what type of data a researcher uses in one's own study, the data collecting methods would be different.

Primary data is collected directly by the researcher for the first time. It is original in its nature and is collected specifically for actual research purposes. (Akua 2021.) This type of type opposes the secondary type by being collected by the researcher through the actual interaction with the studies environment. In contrast, secondary data is collected through already published and available researches. Primary data is more reliable and objective since it has not been altered by a human. (Kabir 2016.) The objectivity of this type of data is one of the strongest advantages since any researcher tries to reach the objectivity of one's own study.

In a counterweight of primary data, there is secondary, which is collected by a researcher from secondary sources of information such as archives, data storages and already published authorized sources (Rabianski 2003). Secondary data is the data, which has already been collected by some other researchers for other purposes, meaning that this kind of data can be reused by later in another study (Hox & Boeije 2005). Secondary data is less expensive to collect. Plus, the detachment of an applicant from the data accuracy and its quality is a strong advantage (Syed 2016).

Although secondary data is easier to obtain, rather than primary data, the question of reliability arises. In order to ensure the reliability of this data, journalists always rely on their members to validate materials. (Newman & Benz 1998.)

On the other hand, primary data is more reliable since it had been collected, especially for the needs of the actual research. However, this type of data is harder to obtain and analyze. The main tools for collecting primary data are surveys, interviews, focus groups, tests, and observations that need much analysis. Each of these methods differs from one another in questions of costs, time, and quality of received data. ((Newman & Benz 1998.)

Thus, those two types of data carry out their advantages and disadvantages. As mentioned above, primary data wins by its reliability and validity since it is collected according to the specific research needs. Also, additional data can be obtained if it is required. (Kabir 2016.) On the other hand, the primary day is less expensive and faster to collect. While using secondary data, there is an opportunity to use conclusions of a previous researcher and study a historical development of a concept or a problem. (Syed 2016; Newman & Benz 1998.)

As usually, both kind of data carries their disadvantages. As for the primary data, it is costly, hard to analyze and validate (Newman & Benz 1998). Secondary data is less reliable, less focused on the specific needs of actual research (Syed 2016).

Talking about this specific research, the one found it wrong to use only one type of data. To minimize risks and disadvantages, the decision was to use both primary and

secondary data. Also, the usage of two data types was dictated by the specification of the research question and the research problem. There is a need to collect secondary information about the technical requirement of an electric kick scooter and its construction, market description, and analysis. On a par, do a survey and collect to collect primary data from potential customers and users of kick-scooters. After the needed data was collected, it became possible to draw a conclusion about the Finnish market and its current level of development. Plus, the research results were based on the information about technical requirements and needs, and wants of potential customers and present users.

2.5 Survey

Simply put, a survey is a methodological tool to collect needed information without direct communication with the target audience. The information is collected using open-ended or test questions. Depending on the analysis methods and questions, a survey can be both qualitative and quantitative. However, it is mainly used to collect quantitative data. The researcher is the only party to determine whether to use a survey as a qualitative or quantitative source of information. (Walliman 2011.)

To collect the needed information, a researcher needs to consider the following factors:

1. The type of needed information
2. The depth of the information
3. The time needed for respondents to ask the questions

(Jovancic 2018.)

Another important focus point when building the survey is its length. Considering the modern overwhelming amount of absorbed content, a common internet user would not sit in front of the long questionnaire for many hours to pass it. Having this in mind, the length of the survey should not be more than 10 questions. Talking about the questions, they should be short with one or two lines of text. (ibid. 2018.)

A researcher should also consider the type of used questions. In general, there are two types of questions: open-ended and close-ended. The first type of questions allows the respondents to answer what they want and tell what they feel. It brings more freedom for the respondents and elimination of bias for the researcher. However, the open-ended question takes more time to answer and is harder to analyze. On the contrary, there are close-ended questions, which allows the respondents to select from a provided set of answers. It makes the process of answering faster. Also, those questions are easier to analyze. On the other hand, sometimes those questions do not allow the respondents to answer what they think is right since the range of answers is limited. (Walliman 2011.)

There are many ways to reach potential respondents: email, post, or personal. Nevertheless, regardless of the methods, each survey should include information about the purpose of the collected data, the privacy policy, and who the researcher is. All this information can be stated in the introduction. (ibid. 2011.)

2.5.1 The research survey

According to the initial plan, at this point, key performance indicators should be determined. However, who can know it better than end customers?

The aim of the survey was to connect a customer's point of view with an engineering one. The questions and the answers had to be informative for both customer and engineer. Also, the survey should cover most of the common answers because of multiple-choice questions.

Nowadays, there are many articles and promotion pages, which provide information about advantages and disadvantages of whatever. Nevertheless, not any opinion should be counted. The survey focused on the ordinary young and middle-aged people of Central Finland and a capital city region. Some of them might never try an electric kick scooter. So, the first question was determined: Have you ever tried to ride an electric kick scooter?

The whole structure of the survey looks as follows:

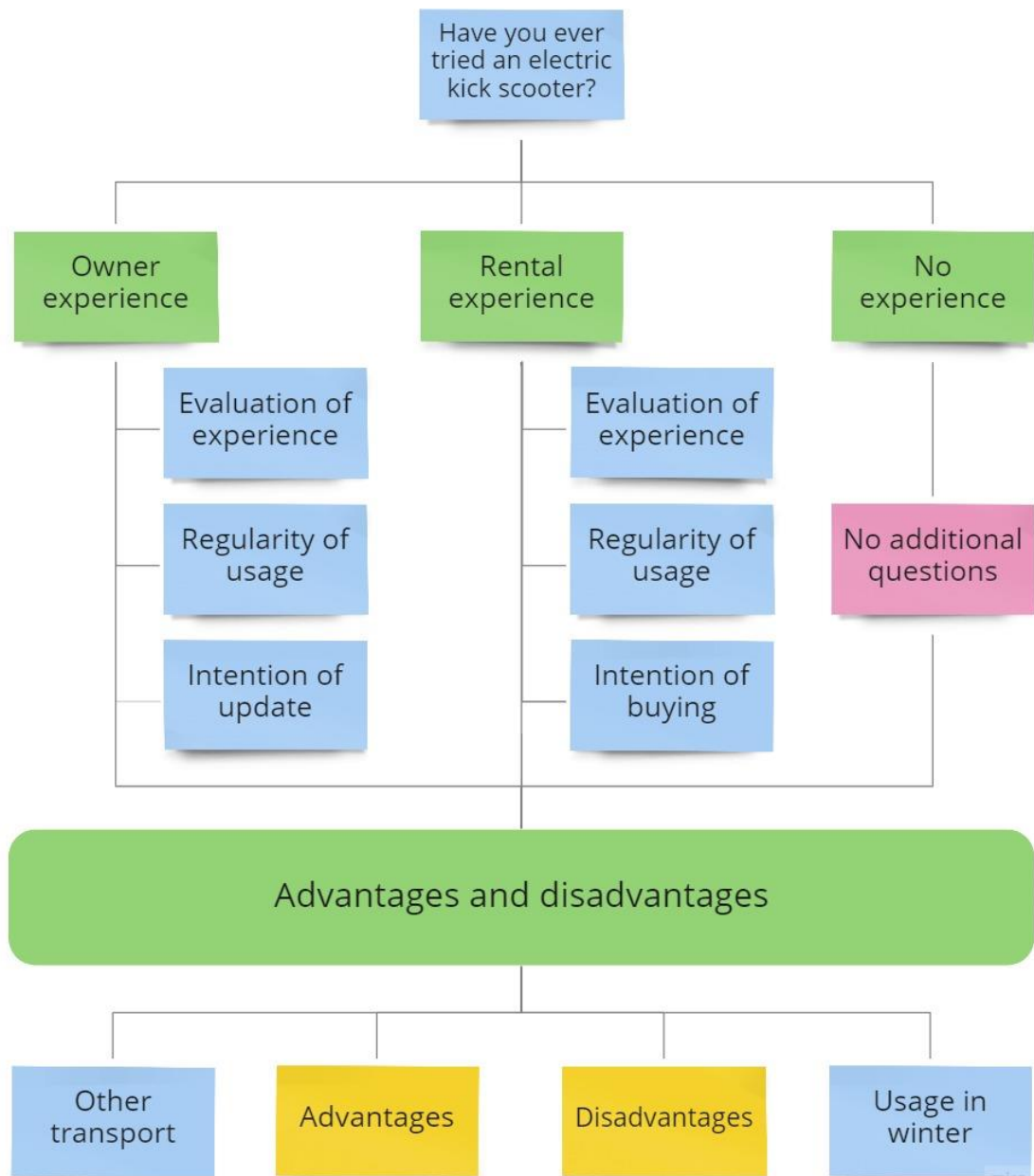


Figure 3 The structure of the survey

Each person has their own experience. Therefore, there is no sense to ask the same questions from the scooter owner and from one who never tried it. The owner and a person with experience can answer the more specific questions. So, some additional questions could be asked from them.

Nevertheless, each participant should end up with a list of advantages and disadvantages, which could be found with or without riding experience. These are one of the most interesting answers for the researcher.

The evaluation of experience, the regularity of usage, the intention to buy or update, another transport usage – these parts should be used as grounds for the SWOT analyses. Advantages and disadvantages are the primary sources for the technical requirement analyses.

The survey was created in Google forms. No verification was needed to pass the survey. The survey was shared through academic resources and social media between students and people aged between 16 and 32. As it was said above, the applicant's identity cannot be determined, so just a row of data was collected.

