

The Electrically Propelled Trailer

Investigating a method to judge the feasibility of a market introduction



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The Electrically Propelled Trailer

Investigating a method to judge the feasibility of a market introduction

By

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Preface

This thesis is the last part of my master Construction Management and of Engineering at the Faculty of Civil Engineering and Geosciences at Delft University of Technology. This graduation thesis researches market opportunities for my own startup called 'E-Trailer'.

The first target in my graduation process was convincing my Masters' Program Director Drs.ir. J.G. Verlaan, to use my own startup as a graduation subject. He agreed but had two conditions: (1) if you can make it scientific enough and (2) if you can find supervisors to guide you. Quickly I found Dr. L. (Dap) Hartmann as my first supervisor. Dap has been selected in 2010 as the most Entrepreneurial Motivator of the TU Delft. He is also Associate Professor Entrepreneurship; so asking him to be my first supervisor seemed a logical choice. Another fact was that earlier collaboration between Dap and myself (during my board year at the YES!Delft incubator) had proven to be good. While searching for my second supervisor I found out that the Faculty of Industrial Design Engineering had a department on Product Innovation Management. Dr. N.M.P. (Nancy) Bocken is an Associate Professor there, specialized in sustainable business models. Since I wanted to conduct my research using a sustainable start-up business model, I asked her to be my second supervisor. I was glad when Dap and Nancy consented.

The electrically propelled trailer is the basis for the start up 'E-Trailer', a start up by Rick Lenssen and myself. The research I conducted for this thesis showed the expected strong potential of the business case for the electrically propelled trailer. It also clarified that the caravan market is the best market to start. The enthusiasm of market stakeholders and potential customers lead to the decision to continue with the development of the electrically propelled trailer. So after my graduation I will be working fulltime on the E-Trailer start up. Meanwhile we succeeded in finding a market player that will fund the project further. It was very helpful I could use my own business case for my graduation project. This made working on my thesis easier and more fun. It was also motivating I could use my research data in real life. This also applies to the interviews; they were not just interviews to collect data for my graduation but also a way to create a network for my start up.

The start of the research was really hard for me. Reading lots of literature, books and articles, defining a proper framework... It was sometimes difficult to keep focus and structure. After this difficult start, the process of researching and thesis writing came in a flow and went according to plan. The pleasure in the graduation process came back. Now I am almost ready writing the thesis I am very happy I have had the opportunity to contribute with my own Framework to research in the field of start-ups and entrepreneurship. During the process it was hard to combine the scientific needs of my thesis with running my own start-up. Sometimes I had the feeling that I had two full time jobs. However, I succeeded to follow my planning and to conduct the research the way I wanted. I am proud that I did a substantial research on the business potential of the Electrically Propelled Trailer.

I want to give special thanks to Dap and Nancy for being my supervisors on my graduation thesis. Dap coached me well on the business perspective of the research and was critical on the style of writing. Nancy helped me through the literature process in a positive way, and being an experienced

researcher, she had good tips on conducting proper scientific research. In addition I would like to thank the Chairman of my graduation committee, Prof. dr. C.P. (Cees) van Beers.

I also want to thank my peer sparring partners during the graduation process: Demelza van der Laan, Esther Korvinus and Lotte van der Kuijp. Working together on our graduation projects was more fun and our conversations helped me in finding structure for my research. I want to give special thanks to my mother, Marlen van Dop, who did the allover editing of my thesis and helped me structuring it. Rick Lenssen, co-founder of E-Trailer, helped me in the process by structuring the information on E-Trailer. I am grateful he organized the work at E-Trailer headquarters in such a way that I had sufficient time for my graduation thesis. And last but not least I want to thank Niels Back for his support and daily telephone calls that helped me through often boring and lonesome days at the computer.

Delft, June 2016

Boy Trip

Summary

Sustainability, safety and user-friendliness are terms frequently used nowadays in articles describing technical innovations and new developments in business. I think it is important to give attention to all new initiatives, whether in research or in business, that can contribute to one -or all three- of these aspects. In this research the business potential of a new innovation, the electrically propelled trailer, will be explored. It is my belief that the electrically propelled trailer can contribute to a more sustainable, safer and user-friendlier transport sector.

The need for a more **sustainable** world is proved by various figures. Carbon emission (CO₂) has increased about 1.6% per year in the last thirty years (Kasman and Dunman, 2015, p. 97). The Intergovernmental Panel on Climate Change (IPCC) reported in 2007 that the increase in carbon emission would result in a rise of the temperature between 1.1 and 6.4 degrees Celsius in the coming 100 years. (IPCC, 2007) Currently the transportation sector is responsible for 23% of the worldwide carbon emission (IPCC, 2013). **Safety** in transport is also an important current issue. In 2008 1.24 million people worldwide were fatally injured due to road traffic crashes (World Health Organization, 2013) (Stigson, 2009). Besides this, 50 million people worldwide are injured seriously by traffic incidents each year (Scurfield et al., 2004) (World Health Organization, 2013). Making vehicles **user-friendlier** can endow to more safety and to more sustainability. Technical innovations are important contributors in this field. An important dilemma is that technical innovations have to be feasible to be able to turn into a realistic business case. (Ries, 2011) (Osterwalder et al., 2015).

This research focuses primarily on the search for a general model to judge the market potential of a technological start-up. In an early stage it should be defined if there is a business case for the new technology or not. Currently no data, scientific research or knowledge is available on an electrically propelled trailer because it is a brand new innovation. Prior to research on user-friendliness, safety or sustainability of the electrically propelled trailer it is important to define the feasibility of this innovation in terms of business potential. To find the best market to enter with the electrically propelled trailer and to learn its potential the following research question is defined: ***How can the feasibility of the market introduction of the electrically propelled trailer be judged and which market has the best potential?***

To find a proper answer to the research question I started with a literature review on technological start-ups (chapter 2). Here is explored if there is already a proper model available to assess the potential of a new technology based innovation. Five books on starting-up a technological business are found. These books written by Ries (2011), Osterwalder et al. (2010 & 2015), Aulet (2013), Blank & Dorf (2012) and von Hippel (1988) have in common that they focus on the subject of 'how to start a technology-based company'. All the books are useful when starting a technology-based company. But they elaborate on different aspects of starting up a company and no overall model is presented with all the steps included. I therefore chose to create a new model based on the theories in these books. The model, called *Market Selection and Feasibility Framework (MSFF) for start-ups (Figure 0.1)*, contains of 8 phases: (1) Technology Idea, (2) Market Selection, (3) Customer Discovery, (4) Minimal Viable Product, (5) Customer Validation, (6) Minimal Viable Business Product (MVBP), (7) First Sales and (8) Growth.

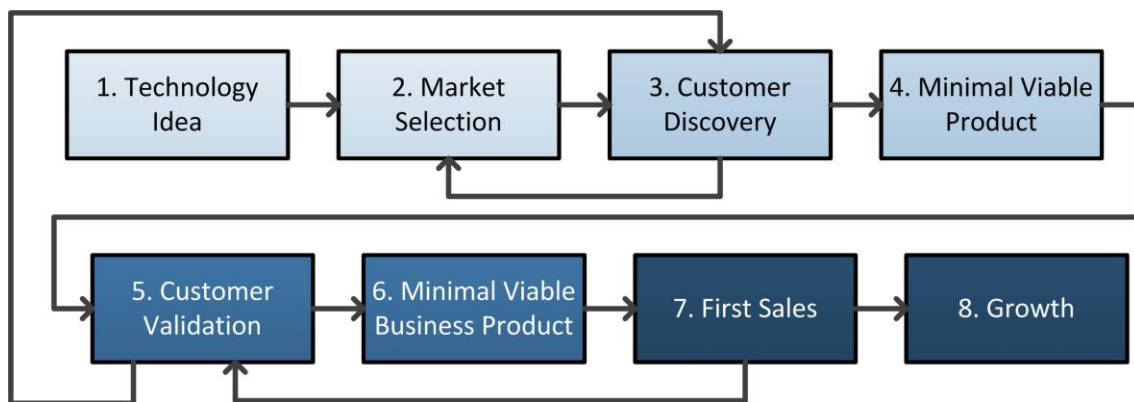


Figure 0.1. Market Selection and Feasibility Framework for start-ups

In paragraph 2.2 all steps of the *MSFF* are explained. In this chapter I give an insight in the different theories found in the books, followed by an explanation which theory relates to what step in the *MSFF*. In the following chapters (3 to 9) the potential of the electrically propelled trailer is defined by using the *MSFF*; my own start-up thus functions as a first business case to test my new model.