3 Literature review

3.1 Product and market analyses

Most start-ups use business plans due to their benefit to create a blueprint road map for development and growth. The plan carefully articulates the merits, requirements, risks, and potential rewards of the opportunity. Even if the outside capital raising is not needed, this homework is vital for a successful start of the business. (Timmons & Spinelli 2009, 270.)

According to the business plan template by Timmons and Spinelli (2009, 276.), new start-ups should follow the structure as follows:

1. EXECUTIVE SUMMARY
2. **THE INDUSTRY AND THE COMPANY AND ITS PRODUCTS**
3. **MARKET RESEARCH AND ANALYSIS**
4. THE ECONOMICS OF THE BUSINESS
<...>
12. THE FINANCIAL PLAN
13. PROPOSED COMPANY OFFERING

The thesis aims to create a research base for the second and third chapters of the business plan by Timmons.

3.1.1 Timmons model

For a more profound theory, Timmons explained the model of the Entrepreneurial Process. This model looks like a triangle where the vertices are Opportunity, Team, and Resources. The edges which connect them are Communication, Leadership, and Creativity. At the base of the triangle, the founder is located, whose mission is to keep the balance in the whole structure.

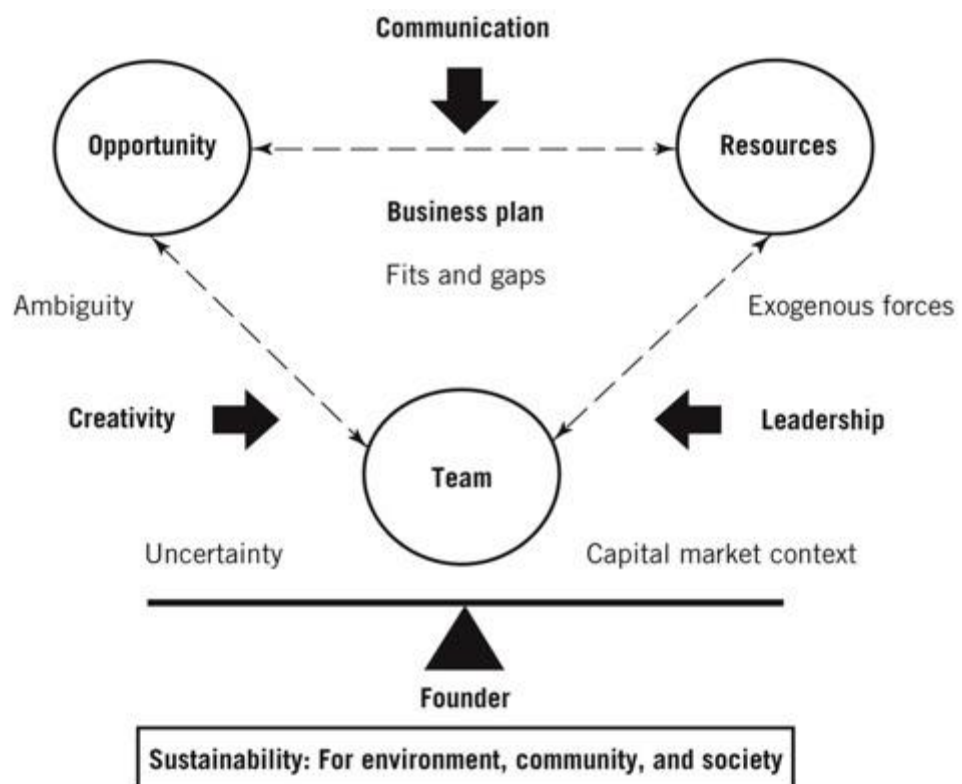


Figure 4 The Timmons model (Timmons & Spinelli 2009)

Timmons pays more profound attention to the Opportunities. He writes that the process starts with an opportunity, not money, strategy, networks, team, or the business plan. Not either the talent and capacity of the team or the initial resources are so essential for a start-up as a genuine opportunity.

3.1.2 SWOT analysis

SWOT analysis is one of the fundamental frameworks in business and the economy. This analysis is used to assess the organization's present position in the market and predict possible outcomes and consequences of business operations. SWOT is also used to determine risks before building any new strategy for a company. Simply put, the analysis is made to evaluate the future and the present of a company, on a par with internal and external factors that might influence the performance. (Grant 2021.)

SWOT is the name of the analysis methods. Those letters stand for strengths, weaknesses, opportunities and threats of the organization, product, or market. The main goal of the analysis is to help an organization develop a full awareness of the factors involved in business decision-making. Important to say that SWOT is a planning process, which requires time and resources to implement. Albert Humphrey created the framework in the 1960s during his study concerning the failure of the corporate planning process. (Shcooley 2019.)

As it was said above, a SWOT analysis should be implemented before rushing into a new strategy or program. Nevertheless, the analysis can be implemented to verify the current environment of a business so that necessary improvements can be made in time. One of the most valuable outcomes of the analysis is that it gives an opportunity to overlook the whole business process and make the right decisions. (ibid. 2019.)

SWOT analysis uses external and internal data, guiding businesses toward strategies that might have a success. Third parties, such as investors and competitors, might

also contribute to the process and help to determine whether a company, products, or the whole industry might be successful or not. (Grant 2021.)

The creation of the analysis is the process when the table, consisting of four columns, is created. In those columns, each impacting element is listed side by side. (Schooley 2019.) When the table is created, the one can start making the analysis.

Table 1 SWOT analysis (Shewan 2021)

S STRENGTHS	W WEAKNESSES	O OPPORTUNITIES	T THREATS
<ul style="list-style-type: none"> • Things your company does well • Qualities that separate you from your competitors • Internal resources such as skilled, knowledgeable staff • Tangible assets such as intellectual property, capital, proprietary technologies etc. 	<ul style="list-style-type: none"> • Things your company lacks • Things your competitors do better than you • Resource limitations • Unclear unique selling proposition 	<ul style="list-style-type: none"> • Underserved markets for specific products • Few competitors in your area • Emerging need for your products or services • Press/media coverage of your company 	<ul style="list-style-type: none"> • Emerging competitors • Changing regulatory environment • Negative press/media coverage • Changing customer attitudes toward your company

WordStream

The first-come Strengths is something a business does well. Those strong points of a company should represent something intangible, such as the company's brand attributes, or unique selling proposition, human resources, strong relationships, reliable suppliers. The next stage is to determine something that holds a business back. The weakness of a company or an industry represents some problems, shortages, and limitations. The next element, which is called Opportunities, represents something

that a business could develop and improve. Simply put, the one can state areas of development and growth. The last dimension is Threats or everything that contains risks, such as the appearance of new competitors, changes in legislation, financial risks, and everything that can question the future of a company or the whole industry. (Shewan 2021.)

Besides listed factors, some researchers make a division on external and internal factors of influence. Strengths and Weaknesses represent internal factors since they are the result of organizational decisions. The list of the most important internal factors includes:

- Financial resources
- Human resources
- Current process
- Trademarks, patents, copyrights

(Schooley 2019.)

On the other hand, there are external factors, which are reflected in Threats and Opportunities. Basically, those factors are not under the control of a company or an industry, such as market and economic trends, social and political factors, legislation, crises. (ibid. 2019.)

The main advantage of SWOT analysis is that it can be applied to a significant number of cases. The analysis can be used to evaluate a company, business unit, team, product line, brand, partnership, or industry. The analysis can also be suitable for many company's operations, from strategic planning to product development. A SWOT analysis requires a combination of qualitative and quantitative information, meaning that the analysis is implemented using the whole range of available data evaluating the objective of analysis from different perspectives. Another advantage is that SWOT does not require any severe knowledge and can be prepared by an individual or an employee without any training, which makes the process cheap and accessible. (Nordmeyer 2019.)

Nevertheless, there are some disadvantages of the analysis, which might affect future operations and decision-making. First of all, SWOT regards each attribute in one dimension. As a result, each attribute seems to have only one influence on a problem, while it can have multiple effects on the analyzed problem. Also, SWOT is a subjective analysis, and the data used can be outdated relatively quickly. After all, the model does not have any tool to rank listed attributes based on their weight in a company or an industry. (ibid. 2019.)

Thus, to overcome any disadvantages and surplus advantages of the discussed analysis tool, SWOT needs to be implemented in combination with another analysis method. It would also help a researcher collect more valuable information and evaluate the data from different perspectives.

3.2 Technical requirements

Electric kick scooter can be evaluated as a system developed with mechanical solutions, electric power usage, material selection, and design adaptation. These characteristics make a difference between the models. That is why some of them sold better than others. (Systems engineering fundamentals 2001.)

Any process of development includes the customer's requirements and the project constraints. Requirements relate directly to the performance characteristics of the system being designed. Development opportunities are limited by external constraints, including project support, technology, interfaces, and life cycle support systems. During the design phase both requirements and constraints must be satisfied. (ibid., 2001.)

3.2.1 Attributes of good requirements

Not every formulation of the requirement can be used for developing the system. The expression should not consist of words such as excessive, sufficient, resistant. It must be complete and contain all operational concepts, mission profiles, utilization

environments, and constraints. The good requirement must include the following attributes:

Table 2 Attributes of good requirements

<ul style="list-style-type: none"> • Achievable 	It must reflect the need for which a solution is technically achievable at granted costs.
<ul style="list-style-type: none"> • Verifiable 	It must be expressed to allow verification to be objective, preferably quantitative.
<ul style="list-style-type: none"> • Unambiguous 	It must have only one possible meaning.
<ul style="list-style-type: none"> • Understandable 	All the information needed to understand the customer's requirements must be there.
<ul style="list-style-type: none"> • Indispensable 	It must be formulated in terms of necessity, not solution.
<ul style="list-style-type: none"> • Non-controversial 	It must be harmonious with other requirements. Conflicts must be solved.