The methodology part of this thesis is described in chapter 3. In chapter 4 the Technology Idea (phase 1 of the *MSFF*) of the Electrically Propelled Trailer is described. This electrically propelled system has five advantages, (1) decrease of fuel consumption (2) easy driving in the mountains, (3) better acceleration, (4) decreasing swaying movement and (5) remote control to steer the trailer at the final destination. In this chapter also six scenarios are described to define the necessary size of the batteries and the electrical motors: (1) driving with a constant speed, (2) accelerate from 0 to 90 km/h, (3) driving with a constant speed (54 km/h) uphill, (4) mover function, (5) stabilizing and (6) driving downhill.

In Chapter 5 is explored what the most suitable market is to enter with the Electrically Propelled Trailer (Market selection Phase 2 of the *MSFF*). Six different markets in three categories were distinguished: (Category 1) normal trailers (< 3.500 kg) consisting of (A) utility trailers and (B) horse and boat trailers, (Category 2) Special trailers (< 3.500 kg) consisting of (C) caravans and (D) refrigerator trailers and (Category 3) heavy trailers (> 3.500 kg) consisting of (E) heavy regular trailers and (F) heavy refrigerator trailers. Based on research in these six markets and the results on six criteria the Electrically Propelled Trailer turned out to be the most suitable for the utility trailer and the caravan market. I chose to explore the caravan market further (and not the utility trailer market) because the caravan market had the highest scores in the research due to its slightly better value proposition and because the caravan market is more a gadget market.

In chapter 6 assumptions on the Electrically Propelled Trailers' Value Proposition are described (Phase 3 of the *MSFF*: Customer Discovery). These assumptions are about (1) the combination of the car and the caravan, (2) driving uphill, (3) problems with the swaying movement of the caravan, (4) fuel expenses and (5) mover ownership. Based on the results of the interviews and the survey 4 of 5 assumptions were validated.

The validated assumptions were:

(1) For the car-caravan combination is proven that people buy their car especially for their caravan [REDACTED] of the caravan owners do so). (2) [REDACTED] of the respondents is willing to pay more than [REDACTED] to solve their problem with driving their caravan in the mountains. (3) [REDACTED] of the caravan owners is willing to pay more [REDACTED] for a system that decreases the chances for swaying movement. (5) [REDACTED] of the caravan owners paid more than [REDACTED] for their mover.

Based on the validated assumptions I decided that the Electrically Propelled Trailers' Value Proposition was strong enough to explore the business case further. Therefore a Minimal Viable Product (MVP) (Phase 4 of the *MSFF*) was built to show the potential of the Electrically Propelled Trailer. In chapter 8 the fifth Phase of the *MSFF* is described. This chapter is on the exploration of the future customer: the Customer Validation Phase. In this phase the last sub-questions on the potential of the market were answered. The assumptions tested in this phase were: (1) the legality on the road, (2) starting country, (3) willingness to pay, (4) amount of sales, (5) distribution channels, (6) intellectual property, (7) target group, (8) installation costs, (9) motor size and price, (10) battery size and price, (11) profitability and (12) investments needed. [REDACTED] assumptions tested in this phase was not validated.

The results were: (1) It is possible to get the Electrically Propelled Trailer road legal, but it has to be proven that the system is safer than the current available system. (2) According to our research The Netherlands is considered an interesting country to start with the sales of the Electrically Propelled Trailer. Other interesting countries are: Denmark, France, Germany, Norway, Sweden and UK. (3) [REDACTED] of the caravan-owners is willing to pay more than [REDACTED] for the Electrically Propelled Trailer (4) It is possible to sell [REDACTED] Electrically Propelled Caravans per year throughout Europe in the future. (5) The Electrically Propelled Trailer can be distributed via retailers and via the caravan-factories. Further research should give information on the best distribution channel. Nine out of the eleven retailers that were interviewed were interested to sell and install the Electrically Propelled Trailer. Both, the factories and the retailers were able to install and maintain the Electrically Propelled Trailer. (6) The result of the research of the European Patent Office will follow later this year. The outcome of this research will show the strength of the intellectual property. (7) The assumption about the target group was not validated: people with a willingness to pay above the [REDACTED] were mainly people with a yearly gross income between the [REDACTED]. More people with an income above the [REDACTED] were expected. It is not a problem that this assumption is not validated. The people with a willingness to pay above the € [REDACTED] were mainly people with an age above the 61. (8) The installation costs for the Electrically Propelled Trailer are between the € [REDACTED]. (9 & 10) Both the batteries and the motors can be smaller than calculated. The tests with the MVP showed that these smaller batteries and motors have sufficient power to deliver the needs for the Value Proposition. Smaller battery and motor power will decrease the cost price of the product. This lower price will make the profitability of the project better. (11) Based on the assumptions used in the research the net profit of the product will be approximately [REDACTED]. Based on a sales level of [REDACTED] Electrically Propelled Trailers per year, the total potential net profit is between the [REDACTED]. (12) The investment needed to finalize the product and get it to the market is approximately [REDACTED]

Concluding upon the above: a new model called *Market Selection and Feasibility Framework for start-ups* was developed to assess the feasibility of the Electrically Propelled Trailer. This framework consisted of 8 steps. Five of the eight steps were applied to the Electrically Propelled Trailer Business Case to define the potential of the market. Within the *MSFF* a selection model is developed to select the most suitable market. In addition a second new model is designed that can be used to define which assumptions are more important than others and should be tested first. Based on the results from the *MSFF* is explored what the Electrically Propelled Trailer is (Phase 1). Then the caravan market is selected as the most suitable market (Phase 2). In Phases 3, 4 and 5 the feasibility of the market introduction is tested. The caravan market has a strong potential and has the possibility to become a profitable market for the Electrically Propelled Trailer. The future will show whether the expectations about the Electrically Propelled Trailer in the caravan market will come true.

Table of Contents

1.	Introduction.....	1
1.1.	General Description	1
1.2.	Business Dilemma	2
1.3.	Focus of this thesis.....	2
1.4.	Problem Statement.....	3
1.5.	Relevance of the research	4
1.6.	Structure of the research.....	4
2.	Entrepreneurship literature review	5
2.1.	The used literature.....	5
2.2.	Market Selection and Feasibility Framework for start-ups	10
3.	Methodology.....	22
3.1.	Research Design.....	22
3.2.	MSFF Phase 1: Technological idea	24
3.3.	MSFF Phase 2: Market Selection.....	24
3.4.	MSFF Phase 3: Customer Discovery.....	26
3.5.	MSFF Phase 4: Minimal Viable Product	31
3.6.	MSFF Phase 5: Customer Validation	32
3.7.	(In)validated assumptions.....	34
4.	MSFF Phase 1: Technology Idea	35
4.1.	Introducing the Electrically Propelled Trailer	35
4.2.	Regulations for the Electrically Propelled Trailer.....	36
4.3.	The Benefits of the Electrically Propelled Trailer.....	37
4.4.	Technical Details of the Electrically Propelled Trailer.....	38
4.5.	The Measurement System	42
4.6.	Cost price of the Electrically Propelled Trailer System	42
5.	MSFF Phase 2: Market Selection	44
5.1.	The Markets	44
5.2.	Normal Trailers (<3.500 kg)	45
5.3.	Special Trailers (<3.500 kg)	46

5.4.	Heavy trailers (>3.500 kg)	48
5.5.	Market Selection	49
6.	MSFF Phase 3 and 5: Customer Discovery	52
6.1.	Customer-segments	52
6.2.	Value Proposition	53
6.3.	Distribution Channels	56
6.4.	Customer Relationships	57
6.5.	Revenue Streams	58
6.6.	Key Resources	59
6.7.	Key Activities	60
6.8.	Key Partnerships	60
6.9.	Cost Structure	61
6.10.	Selection of the Assumptions	61
7.	MSFF Phase 3: Test of the Assumptions	68
7.1.	Assumption 1: Car-caravan combination	68
7.2.	Assumption 2: Driving uphill	69
7.3.	Assumption 3: Swaying movement	70
7.4.	Assumption 4: Fuel expenses	71
7.5.	Assumption 5: Mover Ownership	71
7.6.	Validation of the Assumptions	72
8.	MSFF Phase 5: Customer Validation	73
8.1.	Assumption 1: Road Legality	73
8.2.	Assumption 2: Starting Country	75
8.3.	Assumption 3: Willingness to pay	77
8.4.	Assumption 4: Amount of Sales	78
8.5.	Assumption 5: Distribution Channels; factories	79
8.6.	Assumption 6: Distribution Channels; retailers	80
8.7.	Assumption 7: Intellectual Property	81
8.8.	Assumption 8: Target Group	82
8.9.	Assumption 9: Installation Costs	83
8.10.	Assumption 10: Motor Size and Price	84
8.11.	Assumption 11: Battery Size and Price	85
8.12.	Assumption 12: Profitability	86

8.13.	Assumption 13: Investments Needed.....	88
8.14.	Validation: Conclusions.....	89
9.	Conclusion and Discussion	90
9.1.	Conclusions of the research.....	90
9.2.	Recommendations for further research	93
9.3.	Research limitations and discussion	95
	References.....	97
	Appendix A: Flyer	102
	Appendix B: Survey Caravan Jaarbeurs	103
	Appendix C: Movers	106
	Appendix D: Price of an Electrically Propelled Trailer	107
	Appendix E: Cost Price of batteries.....	108
	Appendix F: Cost Price of the electrical motors	110

List of tables

Table 2.1	Overview of the used literature in the MSFF per phase	12
Table 2.2	Overview of the used criteria for Market Selection.....	15
Table 3.1	Overview of the interviewees for the Market Selection (Phase 2).....	26
Table 3.2	Overview of the Assumption Test Table (Based on Osterwalder et al. 2015)	29
Table 3.3	Overview of Interviewees for the Customer Validation Phase (Phase 5).....	34
Table 4.1	Used constants for the calculations of the scenarios	38
Table 4.2	Overview of the scenarios.....	41
Table 4.3	Cost price of the Electrically Propelled Trailer per mass class	43
Table 5.1	Selection Criteria per market	49
Table 5.2	Market Selection	50
Table 6.1	High and low bound for the price of the Electrically Propelled Trailer.....	58
Table 6.2	Overview of the Customer Discovery assumptions	62
Table 6.3	Overview of the Customer Validation Assumptions	64
Table 7.1	Overview of Assumption 1	68
Table 7.2	Overview of Assumption 2	69
Table 7.3	Overview of Assumption 3	70
Table 7.4	Overview of Assumption 4	71
Table 7.5	Overview of Assumption 5	71
Table 8.1	Overview of Assumption 1	74
Table 8.2	Overview of Assumption 2	75
Table 8.3	Overview of caravan ownership and new sold caravans per EU country.....	76
Table 8.4	Score table of caravan ownership and new sold caravans per EU country	77
Table 8.5	Overview of Assumption 3	77
Table 8.6	Overview of Assumption 4	78
Table 8.7	Overview of Assumption 5	79
Table 8.8	Overview of Assumption 6	80
Table 8.9	Overview of Assumption 7	81
Table 8.10	Overview of Assumption 8.....	82
Table 8.11	Overview of Assumption 9.....	83
Table 8.12	Overview of Assumption 10.....	84
Table 8.13	Overview of Assumption 11.....	85
Table 8.14	Overview of Assumption 12.....	86
Table 8.15	Gross margin for the Electrically Propelled Caravan	86
Table 8.16	Forecast of the net profit for the Electrically Propelled Trailer	87
Table 8.17	Overview of Assumption 13.....	88
Table 8.18	Investments needed to get the Electrically Propelled Trailer to the market	89
Table C.1	Overview of movers.....	106
Table D.1	Overview of motor and battery power vs the trailer mass.....	108
Table D.2	Cost price of a fully propelled trailer.....	108
Table D.3	Cost price of a partly propelled trailer.....	108

List of figures

Figure 0.1.	Market Selection and Feasibility Framework for start-ups	viii
Figure 1.1	Structure of the research.....	4
Figure 2.1	Customer Development process (Blank & Dorf, 2012, p. 23).....	7
Figure 2.2	Phases of the MSF Framework and their place in this thesis	10
Figure 2.3	Overview of the used literature (own production).....	11
Figure 3.1	Flowchart of the research.....	22
Figure 3.2	Business Model Canvas (Osterwalder & Pigneur, 2010).....	27
Figure 3.3	The Selection Model: The ranking of Assumptions (own production)	28
Figure 3.4	Minimal Viable Product of the Electrically Propelled Trailer	31
Figure 4.1	Overview of the research.....	35
Figure 4.2	Render of the MVP (Own production).....	36
Figure 4.3	Schematical drawing of the MVP (Haan, 2015)	36
Figure 4.4	Overview of the 5 advantages of an Electrically Propelled Trailer	37
Figure 5.1	Overview of the Research.....	44
Figure 6.1	Overview of the research.....	52
Figure 6.2	Drawing of the Electrically Propelled Trailer (Caravan).....	53
Figure 6.3	The 5 advantages of an Electrically Propelled Trailer	56
Figure 6.4	Possible distribution channel (own production).....	56
Figure 6.5	Selection of the Customer Discovery assumptions	63
Figure 6.6	Selection of the Customer Validation Assumptions	65
Figure 7.1	Overview of the research.....	68
Figure 8.1	Overview of the research.....	73
Figure 8.2	Willingness to pay for the Electrically Propelled Trailer	78
Figure 8.3	Number of respondents per income group	83
Figure 8.4	Number of respondents per age group	83
Figure 8.5	Respondents per income group with willingness to pay above € 6.500	83
Figure 8.6	Respondents per age group with willingness to pay above € 6.500	83
Figure A.1	The MVP Flyer.....	102
Figure B.1	Survey page 1.....	103
Figure B.2	Survey page 2.....	104
Figure B.3	Survey page 3.....	105
Figure D.1	Mass trailer vs motor power (W)	107
Figure D.2	Mass trailer vs power battery (kWh)	107
Figure E.1	Price of battery vs power.....	109
Figure E.2	Price of Li-Ion battery vs power.....	109
Figure F.1	Price motors vs power.....	110

1. Introduction

1.1. General Description

Sustainability, safety and user-friendliness are terms frequently used nowadays in articles describing technical innovations and new developments in business (Kasman and Dunman, 2015) (Stigson, 2009) (Beetz, 2013) (Nagaki, 2012). It is important to give attention to new initiatives, whether in research or in business, that can contribute to one -or all three- of these aspects. In my opinion businesses, and more specific start-ups, should aim to contribute to a more sustainable, safer and user-friendly world. Start-ups have the flexibility that is necessary to explore current and future possibilities and create value with their business case. Being aware of this responsibility as a future entrepreneur and at the same time prove you have a real business case, is quite a challenge. A challenge I face myself, being co-founder of E-Trailer, a start-up on the development of an Electrically Propelled Trailer.

The need for a more **sustainable** world is proved by various figures. Carbon emissions (CO₂) have increased about 1.6% per year in the last thirty years (Kasman and Dunman, 2015, p. 97). The Intergovernmental Panel on Climate Change (IPCC) reported in 2007 that the increase of carbon emission would result in a rise of the temperature between 1.1 and 6.4 degrees Celsius in the coming 100 years. (IPCC, 2007) A dramatic decrease of carbon emissions is necessary to protect nature for irreversible consequences. On December 12th 2015, 195 countries have adopted the Paris Climate agreement. In this agreement the maximum allowed temperature rise due to climate change (2° C.) is laid down (COP21, 2015).

Currently the transportation sector is responsible for 23% of the worldwide carbon emission (IPCC, 2013). 53% of the carbon emission in the transportation sector is caused by road transportation. Using electrical or hybrid solutions in the transportation sector will contribute to decrease carbon emission. Following the IPCC (2013) is it possible to reduce carbon emission with 20 to 30% by implementing electrical and hybrid vehicles in the transport market (Bachmann et al., 2014). The well to wheel carbon emission of an electrical vehicle is on average 3 to 5 times lower than a conventional gasoline or diesel vehicle (Berhard and Tarpinning, 2006). This means that it is more efficient to generate electricity elsewhere and use it to drive an electrical vehicle, than burn diesel or gasoline in the car. Additionally implementing electrical and hybrid vehicles in the freight transport can reduce carbon emissions with 20 to 30% (IPCC, 2013).