3.2.2 General requirements

Customer requirements are assumptions that define the customer's expectations of the system. These operational requirements will define the primary need in terms of mission and objectives, environment, constraints, and measures of effectiveness and sustainability.

Functional requirements are "what" has to be done, which are necessary tasks, actions, or activities that must be performed.

Performance requirements are "how well" it has to be done, which generally measures quantity, quality, coverage, timeliness, or readiness.

Design requirements are how to build specifications, which are expressed in technical data packages and technical manuals.

4 The study

An electric kick scooter is a new part of the trend in micromobility that solves the last-mile problem. The last-mile problem is the last leg of the trip, which could be rounded to one mile of walking from the bus station to the home or from car parking to the specific destination in the city center.

The last-mile problem tends to be the slowest despite being the shortest part of the way. Highspeed highways and intercity transport lanes are made to cover long distances for a massive amount of people. A typical speed limitation is 100km/h, which is 60 miles per hour. So, people could cover one mile in one minute. Nevertheless, the last mile of walking takes 15 minutes or even more. (Bubnis 2019.)

All forms of micromobility come into play. Electric kick scooters make traveling the last mile faster and easier. Moreover, it is more environmentally friendly compared to taking a taxi or using public transport.

4.1 SWOT analyses

The Timmons model, which was explained in the previous chapter, focuses on three dimensions of business: opportunities, team and resources. Since this study includes market and product analysis, only the opportunity dimension will be analyzed. Thus, a broader model for opportunity analysis was selected – the SWOT analysis,

Even good opportunities have risks and problems. Successful entrepreneurs know that it is important to “think big enough”. Identifying risks and problems before launching a company can significantly reduce any negative effects. (Spinelli & Adams 2012, 85)

The concept of electric kick scooter became already popular on a worldwide scale. In the middle of March 2019, Helsingin Sanomat reported that 120 electric kick scooters would be available for rent in the city center (Jokinen 2019). The article was the first

public announcement about a new transportation mode in Helsinki. Finnish road safety council Juha Valtonen commented on the news: “It is great that there are increasingly more convenient ways to move from one place to another.” (Valtonen n.d.).

However, what is the actual values of the concept of the electric kick scooter in Finland?

4.1.1 Strength

As it was mentioned above, the major strength of the concept is solving a last-mile problem. In other words, an electric kick scooter is a fastest and easiest way to travel on short distances.

The main strengths of the concept are:

- Time saving
- Environmental friendly
- Saving physical energy
- Electricity cheaper than car’s fuel
- Light weight and portability
- Require no regular maintenance
- No driving license needed

Remember that time is money, - wrote Benjamin Franklin (Franklin 1748). Time is an irreparable resource, which no one wants to spoil. The average speed of an electric kick scooter is around 24km/h, which is more than five times faster than the walking speed. (Guide To The Fastest Electric Scooters in 2021 2021).

The scooter consumes electric power, which is much cheaper than car fuel (Costs and benefits of electric cars vs. conventional vehicles 2020). An electric motor does not produce CO₂ or any other pollution for the environment, which makes electric scooters eco-friendly.

A typical foldable electric kick scooter weighs between 10 and 15 kilograms, depending on size, battery, electric motor, and other features (Average electric kick scooter's weight n.d.). The folding mechanism makes a scooter portable and easy to carry inside the building. Neither the electric motor nor battery of the scooter needs regular maintenance as a car's motor or bicycle's chain and gears (Where can you get an electric scooter repair? n.d.).

4.1.2 Weaknesses

The main weakness of the scooter is the battery technology. There is not enough charge for a long-distance trip. Charging time is too long. The battery can not be removed from the scooter; therefore, the scooter must be charged near the socket. The battery is the most expensive component of the scooter. All the above makes the battery to be the weakest part of the scooter.

Nevertheless, the concept of the electric kick scooter has a list of weaknesses:

- High purchasing price
- Accidents (collision, falling from the scooter, etc.)
- Limited distance range
- Charging time
- Limited speed
- No rider's protection from the moisture and dirt
- No locking system

The price of the electric kick scooter can variable between 300 euros for the cheapest model and up to 2000 euros for the premium one. Someone could find the price too high for the alternative to the standard bicycle.

For 2019 the emergency department at Helsinki Töölö hospital recorded 74 e-scooter accidents. Around half of collisions involved inebriated operators (Yle 2020). However, not every collision is reported to the emergency center. In other words, inappropriately riding a scooter can harm the rider and people around.

On average, an electric kick scooter can ride around 25-30 kilometers from one charge. However, if the battery would be discharged, charging time from 0% to 100% would be around 6 hours. (Electric scooter range- how far can you travel n.d.) So, if the daily trip range exceeds the maximum range, it would not be easy to find a suitable place and time to recharge a scooter.

According to the Finnish road safety rules, electric kick scooter relates to light electric vehicles with max power 1kW and maximum speed 25 km/h. Cyclist's traffic rules apply, in which a rider must have a front light when it is dark outside and a device to give a sound signal. (Valtonen n.d.)

Electric components of the scooter should never be directly exposed to water. However, not all electric scooters are alike. Ingress protection (IP) rating is an international standard used to measure how well a piece of equipment can resist dust and moisture without damage to internal parts.

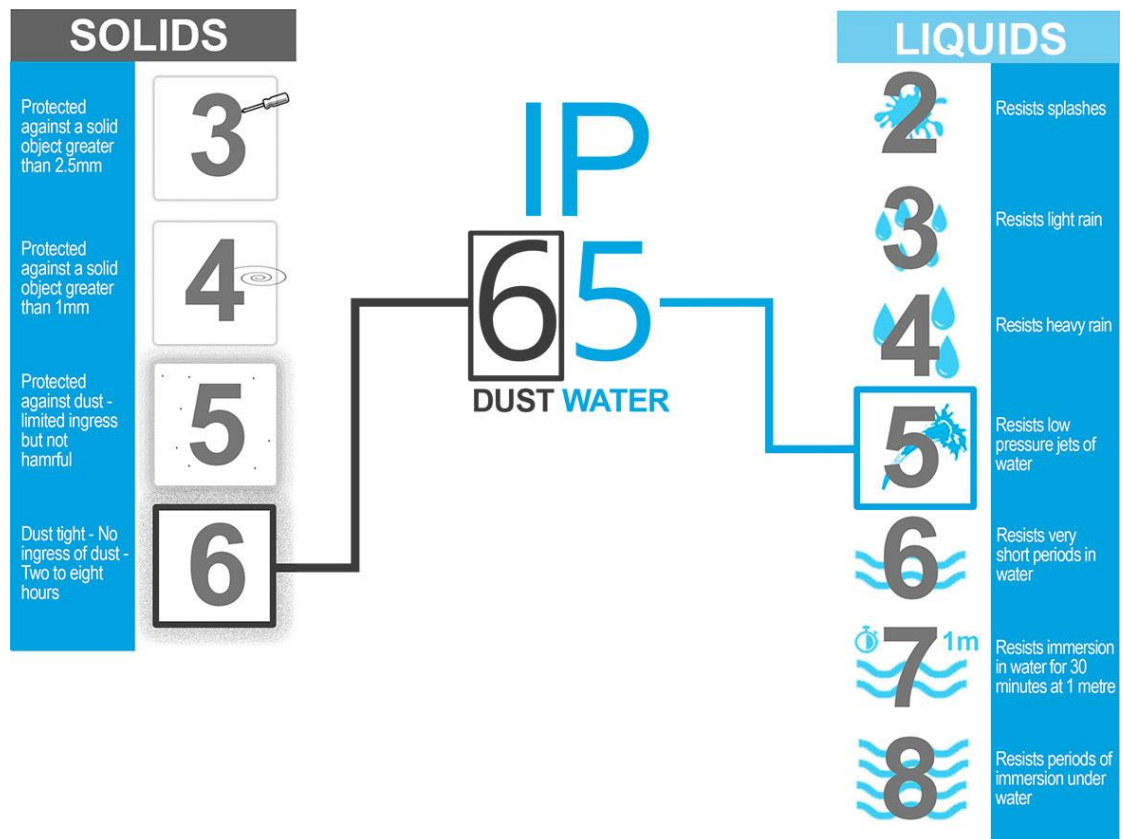


Figure 5 IP rating chart (IP ratings explained n.d.)

The first number explains dust resistance, and the second number explains water resistance. If the scooter has both numbers 4 or higher, it is possible to ride under rain and wet conditions. (Can you ride an electric scooter in the rain, n.d.) However, moisture and dirt would cover the rider's boots and clothes, making the experience worse than riding in a warm and clean car cabin.

The concept of kick scooters was developed so that riders have to carry the scooter inside all the time. In need to leave the scooter on the street, it would be complicated to find a safe place and lock the scooter.

4.1.3 Opportunities

Considering the analysis of the opportunities the concept has in the Finnish market, one of the most important and valuable is the relatively unserved market. As it was in the introduction chapter, in Helsinki, there are only a few companies that offer

rental kick-scooters services for the citizens (Yle 2020). Nevertheless, due to the growing popularity of alternative transportation modes, the Finnish market is poorly represented. Thus, the researcher believes that there are many development opportunities for the concept in the selected market.

Also, there are some other significant opportunities for this concept

- Creation of new urban infrastructure
- The attraction of new investors - establishment of new companies
- Little rivalry on the country market
- Growing customer interest
- The appearance of the product is covered by state and private media in Finland

The new urban infrastructure is the key to city development. Following the modern trends in urbanism, creating new and more convenient transportation modes and transport networks would make a city more attractive and more convenient to live in. The trend represents the renouncement from cars and shifting to bicycles and electric scooters. (Topf 2021.)

Since the Finnish market is represented only by few rental companies, the creation of new enterprises and new product lines would boost the industry. No doubt that the establishment of new business is a huge advantage for the state since it creates new working places. Plus, from the economic point of view, the establishment of new companies would boost the market by introducing new product lines product innovations. However, currently, there are only a few companies to compete with. That is why it is an excellent opportunity for development and growth.

Another substantial opportunity for the concept is the growing customer interest. Due to the growing global public and individual concerns about the environment and nature, it is natural that people think more often to reduce fuel usage and shift to electric energy. Thus, the combination of eco-activism and environmental concerns the customer interest to find alternative than cars way of transport is growing.

Moreover, the last one is the opportunity to have a cheap or completely free advertisement in media, since the appearance of a new electric kick-scooter company in the country or a city is something unusual and big. The confirmation of the presented fact could be various news articles on this theme in Yle, HelsinkiTimes, Hel.fi, and other resources.

4.1.4 Threats

The main threat is a rejection of the concept by its target market. Since there is a long-lasting culture of bicycles in the country and the growing market of rental services of electric kick scooters, the introduction of the retail company might find inevitable barriers in the market. Potential customers might be overwhelmed by offers that already exist in the market and ignore the new offer of purchasing electric kick-scooter.

Other significant threats to the concept are:

- Low demand due to the weather conditions
- Overcomplicating of legislation about individual alternative transport modes
- Tax rises
- New environmental concerns

No doubts that the weather conditions in Finland are complicated. The country has a predominantly subarctic climate due to its closeness to the Polar circle. That is why the country has low temperatures during the cold seasons - Autumn, Winter, and Spring. Plus, the surplus of rains and winds worsen the situation. Thus, there is a threat that the target market will not be satisfied by the offer of an electric kick scooter due to the inconvenience of driving under the cold weather. Also, while driving a bicycle, it is possible to get warm due to physical activity, which cannot be said about the electric (automatic) kick scooter.

The next threat is complicated legislation about the individual alternative transportation modes. According to the Finnish Road Safety Council, it is mandatory to have

special safety equipment, lights, bell, red taillight, reflectors, helmets, etc. (Finnish Road Safety Council, n.d.) Not hard to assume that those rules can be changed and expanded by the Finnish government, which can prevent some people from purchasing electric scooters. Plus, the rules are written only for bicycles. Thus, there is no clarity in their application to electric kick-scooters.

There is also a threat of the tax rise, which might affect the market's purchasing power. If the government decides to raise some transport tax or VAT, the retailer would have no other option but to raise the end price. Even a slight growth of price might harm purchasing power and sales. Another threat is a potential rising of new environmental concerns about the batteries used in electric kick-scooters. Those batteries are mainly lithium because they are more effective and contain more energy than others. Due to the harmful lithium production, the question about battery usage might be asked by environmental activists, green parties, and even the government. (Unwin 2019.) There is no doubt that those discussions or even sanctions to the lithium batteries would affect the production and purchasing of electric kick-scooters.

4.2 Survey analyzing

The survey is an essential data collection method when a customer's opinion is needed.

The survey was handled for one week, while 79 (seventy-nine) participants passed the questionnaire. Most of the questions were gotten during an active promotion period and two days after it.

4.2.1 Experience evaluation

The form was started from getting acquainted with a respondent. Only 6 out of 79 respondents have their own electric kick scooter. The majority have tried to ride on a rental scooter, and around one-third of respondents have no experience.

Have you ever tried to ride an electric kick scooter?
79 responses

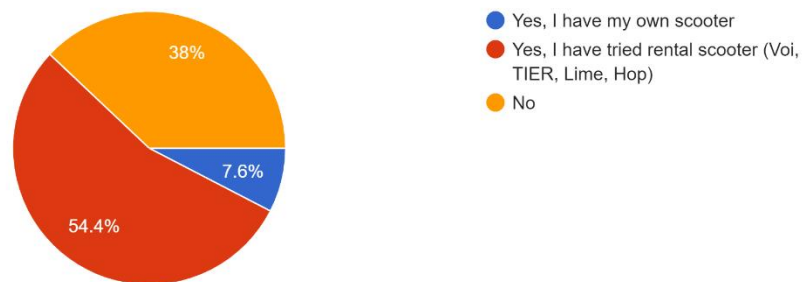


Figure 6 Have you ever tried to ride an electric kick scooter?

The result means that two-thirds of the people are familiar with the concept of electric kick scooters. On the other hand, the market is relatively fresh, and 38% of respondents have never tried the product. That allows the start-up to take this share of the non-distributed market.

The section for owners of the scooter is too small for a deep analysis – only six participants. Still, 5 out of 6 respondents had a good or excellent experience while using a scooter at least once a week or more often. Three respondents were totally satisfied with their current scooter, two respondents would like to update some parts, like battery or lights, and only one would like to buy a new scooter. However, no long-term outputs could be made based on this small section.

The section for participants with experience of rental electric kick scooters consists of 43 answers, which allows making a valuable output. All participants unanimously rated their experience as good or amazing, without a dissentient voice. However, for

most of the participants, it was a few times experience. Just 5% - 2 users - use rental scooters regularly.

The last question handles the clarification of doubts in this section.

Would you like to buy your own scooter?

43 responses

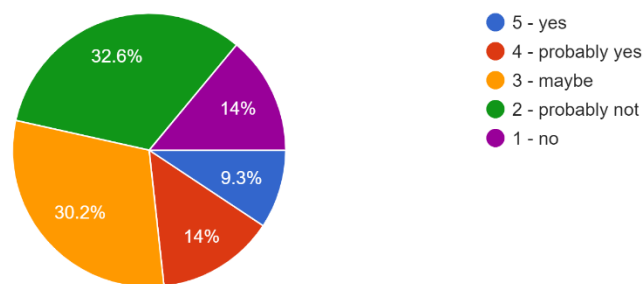


Figure 7 Would you like to buy your own scooter?

Around half of the respondents do not want to buy a scooter for their own. Nevertheless, more than a half are keeping in mind buying a scooter. An active customer group consists of 23% of participants, which is 10 people out of 43 participants.

These young people with good experience and a willingness to buy a brand-new electric kick scooter could be a loyal customer group for a new business model. Moreover, extra customers could be gotten from the group “maybe” by an intelligent promotion.

The participants with no experience are not so interested in a selling business model. Firstly, give customers a chance to fall in love by offering samples or demonstrations (Barrows 2009). Therefore, no additional questions were given to non-experienced participants.

4.2.2 Advantages and disadvantages

After separation on the sections of owner experience, rental experience, and no experience, each participant had to assume the advantages and disadvantages of the concept of the electric kick scooter. The offered answers were based not on the technical characteristics but the customer expectations. So, even not experienced people could find suitable answers from the list.

The advantages were handled first. Each person could pick several answers or write their own:

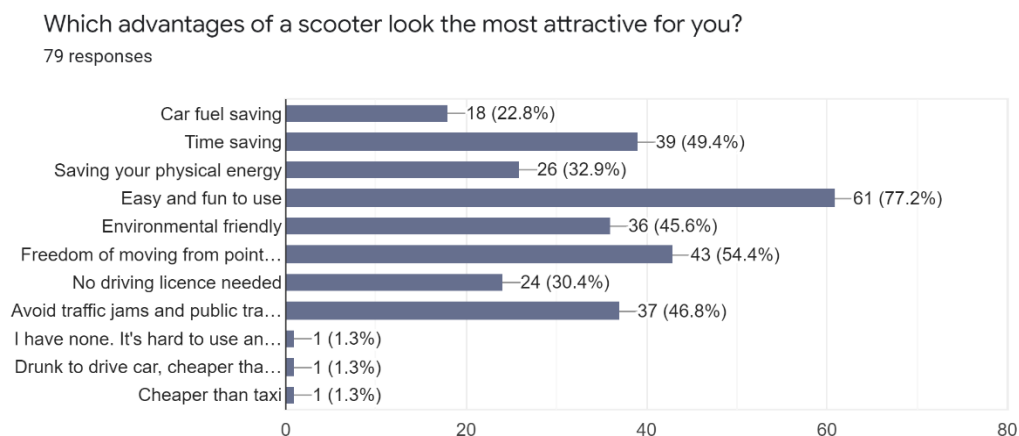


Figure 8 Which advantages of a scooter look the most attractive for you?

The majority of the participants (77%) decided that the best advantage of the electric kick scooter is that it is easy and fun to use. Just above half (54%) of the respondents considering a scooter for transportation from point A to B. In other words, the scooter now looks like a fun toy for pleasure firstly, and like an alternative way of transportation only secondly.

Time-saving, avoiding traffic jams and public transport delays, and environmental impact should also be considered, while scooters would be promoted. Car fuel-saving got the minor points from given answers. However, two responses stated that an

electric kick scooter is cheaper than a taxi from the self-typed answers. So, some people think that better to save money from a taxi, but not from the own car.