Safety in transport is also an important current issue. In 2008 worldwide 1.24 million people were fatally injured due to road traffic crashes (World Health Organization, 2013) (Stigson, 2009). Besides this, 50 million people worldwide are injured seriously by traffic incidents each year (Scurfield et al., 2004) (World Health Organization, 2013). The World Health Organization (2013) has estimated that fatally injured people due to car accidents will be doubled in 2030 being on the fourth place as cause of dead (no. 8 in 2002). Nowadays the leading cause of dead among persons between 15 and 44 in high-income countries is already attributed to traffic injuries (Krug et al., 2000). It is positive that the number of road users that are fatally injured in high income countries have decreased with approximately 50% over the last 35 years, however the numbers are still high, 42.000 road users in the EU for example per year

(OECD, 2008) (Hobbs et al., 2001). *“To further reduce the number of road casualties, a safer road transport system must be created”* (Stigson & Hill, 2009, p. 441). *“Vehicle engineering improvements for safety can either be achieved by modifying the vehicle to help the driver avoid accidents, or by modifying the vehicle to provide protection against injury in the event of a crash”* (Hobbs et al, 2001, p4) *“Even small improvements in safety can have an impact on reducing deaths in vehicle crashes”* (Baron & Green, 2006, p8).

Making vehicles **user-friendlier** can endow to more safety and to more sustainability. Technical innovations are important contributors in this field. Most innovations in the transport industry already contributed to more sustainable transport (for example fuel reduction) or safer driving (Serafin, et al. 1993) (Beetz, 2013) (Nagaki, 2012). These innovations are for example: the hands free car phone system, (adaptive) cruise control, navigation system, lane-keeping control, board computer and voice control (Handbook of intelligent vehicles, 2012). Innovations that decrease the cost of driving (fuel expenses) and add more safety to the car are important innovations to the nowadays customer (Cisco, 2013)(Reiner & Cornubert (2013)). But also adding comfort to driving is an issue. Nowadays the costs of a car caused by R&D are 4 to 5% of the total manufacturing costs. Probably this percentage will grow in the coming years (Reiner & Cornubert, 2013). The most promising innovation in the car industry is probably the self-driving car.

1.2. Business Dilemma

Both consumers and governments opt to a more comfortable, safe and sustainable transportation sector. Buehler and Pucher (2011) stated that sustainability could be split up in three categories: environment, social and economic. Sustainable innovations will only succeed if the innovation is economical feasible. An important dilemma is that technical innovations have to be feasible to be able to turn into a realistic business case. Without a business potential the innovation will never make it to the market (Ries, 2011) (Osterwalder et al., 2015). This is the reason that this research focuses on the search for a general model to judge the market potential of a technological start-up. Literature review will be conducted to search for an existing suitable model. Already 5 interesting books on starting-up a technological business are found. When a suitable model is not found, I will design a new model based on the reviewed literature. The goal is to use this model to judge the feasibility of the E-Trailer start-up in order to experience the usability of this specific model. As pointed out previously, it is important to a starting entrepreneur to have a method available to judge business cases on their potential at an early stage. The E-Trailer start-up is a good example to prove the applicability of the model because the Electrically Propelled Trailer seems to be a promising answer to the demand for a safer, user-friendly and sustainable transportation. Several studies show the positive effects electrical and hybrid vehicles have on carbon emission. Beside this: nowadays drivers encounter many cons when towing a trailer. The Electrically Propelled Trailer also expects to eliminate the downsides of towing a trailer.

1.3. Focus of this thesis

Knowledge gaps on the subject of the Electrically Propelled Trailer are obvious. Currently no scientific research has been conducted on this subject. Google scholar and Scopus were used

to search for articles but no results were found on the following search queries: electrical trailer, propelled trailer, self-powered trailer or self-propelled trailer. Even when using a broader scope of search terms, no results came up. This indicates that no prior research has been conducted in this specific area. So in this master thesis the first research steps will be set in the field of Electrical and Self-Propelled Trailers.

The focus of this thesis will be on the identification of a model to judge the viability of a technological innovation at an early stage and apply this model to the business case E-Trailer. To define the potential of the business case, potential markets to implement the Electrically Propelled Trailer should be defined. A broader market research is necessary to define the knowledge gaps that exist on this subject. This thesis concentrates on two questions:

- (1) Is it possible to find or develop a model to judge the viability of a technologically based start-up in an early phase?
- (2) Can we use this model to determine the most appropriate market in terms of business potential to introduce the Electrically Propelled Trailer?

1.4.Problem Statement

The Electrically Propelled Trailer system promises to be an option to reduce carbon emission in the transport industry also contributing to safety and user-friendliness. It is a continuous challenge to get a sustainable innovation to the market. Since there are no calculations and case studies available on the subject Electrically Propelled Trailer it is difficult to judge the viability of this innovation. In this thesis potential markets are indicated where the introduction of the Electrically Propelled Trailer is expected to be successful. This brings us to the following problem statement:

“How can the Electrically Propelled Trailer add to a safer, more sustainable and more user-friendly transport sector and still have a positive business case?”

What data are necessary to find a solution for the stated problem? What is the best way to judge the potential of the innovation in certain markets? First more knowledge should be gathered on the technology and marketability of the Electrically Propelled Trailer. Subsequently more information is needed on the potential markets where the Electrically Propelled Trailer can be introduced. For each of these markets should be defined if there is a potential business case. Based on these knowledge gaps the research question that will be explored in this thesis is defined as follows:

How can the feasibility of the market introduction of the Electrically Propelled Trailer be judged and which market has the best potential?

To answer this it should be clear what the Electrically Propelled Trailer is and what its value is to potential customers. Then research has to be conducted on the criteria to select a potential market. Then a specific market is selected and more information on this market segment is collected. To judge the potential of this market a model will be used to canvas this market and its potential for the Electrically Propelled Trailer. As part of this model assumptions on the introduction of the technical innovation in this market are stated and validated. The validated assumptions give information on the feasibility of the introduction of the Electrically Propelled Trailer technology in this selected market.

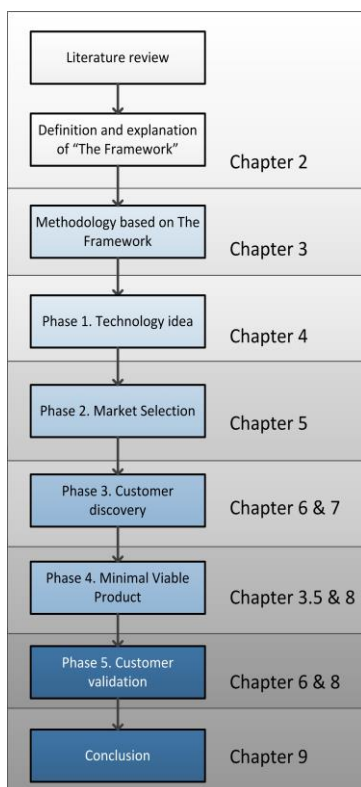
This leads to the following sub questions:

- (1) What a useful method to assess a business case for a technology-based innovation?
- (2) What is the most suitable market to introduce the technology of the Electrically Propelled Trailer?
- (3) What is the Value Proposition in this most suitable market?
- (4) What is the potential of the Electrically Propelled Trailer in this selected market?

1.5. Relevance of the research

The relevance of this research can be split in to three categories: (1) scientific, (2) socially and (3) entrepreneurially. This research is scientific relevant in two ways: it will be the first research on Electrically Propelled Trailers; no data and knowledge are available on this topic. Also this research elaborates on existing literature focussing on high-tech start-ups by assembling known information from the literature into a new model. Other entrepreneurs that want to judge the viability of their technology-based start-up can use this model. The social relevance of this research is based on the potential carbon emissions that can be saved by using an Electrically Propelled Trailer. The Electrically Propelled Trailer can be one of the numerous ways in which we can succeed in keeping the raise of the worlds' temperature below 2 degrees Celsius. Also the trailer contributes to more safety and user comfort on the road. The entrepreneurial relevance: based on the information from books by famous authors publishing on starting-up businesses a new model is designed that makes it possible to judge the market potential of a technological innovation in an early phase. Also this thesis leads to a conclusion on the market potential for the Electrically Propelled Trailer. With the information assembled with the model the entrepreneurs (being my co-founder and me) can judge whether they have a feasible business case or not.