Also, one participant could not find any valuable advantage of the scooter.

From the side of disadvantages, there was not any prime leader. All disadvantages took less than half of the votes from respondents.

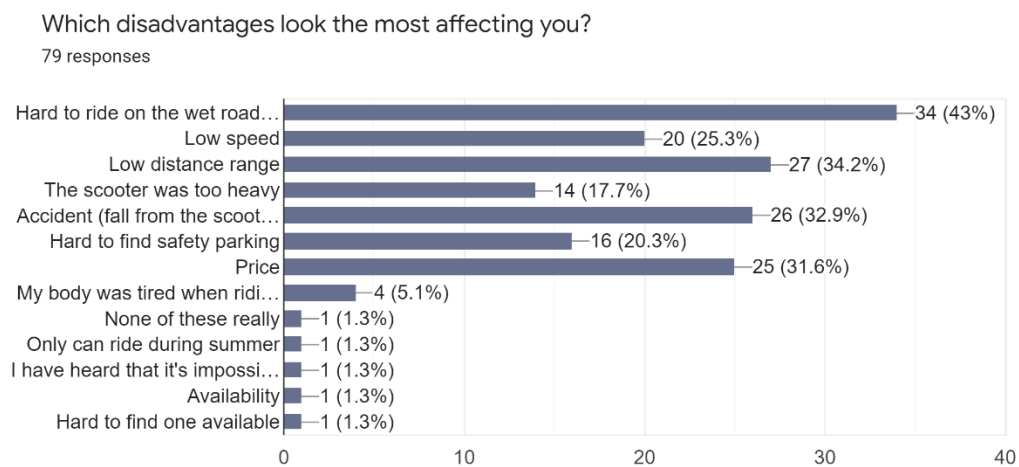


Figure 9 Which disadvantages look the most affecting you?

The worst disadvantage (43%) was that it is hard to ride on the wet road and under the rain. In other words, when it is not easy and fun to use. In that case, the best advantage of the scooter becomes worthless.

The distance range, safety equipment, price drop should be the main improvements, giving the business a competitive advantage. Furthermore, low speed, parking safety, and weight should be considered as room for further improvement.

Only 4 participants (5%) found that the body is tired during long-distance riding. So, comparing to the unpopular advantage of saving physical energy, the output is that riding a scooter does not consume much energy but not saving much.

Two self-typed answers mentioned the availability of rental scooters, but it does not affect the selling business model. Moreover, if a person has their own scooter, it is always available!

One participant mentioned that it is impossible to ride the scooter when the battery is exhausted. The claim can be counted as a heavyweight problem combined with the battery recuperation process.

The disadvantage of the seasonal usage could be counted as a weather condition, which only worsens the problem.

Just one participant could not find any disadvantages of the scooter.

What is the most popular combination of transportation modes for students?

Do you use other transport?
79 responses

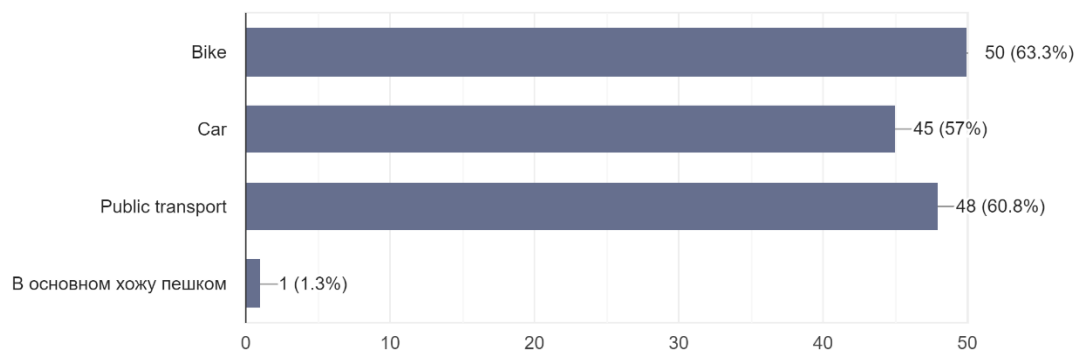


Figure 10 Do you use other transport?

On average, students have two transportation modes at the same time. The most popular response was both bike and public transport. The least prevalent combination is car plus public transport. This statistic means that the scooter should also compete with current transportation modes and habits of the users.

The last question was about long-term development. If the electric kick scooter wants to become the main transportation mode, it needs to provide a good experience even in winter.

Would you like to use the scooter during the winter season?
79 responses

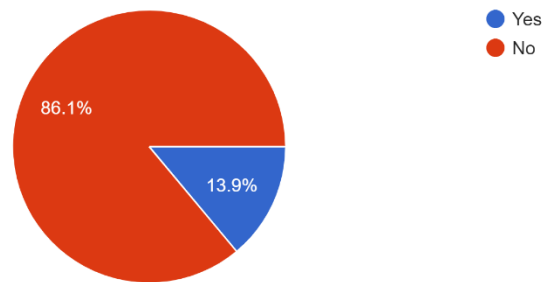


Figure 11 Would you like to use the scooter during the winter season?

However, in the current development of the product, most people can not imagine themselves riding a scooter in winter. Nevertheless, “there is no such thing as bad weather, only unsuitable clothing” (Wainwright 2003).

4.3 Technical requirements

4.3.1 Anatomy of the scooter

Electric kick scooter consists of complex parts, but the major ones are batteries, brakes, controller, deck, handlebars, lights, motor, stem, suspension, and tires (ultimate guide to electronic scooters n.d.).

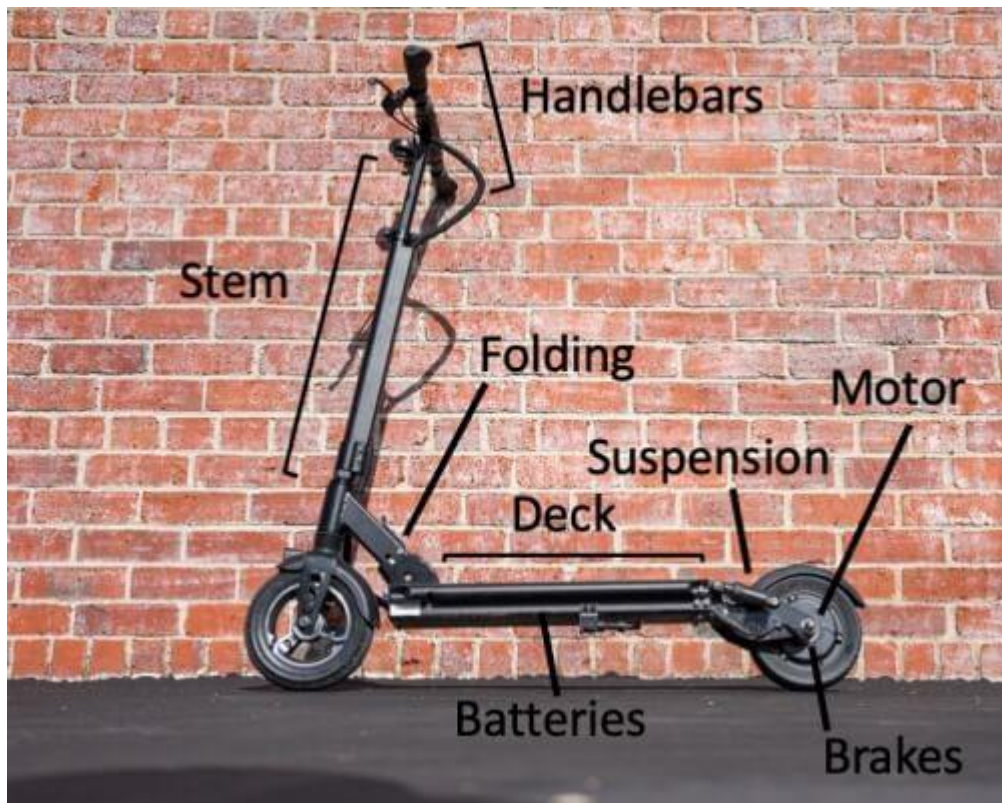


Figure 12 Anatomy of an Electric Scooter (Ultimate guide to electric scooters n.d.)

The combination of the quality of components and their assembly makes the difference between electric kick scooters and the performance characteristics. Adult electric scooters have hub motors built into one or both wheels. A quality braking system is essential for staying safe and in control while riding an electric scooter. Good scooter lighting is vital for seeing and staying visible at night. The battery stores the energy that is consumed by the electric motor and other accessories, including lights. The suspension of the electric scooter helps to improve the ride quality and damping bumps in the road. However, many electric scooters have no suspension at all.

4.3.2 Customer requirements

Each detail of the scooter is essential for the smooth working of the system. However, some electric kick scooters are in great demand, but others are not. Furthermore, only the end customer knows which is the best one for his or her needs.

Therefore, the survey, which potential customers responded, can measure the importance and indicate the actual willingness and customer's needs.

Nevertheless, end customers might have no knowledge about the performance characteristics of the scooter. They can describe their feelings, emotions, unmet expectations. The description would be on a "user language," but the aim of the expert to translate it into technical requirements.

First of all, customer's requirements should be distinguished from the responses. The evaluation of the experience does not contain any information about the needs. Advantages mostly describe the generally positive impact of the concept, but not a particular scooter's characteristics. However, disadvantages are equal unmet expectations and show unmet requirements, which were both necessary and sufficient.