1.6. Structure of the research



Chapter 2 gives an overview of current available literature on high-tech start-ups. Subsequently, a new model, based on the literature, is presented (Figure 1.1). It shows the 8 steps that lead to the judgement of the viability of a technology-based start-up. In chapter 3 the research approach and methodology are discussed. In chapter 4 the details of the technology behind the Electrically Propelled Trailer are explained. In chapter 5 all potential markets for the Electrically Propelled Trailer are presented. Subsequently the highest potential market is selected to define in more depth. This is described in chapter 6 where the assumptions for the judgement of the viability of the start-up are summarized. In chapter 7 and 8 these assumptions are tested and the results of these tests are presented. In chapter 9 the conclusion of the research is made and an answer to the research question is given.

A discussion on the outcome of the research is provided in chapter 9. Based on the discussion and the conclusion recommendations for further research are given.

Figure 1.1 Structure of the research

2. Entrepreneurship literature review

In this literature review six books on starting an enterprise are being discussed. Based on this literature a new Framework for start-ups is designed in this thesis. This Framework, developed to support the start of a technology-based company, is described in paragraph 2.2.

2.1. The used literature

The books used for this chapter are the books by Ries (2011), Osterwalder et al. (2010 & 2015), Aulet (2013), Blank & Dorf (2012) and von Hippel (1988). These books have in common that they focus on the subject of 'how to start a technology-based company'.

In an article in Wall Street Journal Gage (2012) points out that 3 out of 4 start-ups fail. This high failure rate leads to a waste of resources (mainly time and capital) for the founders of the start-ups. It is not only a loss for the start-ups, but investors, coaches, potential customers and universities are also confronted with a loss of resources due to start-up failures. It is important to develop a start-up method that makes starting a company less risky.

Eric Ries (2011) published such a method. It is a different way to tackle the start-up of a technology-based company: the 'Lean Start-up Method'. Basically the Lean Start-up Method exists of three key principles:

- (1) Test your hypotheses. When you start an enterprise you only have a list with hypotheses. These hypotheses should be tested to explore if there is a possibility to build a profitable business from this start-up.
- (2) Get out of the building. The only way to define if the hypotheses are true or false is to get out and talk to potential customers.
- (3) Learn fast and quick. Do not start with a development process of several years. Start with a simple version of your product and test it. Then make a fast update and use split testing to explore if the update adds value for your customers.

The traditional way of starting a business is by writing a business plan. Blank (2013) who wrote an article on the changes in the start-up environment due to the introduction of the Lean Start-up Method, and his colleague Ries (2011) both state that: "*a business plan never survives the first customer contact*". Before the introduction of the Lean Start-up, start-ups wrote a business plan, got funding from an investor and started to develop the technology. After a long period of development the start-up tried to sell the product to potential customers. However, when the potential customers are not willing to buy the product for whatever reason, money and time are wasted.

Blank (2003) states in his first book, *The Four Steps to the Epiphany*, that "*start-ups are not smaller versions of large companies*". Ries (2011) and Osterwalder & Pigneur (2010) follow this theory in their books. Ries (2011) states that it is important to start with a list of all hypotheses and test them with customers. Osterwalder & Pigneur (2010) make a schedule, the Business Model Canvas that makes it easy to summarise and categorise the different hypotheses. All authors agree that the different hypotheses should be tested before a lot of resources are being wasted. As a reaction to these theories Aulet (2013) wrote a book on the different steps

that should be taken to go through this hypothesis testing process. Aulet (2013) gives 25 steps to describe the process from a technology to the first sell of the product. Two years later Osterwalder et al. (2015) wrote a second book, now on validating hypotheses and defining a good Value Proposition. After their first book Osterwalder & Pigneur (2010) were not satisfied with their description on the testing of hypotheses and the Value Propositions. In their new book Osterwalder et al. (2015) they state that the Value Proposition is the most important part of starting up a business. In this Value Proposition the problem of the customer and the way the start-up tries to solve this problem are being described.

Von Hippel (1988) wrote his book 23 years before the Lean Start-up Method entered the entrepreneurship literature. Nevertheless there are there a lot of similarities between the Lean Start-up and the book of von Hippel. According to von Hippel co-creation with an early adopter in the market is necessary. This co-creation is in that way similar to the Customer Validation method of Ries (2011). The only difference is that von Hippel only tests the product on one customer.

The books in this paragraph are used for the literature review and are described more fully in the next paragraphs. Based on these theories a new Framework (*Market Selection and Feasibility Framework (MSFF) for start-ups*) is introduced in paragraph 2.2.

2.1.1. Lean Start-up – Erik Ries (2011)

The Lean Start-up Method is a new paradigm in the start-up environment (Blank, 2013). The Lean Start-up Method is based on the lean manufacturing in the car industry. Lean manufacturing is started in the Toyota factory in Japan. The philosophy of lean is to minimize waste streams. Here waste can be money, time, materials etc. The goal is to minimize waste streams through the application of a structural approach and learning by measuring the waste streams. In Ries' (2011) opinion being lean in a start-up is focussing on providing benefits to the customer; anything else is waste. He believes that the former way of starting a business (writing a business plan, develop your technology and try to sell your products) leads to a lot of waste. When the customer finally provides feedback on the product it is too late to change the product because it is already manufactured. This method of starting up a business is based on uncertain assumptions. Therefore Ries states (2011) that the entrepreneur should start the business process by talking with future customers in an early stage. In this way the entrepreneur can explore what the customer needs and wants. This is a way to validate assumptions. Following Ries (2011) the entrepreneur should not think as an engineer (it is not about what the entrepreneur can make) but the entrepreneur should focus on what the customer wants. Ries (2011, p. 64) defined 4 questions that should be answered to validate if the customer has a problem and if the problem can be sold by the start-up's product. These questions are:

1. "Do customers recognize that they have the problem you are trying to solve?"
2. If there were a solution would they buy it?"
3. Would they buy it from you?"
4. Can you build a solution for the problem?"

The entrepreneur should try to find answers to these questions. Before starting to test the hypotheses, for each hypothesis an expected outcome is defined. Then experiments are

carried out. The best way to test the assumptions is by manufacturing a 'Minimal Viable Product' and to test this with early adopters. Based on the outcome of the experiments it can be decided whether it is sensible to pivot or to preserve. If the hypotheses are validated you can preserve and build your product. If not, learn from the customers and pivot to a product that they do want. After the experiments testing can be continued with next hypothesis. According to Ries (2011) the lean principle should also be applied to the tests: they should be conducted in a short period of time. Learn quickly and pivot fast if necessary. When the entrepreneur is confident the business can become profitable the acceleration of the start-up comes into sight. Start with the production of a small batch of products. Sell this batch and learn quickly from the customers that buy these products. When the entrepreneur is sure about the product the business can grow and scale up.

2.1.2. The Start-up Owner's Manual – Blank & Dorf (2012)

In this Start-up Owners' Manual the process of starting up with the Lean Start-up Method is described in more depth. Blank & Dorf (2012) name the process of testing the hypotheses the Customer Development. The Customer Development exists of two main phases and four sub phases. The two main phases are the Search and the Execution Phase. In the Search phase is started with the Customer Discovery and after that with the Customer Validation. In the Execution phase the focus is on the Customer Creation and next on Company Building (Figure 2.1).

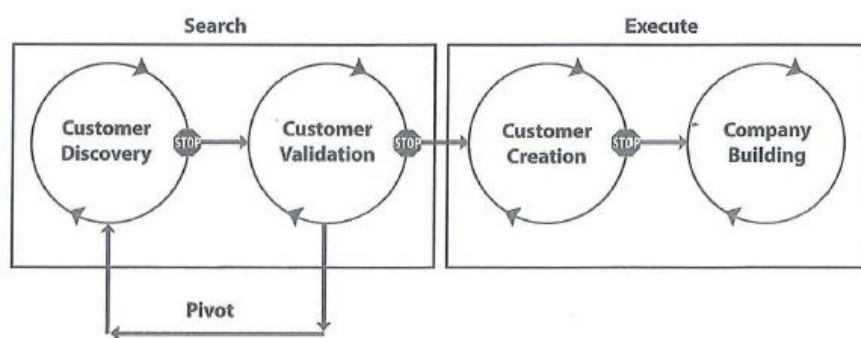


Figure 2.1 Customer Development process (Blank & Dorf, 2012, p. 23)

A start-up runs in a different way than a big company. In a big company the business, the products, the customers and the business model are known factors. In a start-up the entrepreneur has to explore all these factors; they are unknown and uncertain. The start-up should focus on the customer to find a problem to solve and a market to sell to: The Customer Discovery Phase. Based on conversations with customers hypotheses are tested in this Phase. When the entrepreneur has obtained enough information from the customers a 'Minimal Viable Product' (MVP) can be build. This MVP is used to go 'out of the building' and collect as much customer feedback as possible. The entrepreneur learns quickly from the customers and can continue with the next assumption. When the MVP has proven the hypotheses, the entrepreneur has to gather further market data to formulate hard conclusions about the business chances.

The next step in the Search Phase is the Customer Validation. Here the first sale has to be made to prove whether the customer is interested in the product. The entrepreneur has to prepare sales by searching for an early adopter who will buy the product. This Phase is still a

Phase of experimenting and testing the hypotheses to learn. It can be very hard and sometimes confrontational when nobody wants to buy the product. However, the entrepreneur should be happy that not much time and money is invested yet! After the first sales the business enters the Execution Phase and the Customer Creation takes off. In this Phase the business plan will be executed. Because the assumptions are validated, the business plan does make sense in this Phase. Now the customers are known and also are the ways they can be acquired. Subsequently in the fourth Phase, Company Building, the steps that are necessary to scale up the company are described.

2.1.3. Disciplined Entrepreneurship – Aulet (2013)

Aulet (2013) tried to create a handbook with 25 (24 steps plus step 0) steps starting from a technical idea to the first sell. It is hard to formulate a systematic process that fits the process of starting a company for all types of start-ups. Therefore the 25 steps are an advised order and should not necessary be followed in the sequence presented by Aulet (2013). The 25 steps are divided in 6 categories: “(1) who is your customer, (2) what can you do for your customer, (3) how does your customer acquire your product, (4) how do you make money off your product, (5) how do you design and build your products and (6) how do you scale your business” (Aulet, 2013, p 13). The book of Aulet (2013) focuses, like Ries (2011) and Blank & Dorf (2012) on start-ups that, due to their scalable business model, have the possibility to grow fast.

The first steps in the book of Aulet (2013) are different than the first steps of Ries (2011) and Blank & Dorf (2012). Aulets’ first steps focus on the question: ‘What can I do well that I would love to do for an extended period of time?’ It focuses on the interests and capacities of the entrepreneur instead of the customer and the customer pain. Aulet (2013) believes that when you have a passion you will find a customer with a problem you can solve. Aulet (2013) makes the same remark as Blank (2003) on a start-up not being a small version of a large company. Quantifying is important following Aulet (2013). To calculate that you are 50% faster or 30% cheaper is a way to quantify your Value Proposition. In his opinion after having quantified your Value Propositions, a business model should be designed. Different possible business models are described in the book. The book gives much attention to the subject of pricing: how do you set your prices and what are the effects of different prices?

The last steps in the book are the creation of a Minimal Viable Product (MVP). The MVP should meet three main requirements: the customer has to get value out of the product, the customer pays for the product and the product is sufficient enough to start the customer feedback loop. The MVP should be used to validate business. When the first MVP is sold the business is validated.

2.1.4. Value Proposition Design – Osterwalder et al. (2015)

The Value Proposition Design book of Osterwalder et al. (2015) is a sequel on the Business Model Generation book of Osterwalder & Pigneur (2010). Their first book gives a good overview of the (hypotheses of the) business. In the second book two parts of the Business Model Canvas are elaborated: (1) the Value Proposition (chapter 1) and (2) the Validation of the Hypotheses (chapter 2 and 3). The book explains in detail what a good Value Proposition is

and how to design it. The customer should be the centre of the Value Proposition: a good Value Proposition solves the customers' pains. To create a Value Proposition the customers' pains, jobs and gains must be defined: the so-called Customer Profile. Subsequently, the Value Map should be created. In the Value Map is defined what can be delivered to relieve the customers' pains, to create gains for the customers and what exactly will be delivered to the customer. When the Customer Profile and the Value Map are defined, it has to be determined if there is a fit between them. When there is no fit between the Customer Profile and the Value Map, the Value Proposition is not good.

The second chapter is about design: the creation of a prototype. The prototype can visualise the product and makes it easier to communicate with potential customers. With this prototype the entrepreneur can learn more about the customer. This can be done by interviews, desk-research, surveys, observations and co-creation. Another important facet is to know the competitors and the differences between their Value Proposition and yours. In this chapter of the book the whole business is designed based on first customer insights and a lot of assumptions.

In the third chapter is described how these assumptions can be tested. The book gives good methods to test the assumptions in the Business Model Canvas. Advised is to start with the extraction of all hypotheses from the Business Model Canvas and to prioritise the hypotheses on their impact on the business. The next step is to validate the hypotheses, starting with the hypotheses with the highest impact. For each hypothesis should be defined what outcome makes happy and with what method the hypothesis is being tested. The test can be conducted by: ad tracking, link tracking, customer test with prototype, landing page, split testing and/or presales. When the tests are conducted, it can be concluded if the hypothesis is true or not. If true, go on with the next hypothesis. If not, try to understand why and change things in your Business Model Canvas (pivot) and test again. Try to make the learning cycle of testing different hypothesis as short as possible. So, try to test as many hypotheses in a short amount of time to learn quickly.

2.1.5. The Sources of Innovation – Eric von Hippel (1988)

In his, *The sources of Innovation*, Von Hippel (1988) he explains how innovation arises. The book uses the 'Lead Users' definition: "*A lead user face needs that will be general in a marketplace, but they face them months or years before the bulk of that marketplace encounters them, and lead users are positioned to benefit significantly by obtaining a solution to those needs.*" (Von Hippel, 1988 p. 107). Von Hippel concludes that the best way to innovate is searching a party that tries to solve the problem by themselves before the rest of the people face the problem.

Von Hippel states that the inventor should explore a specific market. Than the inventor should define how to find Lead Users. In addition to that is it important to select criteria to measure if a potential Lead User is really a Lead User. Subsequently is it important to find the Lead Users in the market. When the Lead User is identified a concept product should be created together with the Lead User. This can be a concept product but also a fully implemented product. The last step is to test the new concept/product. Make changes based on the tests until the product is ready scale up to the rest of the market.

2.2. Market Selection and Feasibility Framework for start-ups

Based on the literature discussed in the former paragraphs I designed a new Framework containing the main phases of going from a technical business idea to a successful business. This framework is named the Market Selection Feasibility Framework (MSFF) for start-ups. The MSFF consists of eight phases: (1) Technology Idea, (2) Market Selection, (3) Customer Discovery, (4) Minimal Viable Product, (5) Customer Validation, (6) Minimal Viable Business Product (MVB), (7) First Sales and (8) Growth (Figure 2.2).

In this paragraph the eight phases are explained and the viewpoints of the different authors are added. Figure 2.3 shows these different definitions and phases from the different authors.