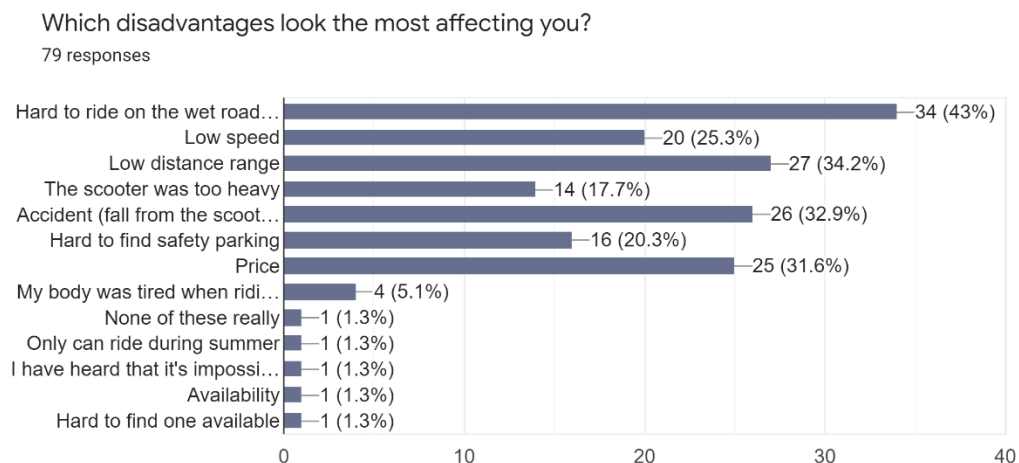


Figure 13 Which disadvantages look the most affecting you?

As the survey shows, "Hard to ride on the wet road and under the rain" was the worst disadvantage. In other words, the weather plays a significant role while using an electric kick scooter. There could be many reasons why the weather disturbs the most. From a personal experience, the factors could be like wet feet and clothes,

cold hands, inappropriate appearance when arriving at the destination. All these factors make the experience worse.

Nevertheless, none of the electric kick scooters provide the solution to the problem. The scooter concept is so that the user gains mobility of movement without any weather protection. Pneumatic tires give a perfect grip even on wet surfaces. However, nothing could save clothes still clean and dry under the rain.

The rider could solve the problem itself. Wearing a waterproof coat, warm gloves, and reliable boots are the best decisions, while the weather forecast is changeable.

All the other disadvantages listed in the survey could be interpreted into customer requirements quite easily.

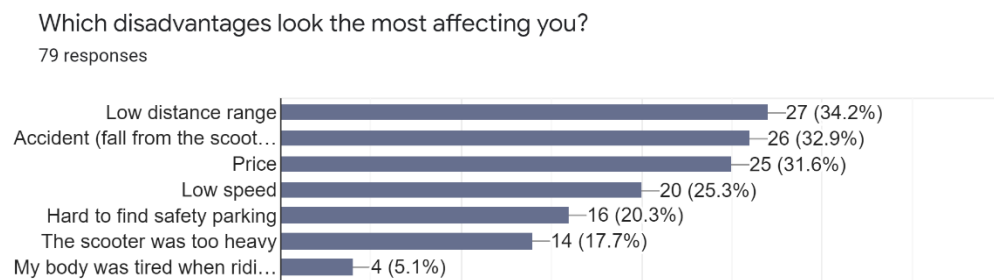


Figure 14 Which disadvantages look the most affecting you?

In general, the customer wants an electric kick scooter with a long distance range, safe equipment, cheap, fast, with a safety lock, light and flexible. And all of these at the same time. However, some of the requirements contradict each other. For example, higher speed requires more power and consumes more energy, which would decrease the distance range.

Nevertheless, due to the survey, the distance range has more privilege than speed. Therefore, the balance between these two should be offset to the increasing distance range through decreasing a speed.

As far as the distance range is the major, the characteristics could be improved through any changes of the other parameters. However, the motor's power could be increased only by dealing with columns five, six, and seven.

Therefore, the result is that an efficient battery with a big capacity, braking system, and lights could be afforded for extra costs. On the other side, motor, locking system, material selection, and suspension must be chosen within minimum necessary.

4.4 Real-life results and rating

All the research was aimed to find out what is the best scooter for the Finnish customers. Now it is time to find examples of scooters from the open market.

On the market, there are thousands of scooters with a different price range. The most common separation is between commuting and premium segments. The commuting electric kick scooters are below 1000 US dollars, the premium one – above 1000 USD.

Only commuting electric kick scooters, which have a price less than 1000 USD (800 euros), would be used for the research. The choice was made so because all the best seller scooters in America are under that price, according to the Amazon stats. (Amazon best sellers n.d.)

4.4.1 Database

The database of electric kick scooters contains 26 models from 14 different manufacturers. The database includes characteristics of the scooter and information about the most significant components such as price, range, weight, speed, motor, battery, brakes, tires, water resistance. Each model is connected with a hyperlink to the manufacturer's or distributor's webpage. Moreover, some new brands were looking for a distributor, which was mentioned in the database.

Table 4 Database

	Make	Model	Price (\$)	Range (km)	Weight (kg)	Speed (km/h)	Motor (W)	Battery (Wh)	Brakes	Tires	Water resistance	Link
	Apollo	Air	499	24	15	24	250	281	Disc	Pneumatic	IP54	https://apx
	Apollo	Light	799	35	16	35	350	490	Drum	Mixed	IP54	https://apx
	Apollo	City	999	45	18	40	600	634	Disc	Pneumatic	IP54	https://apx
LFD	EMOVE	Touring	899	38	18	40	500	624	Drum	Mixed	IP54	https://ww
LFD	Fluid Freeride	CityRider	449	16	12	28	300	270	Drum	Solid	None	https://eu
LFD	Fluid Freeride	Horizon	799	32	18	40	500	480	Drum	Mixed	None	https://eu
	GOTRAX	GMAX Ultra	799	72	16	32	350	630	Disc	Pneumatic	IP54	https://got
	GOTRAX	G4	499	40	16	32	350	374	Disc	Pneumatic	IP54	https://got
	GOTRAX	XR Elite	349	28	14	25	300	281	Disc	Pneumatic	IP54	https://got
	GOTRAX	GXL 2V	299	19	11	25	250	187	Disc	Pneumatic	IP54	https://got
	Hiboy	S2	409	27	13	24	350	270	Disc	Solid	IP54	https://hit
LFD	Inmotion	L9	999	94	23	30	500	675	Disc	Pneumatic	IP55	https://ww
LFD	Kaabo	Skywalker 8H	999	50	18	38	500	624	Drum	Solid	None	http://www
LFD	Kugoo	S1	299	30	11	30	350	216	Drum	Solid	None	https://ku
	Segway	Ninebot Max	949	64	18	30	350	551	Drum	Pneumatic	IPX5	https://sto
	Segway	Ninebot E45E	819	45	16	30	700	368	Regenerative	Solid	IPX4	https://sto
	Segway	Ninebot E22E	549	22	13	19	300	184	Foot	Solid	IPX4	https://sto
	Splach	Turbo	999	35	20	45	600	541	Drum	Mixed	IPX5	https://spl
	Splach	Ranger	899	59	20	40	350	655	Drum	Mixed	IPX5	https://spl
LFD	Turboant	X7 Pro	699	48	14	32	350	360	Disc	Pneumatic	IPX4	https://tur
LFD	Unagi	The model one	990	25	12	32	500	282	Regenerative	Solid	IP54	https://un
LFD	Uscooters	Eco	699	33	10	24	250	156	Foot	Solid	None	https://usc
	Xiaomi	M365	439	45	11	25	250	280	Disc	Pneumatic	IP54	https://ww
	Xiaomi	M365 Pro	716	43	13	25	300	474	Disc	Pneumatic	IP54	https://ww
	Xiaomi	Mi Pro 2	617	45	13	25	300	446	Disc	Pneumatic	IP54	https://ww
LFD	Zero	8	799	40	18	35	500	624	Drum	Mixed	None	https://zer
	LFD - Looking for a distributor											

The next excel list contains values of the components according to the survey. Therefore, each characteristic would have a different value and influence on the final rating. For example, the weight would have less value than a range, which got more points in the survey. (See figure "Disadvantages" on page 43) In other words, the characteristics got a value from survey responses.

Table 5 Value of components, according to the survey

Component	Survey value	Survey question
Price	25	Price
Range	27	Low distance range
Weight	14	The scooter was too heavy
Speed	20	Low speed
Motor	20	Low speed
Battery	27	Low distance range
Brakes	26	Accident (fall from a scooter, collision, etc.)
Tires	30	Average between "Accident (fall from a scooter, collision, etc.)" and "Hard to ride on a wet road and under the rain"
Resistance	34	Hard to ride on a wet road and under the rain
Total points	223	

Total points represent the sum of the values above. The maximum of points is a perfect electric kick scooter, which is the best in each category – 25/25 for the price, 27/27 for range, etc.

4.4.2 Analysis

Before starting the analysis, the database should be converted into a list of scooters, which includes only numbers. Therefore, columns with text should be removed with an analog number. The best component got the highest number. So, the regenerative braking system got 4, and the basic foot brake got 1.