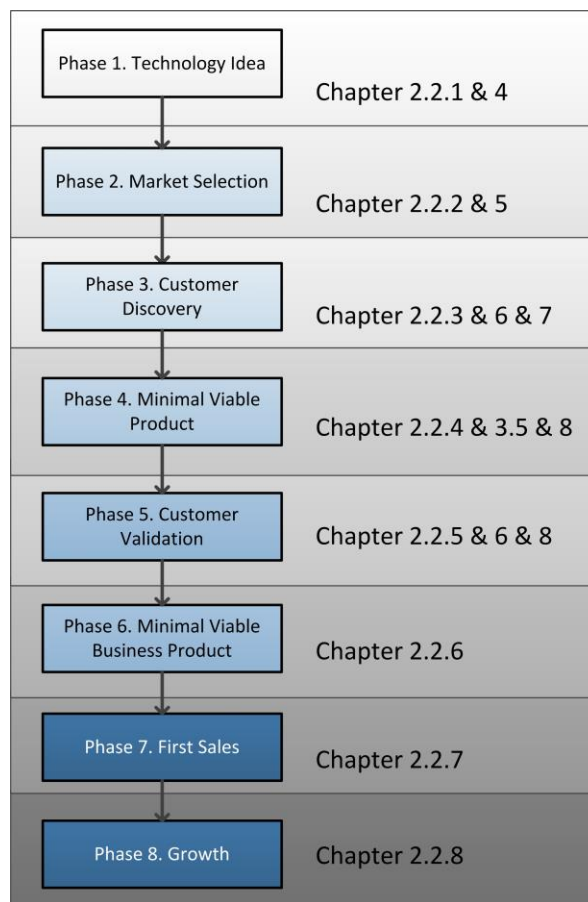


Figure 2.2 Phases of the MSF Framework and their place in this thesis

Table 2.1 gives an overview which literature is used to define the 8 steps of the MSF Framework. The first step is the Technology Idea: all books start with this basic step. The next step, Market Selection, is based on the Market Selection step of Aulet (2013). When the market is known the customer should be explored. This investigation is conducted in the third step, the Customer Discovery (Blank & Dorf, 2012). The Fourth step (Minimal Viable Product (MVP)) is based on the definition of Blank & Dorf (2012) and Osterwalder et al. (2010 & 2015). The MVP will be used in step 5 to test all assumptions that were not tested in the Customer Discovery phase. This phase is mainly based on the theory of Blank and Dorf (2012).

The Sixth Step, Minimal Viable Business Product (MVB), is based on the theory of Aulet (2013) and Ries (2010). The difference between a MVP (phase 4) and a MVB (phase 6) is that a MVP is a proof or concept that is used to validate the business case. A MVB is a real product that is ready to be sold for a reasonable price.

The last phase (8) is the Growth phase of the company. The used literature does not focus on this phase. However, Ries (2010) shortly explains some theory about growth and Blank & Dorf (2012) end their book with the statement that they will explain the growth of a start-up in the next edition of their book.

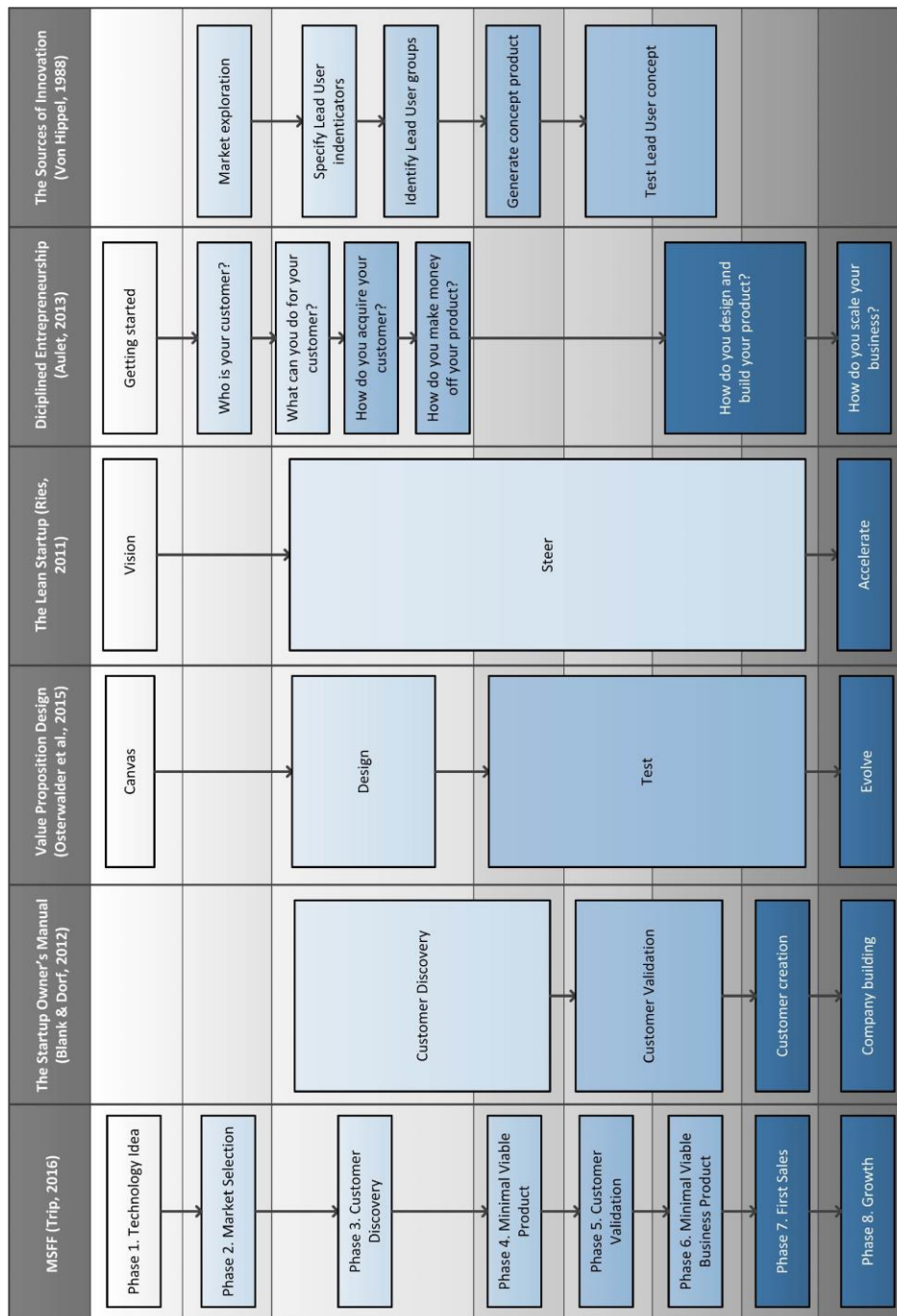


Figure 2.3 Overview of the used literature (own production)

Table 2.1 Overview of the used literature in the MSFF per phase

Phase	Author	Literature parts	Description
Phase 1, Technology Idea	Aulet (2013)		“(1) have an idea that can change the world, (2) have a technology that have a positive effect on society and/or (3) have a passion for a specific skill or market”.
Phase 2, Market Selection	Aulet (2013)	Step 0, 1 and 2	(0) Getting started (1) Market segmentation (2) Select a beachhead market
	Osterwalder et al. (2015)	Page 122	10 Questions to assess your value proposition
Phase 3, Customer Discovery	Aulet (2013)	Step 3, 4, 5, 6, 7, 8, 10, 11, 12 and 13	(3) Build an end user profile (4) Calculate the TAM size for the beachhead market (5) Profile the persona for the beachhead market (6) Full life cycle use case (7) High-level product specification (8) Quantify the value proposition (10) Define your core (11) Chart your competitive position (12) Determine the customer’s decision-making unit (13) Map the process to acquire a paying customer
	Blank & Dorf (2012)	Step one (Chapter 3 – 7)	Customer Discovery
	Osterwalder et al. (2015)	Chapter 1	Canvas
	Ries (2011)	Part 1	Vision
Phase 4, Minimal Viable Product	Osterwalder et al. (2015)	Chapter 2	Design
Phase 5, Customer Validation	Blank & Dorf (2012)	Step two (chapter 8 -12)	Customer Validation
	Osterwalder et al. (2015)	Chapter 3	Test
	Ries (2011)	Part 2	Steer
	Von Hippel (1988)	Chapter 8	Predicting the source of innovation: Lead Users
Phase 6, Minimal Viable Business Product	Aulet (2013)	Step 22	Define the minimum viable business product
	Osterwalder et al. (2015)	Definition on page 222	“A representation or prototype of a value position designed specifically to test the validity of one or more hypotheses/assumptions.”
Phase 7, First Sales	Blank & Dorf (2012)	Chapter 10, 11 and 12	(10) Get out of the building and sell (11) Develop product and company positioning (12) The toughest question of all: pivot or proceed?
	Aulet (2013)	Step 23	Show that the dogs will eat the dog food
Phase 8, Growth	Ries (2011)	Part 3	Accelerate