Table 6 The list of scooters for analysis

Make	Model	Price (\$)	Range (km)	Weight (kg)	Speed (km/h)	Motor (W)	Battery (Wh)	Brakes	Tires	Water resistance
Apollo	Air	499	24	15	24	250	281	3	3	4
Apollo	Light	799	35	16	35	350	490	2	2	4
Apollo	City	999	45	18	40	600	634	3	3	4
EMOVE	Touring	899	38	18	40	500	624	2	2	4
Fluid Freeride	CityRider	449	16	12	28	300	270	2	1	1
Fluid Freeride	Horizon	799	32	18	40	500	480	2	2	1
GOTRAX	GMAX Ultra	799	72	16	32	350	630	3	3	4
GOTRAX	G4	499	40	16	32	350	374	3	3	4
GOTRAX	XR Elite	349	28	14	25	300	281	3	3	4
GOTRAX	GXL 2V	299	19	11	25	250	187	3	3	4
Hiboy	S2	409	27	13	24	350	270	3	1	4
Inmotion	L9	999	94	23	30	500	675	3	3	5
Kaabo	Skywalker 8H	999	50	18	38	500	624	2	1	1
Kugoo	S1	299	30	11	30	350	216	2	1	1
Segway	Ninebot Max	949	64	18	30	350	551	2	3	3
Segway	Ninebot E45E	819	45	16	30	700	368	4	1	2
Segway	Ninebot E22E	549	22	13	19	300	184	1	1	2
Splach	Turbo	999	35	20	45	600	541	2	2	3
Splach	Ranger	899	59	20	40	350	655	2	2	3
Turboant	X7 Pro	699	48	14	32	350	360	3	3	2
Unagi	The model one	990	25	12	32	500	282	4	1	4
Uscooters	Eco	699	33	10	24	250	156	1	1	1
Xiaomi	M365	439	45	11	25	250	280	3	3	4
Xiaomi	M365 Pro	716	43	13	25	300	474	3	3	4
Xiaomi	Mi Pro 2	617	45	13	25	300	446	3	3	4
Zero	8	799	40	18	35	500	624	2	2	1
	Value	25	27	14	20	20	27	26	30	34
	Min	299	16	10	19	250	156	1	1	1
	Max	999	94	23	45	700	675	4	3	5
								1 - Foot 2 - Drum 3 - Disc 4 - Regenerative	1 - Solid 2 - Mixed 3 - Pneumatic	1 - None 2 - IPX4 3 - IPX5 4 - IP54 5 - IP55

Pneumatic (filled with air) tires are the best on the market nowadays. Some models use mixed tires, which means a pneumatic tire installed in front and a solid tire installed on the back side. Solid tires have worse grip and suspension than the pneumatic tires, so solid one has the lowest rating number.

As it was mentioned above, the IP rating is as better as higher both numbers. The X letter means that the dust test was not completed. No rating is worse than it would be done.

The minimum and the maximum values were added for further calculations. Values are selected automatically with a min\max function of the excel. So, the list could be moderated without a lack of credibility.

4.4.3 Ratings

The algorithm of the rating works on the basis of sub-ratings of each component. Sub-rating was evaluated according to the maximum magnitude of the column. So, the magnitude was divided by the maximum one. The received ratio was multiplied by the value of the component. So, the sub-rating of the price = (the price of the scooter / the maximum price of all scooters) / the value of the scooter's price, according to the survey. (see figure 15) As higher the variable, than higher the ratio and the sub-rating. The formula works fine for increasing the worth of the variable – the rule “the highest is the best.”

	A	B	C	D	E	F	G	H
		Make	Model	Price (\$)	Range (km)	Weight (kg)	Speed (km/h)	Motor (l)
2								
3		Apollo	Air	499	24	15	24	250
4		Apollo	Light	799	35	16	35	350
5		Apollo	City	999	45	18	40	600
6		EMOVE	Touring	699	38	18	40	500
7		Fluid Freeride	CityRider	449	16	12	28	300
8		Fluid Freeride	Horizon	799	32	18	40	500
9		GOTRAX	GMAX Ultra	799	72	16	32	350
10		GOTRAX	G4	499	40	16	32	350
11		GOTRAX	XR Elite	349	28	14	25	300
12		GOTRAX	GXL 2V	299	19	11	25	250
13		Hiboy	S2	409	27	13	24	350
14		Inmotion	L9	999	94	23	30	500
15		Kugoo	K10	388	38	15	30	500
16		Kugoo	K12	300	30	15	30	350
17		Scooter	S1	300	30	15	30	350
18		Segway	Ninebot E45E	819	45	16	30	700
19		Segway	Ninebot E22E	549	22	13	19	300
20		Splach	Turbo	699	35	20	45	600
21		Splach	Ranger	599	59	20	40	350
22		Turboant	X7 Pro	699	48	14	32	350
23		Unagi	The model one	990	25	12	32	500
24		Uscooters	Eco	699	33	10	24	250
25		Xiaomi	M365	439	45	11	25	250
26		Xiaomi	M365 Pro	716	43	13	25	300
27		Xiaomi	Mi Pro 2	617	45	11	25	300
28		Zero	8	599	40	18	35	500
29								
30			Value	27	14	20	20	
31			Min	299	16	10	19	250
32			Max	999	94	23	45	700

Figure 15 The formula of the rating with the rule “the highest is the best”

However, if the price is lower, then the sub-rating should be better. In that case, the price’s sub-rating should be the opposite of the formula. That could be achieved by subtracting the “positive” sub-rating from “the value of the variable, according to the survey.” The subtraction provides the sub-rating with a rule “the lowest is the best.”

Nevertheless, even the lowest price can not achieve the total points due to the subtrahend would never be zero. Therefore, the first step should be “variable = price - the minimum price,” which could give 0 if the price is the minimum one. (see figure 16) That extension applies only with the rule “the lowest is the best.”

	A	B	C	D	E	F	G	I	
		Make	Model	Price (\$)	Range (km)	Weight (kg)	Speed (km/h)	Motc	
2									
3		Apollo	Air	499	24	15	24	2	
4		Apollo	Light	799	35	16	35	3	
5		Apollo	City	999	45	18	40	6	
6		EMOVE	Touring	899	38	18	40	5	
7		Fluid Freeride	CityRider	449	16	12	28	3	
8		Fluid Freeride	Horizon	799	32	18	40	5	
9		GOTRAX	GMAX Ultra	799	72	16	32	3	
10		GOTRAX	G4	499	40	16	32	3	
11		GOTRAX	XR Elite	349	28	14	25	3	
12		GOTRAX	GXL 2V	299	19	11	25	2	
13		Hiboy	S2	409	27	13	24	3	
14		Inmotion	L9	999	94	23	30	5	
15		Kaabo	Skywalker 8H	999	50	18	38	5	
16		Kugoo	S1	299	30	11	30	3	
17		Segway	Ninebot Max	949	64	18	30	3	
18								7	
19		Rating = D30-(D3-D31)/D32*D30							3
20								6	
21		Splach	Ranger	899	59	20	40	3	
22		Turboant	X7 Pro	699	48	14	32	3	
23		Unagi	The model one	990	25	12	32	5	
24		Uscooters	Eco	699	33	10	24	2	
25		Xiaomi	M365	439	45	11	25	2	
26		Xiaomi	M365 Pro	716	43	13	25	3	
27		Xiaomi	Mi Pro 2	617	45	13	25	3	
28		Zero	8	799	40	18	35	5	
29									
30			Value	25	27	14	20	2	
31			Min	299	16	10	19	2	
32			Max	999	94	23	45	7	
33									

Figure 16 The formula of the rating with the rule "The lowest is the best"

While each component got the sub-rating, the total points could be summed up in the score column (see Table 8). At the bottom of the column, the minimum and the maximum scores were selected automatically by the min and max excel functions. The perfect score is the best possible score, which is the sum of the Value row.

Table 7 Analyzing process

Make	Model	Price (\$)	Range (km)	Weight (kg)	Speed (km/h)	Motor (W)	Battery (Wh)	Brakes	Tires	Water resistance	Score	Final Rating
Apollo	Air	20	7	11	11	7	11	20	30	27	144	80%
Apollo	Light	12	10	10	16	10	20	13	20	27	138	77%
Apollo	City	7	13	9	18	17	25	20	30	27	167	93%
EMOVE	Touring	10	11	9	18	14	25	13	20	27	147	82%
Fluid Freeride	CityRider	21	5	13	12	9	11	13	10	7	100	56%
Fluid Freeride	Horizon	12	9	9	18	14	19	13	20	7	122	68%
GOTRAX	GMAX Ultra	12	21	10	14	10	25	20	30	27	170	95%
GOTRAX	G4	20	11	10	14	10	15	20	30	27	158	88%
GOTRAX	XR Elite	24	8	12	11	9	11	20	30	27	151	84%
GOTRAX	GXL 2V	25	5	13	11	7	7	20	30	27	146	82%
Hiboy	S2	22	8	12	11	10	11	20	10	27	130	73%
Inmotion	L9	7	27	6	13	14	27	20	30	34	179	100%
Kaabo	Skywalker 8H	7	14	9	17	14	25	13	10	7	117	65%
Kugoo	S1	25	9	13	13	10	9	13	10	7	109	61%
Segway	Ninebot Max	9	18	9	13	10	22	13	30	20	145	81%
Segway	Ninebot E45E	12	13	10	13	20	15	26	10	14	133	74%
Segway	Ninebot E22E	19	6	12	8	9	7	7	10	14	92	51%
Splach	Turbo	7	10	8	20	17	22	13	20	20	138	77%
Splach	Ranger	10	17	8	18	10	26	13	20	20	142	80%
Turboant	X7 Pro	15	14	12	14	10	14	20	30	14	142	80%
Unagi	The model one	8	7	13	14	14	11	26	10	27	131	73%
Uscooters	Eco	15	9	14	11	7	6	7	10	7	86	48%
Xiaomi	M365	21	13	13	11	7	11	20	30	27	154	86%
Xiaomi	M365 Pro	15	12	12	11	9	19	20	30	27	154	86%
Xiaomi	Mi Pro 2	17	13	12	11	9	18	20	30	27	156	88%
Zero	8	12	11	9	16	14	25	13	20	7	128	71%
	Value	25	27	14	20	20	27	26	30	34	223	Perfect score
	Min	299	16	10	19	250	156	1	1	1	86	Min score
	Max	999	94	23	45	700	675	4	3	5	179	Max score

The best characteristics in each column were highlighted by the green cell. The formula finds the top 10% values from the column, so the seller's green style applies automatically.

The final rating is the ratio, where the scooter's score is divided by the maximum found score. Therefore, the best electric kick scooter from the list would get the 100% rating. To be more illustrative, the list was sorted by the final rating.

Table 8 The final rating

	Place	Make	Model	Price (\$)	Range (km)	Weight (kg)	Speed (km/h)	Motor (W)	Battery (Wh)	Brakes	Tires	Water resistance	Score	Final Rating	Rating from perfect
LFD	1	Inmotion	L9	7	27	6	13	14	27	20	30	34	179	100%	80%
	2	GOTRAX	GMAX Ultra	12	21	10	14	10	25	20	30	27	170	95%	76%
	3	Apollo	City	7	13	9	18	17	25	20	30	27	167	93%	75%
	4	GOTRAX	G4	20	11	10	14	10	15	20	30	27	158	88%	71%
	5	Xiaomi	Mi Pro 2	17	13	12	11	9	18	20	30	27	156	88%	70%
	6	Xiaomi	M365 Pro	15	12	12	11	9	19	20	30	27	154	86%	69%
	7	Xiaomi	M365	21	13	13	11	7	11	20	30	27	154	86%	69%
	8	GOTRAX	XR Elite	24	8	12	11	9	11	20	30	27	151	84%	68%
LFD	9	EMOVE	Touring	10	11	9	18	14	25	13	20	27	147	82%	66%
	10	GOTRAX	GXL 2V	25	5	13	11	7	7	20	30	27	146	82%	66%
	11	Segway	Ninebot Max	9	18	9	13	10	22	13	30	20	145	81%	65%
	12	Apollo	Air	20	7	11	11	7	11	20	30	27	144	80%	64%
	13	Splach	Ranger	10	17	8	18	10	26	13	20	20	142	80%	64%
LFD	14	Turboant	X7 Pro	15	14	12	14	10	14	20	30	14	142	80%	64%
	15	Apollo	Light	12	10	10	16	10	20	13	20	27	138	77%	62%
	16	Splach	Turbo	7	10	8	20	17	22	13	20	20	138	77%	62%
	17	Segway	Ninebot E45E	12	13	10	13	20	15	26	10	14	133	74%	60%
LFD	18	Unagi	The model one	8	7	13	14	14	11	26	10	27	131	73%	59%
	19	Hiboy	S2	22	8	12	11	10	11	20	10	27	130	73%	58%
LFD	20	Zero	8	12	11	9	16	14	25	13	20	7	128	71%	57%
LFD	21	Fluid Freeride	Horizon	12	9	9	18	14	19	13	20	7	122	68%	55%
LFD	22	Kaabo	Skywalker 8H	7	14	9	17	14	25	13	10	7	117	65%	52%
LFD	23	Kugoo	S1	25	9	13	13	10	9	13	10	7	109	61%	49%
LFD	24	Fluid Freeride	CityRider	21	5	13	12	9	11	13	10	7	100	56%	45%
	25	Segway	Ninebot E22E	19	6	12	8	9	7	7	10	14	92	51%	41%
LFD	26	Uscooters	Eco	15	9	14	11	7	6	7	10	7	86	48%	38%
LFD - Looking for a distributor		Value		25	27	14	20	20	27	26	30	34	223	Perfect score	
		Min		299	16	10	19	250	156	1	1	1	86	Min score	
		Max		999	94	23	45	700	675	4	3	5	179	Max score	

According to ABC analyses, all models were divided into three categories. The green group A contains electric kick scooters, which has a final rating is over 90%. Scooters, which has a final rating of over 80%, but less than 90%, were divided into the yellow group B. The rest are in the red group C.

Nevertheless, sky is the limit. The last column from the right represents how far (or how close) the scooter's score from the perfect one. The manufacturer of the scooter should improve every characteristic to strive for perfection.

According to the results, the best electric kick scooters are produced by big manufacturers like Xiaomi, GOTRAX, and Apollo. These companies already have stable distribution channels, which provide local marketing almost all over the world. However, good odds on underdogs are still available. Three models with over 80% of the rating are looking for distributors in Europe and the Scandinavian region.

5 Discussion

5.1 Analysis of the study

As it was written in the introduction, the aim of the research was to find the best electric kick scooter model for the Finnish market. The research was supported by a SWOT analysis of the electric kick scooter's concept. The survey was handled to hear the end customer's opinion. The survey collected 79 responses, which were analyzed and converted into customer requirements. The requirements were juxtaposed with technical characteristics. Each component got a value, which was based on responses from the survey.

At this point, the preparation for making a rating list was finished. The database was created, including the 26 models from 14 different manufacturers such as Xiaomi, Segway, GOTRAX, Apollo, etc. The models were selected with a price range under 1000 US dollars. The database includes 9 main characteristics: the price, distance range, weight, speed, motor, battery, braking system, tires, and water resistance. Each characteristic was analyzed with the aim to find the best performance, which gave the rating for characteristics. The total score was calculated, and the final rating was made.

The top three models, which were divided into group A, have an overall performance of over 90% compared to the models from the database. The best model has an 80% rating of the performance compared to the best possible score, which still means for the manufacturer a room for improvement. The group B counts 11 models, which has a performance level of over 80%. These models are better than average and should be taken into consideration. Models from the rest of the list are needed to be improved since their price-to-quality ratio does not meet the market competition.

5.2 Limitation of the research

Talking about the limitation of the present research, the process showed several of them. First, the unavailability to access inside market information, meaning that the research was limited to the access of data, which was available in the open sources. To overcome the boundary, the researcher collected the information using a deep analysis and validation process to ensure the collected data is reliable and authorized.

The second limitation is connected to the survey. The limited number of people the researcher could ask and send the questionnaire to could affect the research results. Nevertheless, the collected amount of answers was enough to make sufficient conclusions on the market of electric kick-scooters and customers' attitudes. Also, the survey was conducted regarding the Finnish market and its preference and specifications, such as the importance of usage of the product during the winter season and the spreading towns and cities.

Another limitation of the research is connected to its primary and foremost goal – to make the research of the Finnish market. Thus, the study was bounded only to the Finnish market and its electric kick-scooters users. In the study, the market analysis of the market was made based on the current economic situation and the development of the local market. The research did not focus on the foreign or global market of electric kick-scooters and their present development stage.

Nevertheless, regardless of those limitations, the validation of used information was done successfully through collecting both qualitative and quantitative data. Also, some archival and historic information was used to reach a general understanding of the industry development. The validation process was also held by collecting data from different sources. The information from local and country sources was used combined with information from international authorized sources, personal blogs, and forums. Important to say that the data collection process used not only

academic sources but also some periodical publications, like newspapers mentioned above, blogs and forums, reports, etc.

The objectivity of the research, which is one of the main goals when conducting any research, was reached using a mixed-method approach. Qualitative and quantitative information was collected equally to gather different data, to access and evaluate it. However, the objectivity of the research might be in question since the researcher is a passionate electric kick scooter user. On the other hand, the personal interest and riding experience helped during the study evaluation process.

5.3 Suggestions for future research

To sum up, the electric kick-scooter industry is a rapidly developing market, which must be analyzed and explained deeply. That is why future research must be done to gather more information about the market and its development.

The below suggestions are based on the research limitation and might be taken into consideration in the future.

First of all, the global electric kick-scooter market analysis would be helpful and valuable in understanding general concepts. This analysis would help gather more useful information on trends, fluctuations, phases, and market cycles. Also, the analysis of the subregional markets, such as the Scandinavian market, would help understand each geographical region's specifics.

Another important suggestion is to make the survey (questionnaire) available for more respondents to be able to collect more valuable information, experience, and thoughts of current and potential customers. Since in the present research, the number of respondents was limited by the researcher's private connections, the broader spread of the survey would contribute the best to future research.

5.4 Conclusion

As mentioned above, the main objective of the research was to determine the best types of electric kick scooters for the Finnish market based on the list of technical requirements and customer requirements. The last ones were made through the analysis of the survey. Also, the analysis of the opportunities and general prospects of the Finnish market was made through the SWOT model. As the various types of information were collected regarding different requirements, the researcher determined the best suitable technical and customer requirements used in the present study and can be used in the future.

The practical implementation of the study is considered to be the most important one. The database (the list) of electric kick scooters, which represent the ratio of quality-price, and the most and the least suitable one for this of that technical and customer requirement can be used as the basement in the creation of a product line for a start-up in the industry. The database can also be used for the first company procurement. Also, the survey can be used to make the first stage of marketing campaign and promotion.

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