2.2.1. Phase 1: Technology Idea

All books discussed in this chapter are written for entrepreneurs that want to start a technology-based company. According to **Aulet** (2013, p.17) there are three ways to start a new business: “(1) have an idea that can change the world, (2) have a technology that have a positive effect on society and/or (3) have a passion for a specific skill or market”. The book of **Blank and Dorf** (2012) is written for scalable start-ups. These are traditional ventures with a technology bases. “These entrepreneurs believe that they can change the world with their technology and are able to earn hundreds of millions dollars with their idea”. (Blank and Dorf, 2012). Following **Ries** (2011, p. 27) “A start-up is a human institution designed to create a new product or service under conditions of extreme uncertainty”. **Osterwalders’** The Value Proposition Design book (2015) is written for teams that want to create a great Value Proposition and a Business Model from scratch to build a new venture. **Von Hippel** (1988) states that a new venture should be based on an innovation. In the opinion of all authors the basis of a scalable business should be a technology. The three starting points of Aulet (2013) are the most applicable to my idea of a start-up. The definition of a technology idea that will be used in this new Framework is: “A new technology based innovative idea that has the potential to change the market”. In addition to that is the passion of the entrepreneur for either the technology of the market.

2.2.2. Phase 2: Market Selection

The second Phase in the process of starting a business is market selection. The different authors have different opinions on market selection. In his Lean Start-up book **Ries** (2011) does not speak about market selection at all. Described in paragraph 2.1.1. Ries’ (2011) 4 questions are formulated that are the most important in starting a business. From these questions it can be concluded that to Ries (2011) the selection of a market is not important. His opinion is that if you find a problem you can solve, and customers want to pay for the solution you can start your business. If you discover in the Customer Discovery Phase that you do not solve a problem you should pivot to a different market. These markets can be selected randomly. **Blank & Dorf** (2012) agree with Ries (2011) on this matter.

Aulet (2013) has different ideas on selecting a starting market. He states that the entrepreneur should focus on his/her own capabilities. As he formulates it: “capabilities in terms of skills, technical knowledge and network”. Besides the capabilities of the entrepreneur the selection of the market should start with a brainstorm about all different markets that you can think of. Subsequently all these markets are reviewed based on seven questions: (1) “Is the target customer well funded? (2) Is the target customer readily accessible to your sales force? (3) Does the target customer have a compelling reason to buy? (4) Can you today, with the help of partners, deliver a whole product? (5) Is there entrenched competition that could block you? (6) If you win this segment, can you leverage it to enter additional segments? (7) Is the market consistent with the values, passions, and goals of the founding team?” (Aulet, 2013, p. 31). The scores of the different markets should be added to define what is the best market to start. Aulet (2013) transfers the 7 questions to 8 criteria to select the right market: (1) end user, (2) application, (3) benefits, (4) lead customer, (5) market characteristics, (6) partners, (7) market

size and (8) competition. To select the right market the value of each criterion has to be defined.

In the book by **Osterwalder et al.** (2015) different market selection tools are mentioned. The book starts with 10 questions to assess different Value Propositions (p. 122): *“(1) Is it embedded in a great business model? (2) Does it focus on the most important jobs, most extreme pains and most essential gains? (3) Does it focus on unsatisfied jobs, unresolved pains and unrealized gains? (4) Does it concentrate on only a few pain relievers and gain creators but those extremely well? (5) Does it address functional, emotional and social jobs altogether? (6) Does it align with how customers measure success? (7) Does it focus on jobs, pains, or gains that a large number of customers have or for which a small number are willing to pay a lot of money? (8) Does it differentiate from competition in a meaningful way? (9) Does it outperform competition substantially on at least one dimension? (10) Is it difficult to copy?”*

The difference between these questions and the questions of Aulet (2013) is that they are about assessing Value Propositions. The questions focus more than those of Aulet on the Business Model and the Customer Pains. Competition is also an important point in selecting the right Value Proposition according to Osterwalder et al. (2015).

According to **von Hippel** (1988) market selection should be started with market analyses. Find out what the trends are in the market. It has to be explored what problems can be solved and which of these problems can have the most potential benefits. Within the market identifiers should be defined to determine which users in the market could be potential Lead Users and how these Lead Users can benefit from the innovation. When these identifiers are selected they are used to select Lead Users in the market. In this methodology no market selection is conducted. A market is selected and in this market further research is conducted.

In **my opinion** it is important to define what is the best market to start. A random start in a market and find out if there is a business case does not seem a wise approach. The method of Aulet (2013) is a good method to define different potential markets you can serve with your technology. The 10 questions of Osterwalder et al (2015) are added to this because it is very important to have a good Value Proposition. If there is no Value Proposition there is no business. (Zider, 1998) The 4 questions of Ries (2011) are also used, these questions give a good overview of the potential of the idea: when there is no customer pain there is no customer that will pay for the solution. Despite the fact that Ries (2011) does not use any form of market selection his questions are going to be used in the new Framework (MSFF) to assess a market.

In *Table 2.2* the criteria and questions of Aulet (2013, Ries (2011) and Osterwalder et al. (2015) are combined to new selection criteria. The 6 criteria that arise from this combination are: (1) willingness to pay, (2) investments needed, (3) competition, (4) market growth, (5) market size, (6) cost price. Based on these 6 criteria the different markets for a technical solution can be distinguished. Aulets' (2013) question 6 and 7 are not used in this tool. Question 6 is not used because it focuses on additional segments. All other markets that are explored by these criteria could be additional segments so all markets will score the same. Question 7 is not used because it is too subjective. Each entrepreneur should decide for him/herself if this question is fulfilled. This is not a hard and measurable criterion, so it is not used.

Table 2.2 Overview of the used criteria for Market Selection

Questions of Aulet (2013)	Criteria of Aulet (2013)	4 questions of Ries (2011)	10 Questions of Osterwalder et al. (2015)	Used Criteria
1. Is the target customer well funded? 3. Does the target customer have a compelling reason to buy?	1. End user, 2. Application, 3. Benefits, 4. Lead Customer	1. Do customers recognize that they have the problem you are trying to solve? 2. If there is a solution would they buy it?	1. Is it embedded in a great business model? 2. Does it focus on the most important jobs, most extreme pains and most essential gains 3. Does is focus on unsatisfied jobs, unresolved pains and unrealized gains? 4. Does is concentrate on only a few pain relievers and gain creators bur those extremely well? 5. Does it address functional, emotional and social jobs all together? 6. Does it align with how customers measure success? 7. Does it focus on jobs, pain, or gains that a large mummer of customers have or for which a small number are willing to pay a lot of money?	Willingness to pay
4. Can you today, with the help of partners, deliver a whole product?	6. Partners	4. Can we build a solution for the problem?		Investment needed
2. Is the target customer readily accessible to your sales force? 5. Is there entrenched competition that could block you?	8. Competition	3. Would they buy it from us?	8. Does it differentiate from competition in a meaningful way? 9. Does it outperform competition substantially on at least on dimension 10. Is it difficult to copy?	Competition
6. If you win this segment, can you leverage it to enter additional segments?	5. Market characteristics			Market growth
	7. Market size	4. Can we build a solution for the problem?	7. Does it focus on jobs, pain, or gains that a large mummer of customers have or for which a small number are willing to pay a lot of money?	Market size
		4. Can we build a solution for the problem?	1. Is it embedded in a great business model?	Cost price
7. Is the market consistent with the values, passions, and goals of the founding team?				-

2.2.3. Phase 3: Customer Discovery

The name of this third Phase: Customer Discovery is adopted from **Blank & Dorf** (2012). Their definition of Customer Discovery is: “*Customer Discovery translates a founder’s visions for the company into hypotheses about each component of the business model and creates a set of experiments to test each hypothesis.*” (Blank & Dorf, 2012, p. 24) The Customer Discovery will be used to find a customer segment that will fit to the product vision. This Phase exists of two ‘get out of the building moments’. First the customer problem is tested, followed by the testing of the willingness to pay to solve this problem. During the second ‘get out of the building moment’ a test should be conducted with a Minimal Viable Product to find out if the solution fulfils the needs of the customer. During the first and the second customer contact pivots may happen. Based on the information that comes from the customers’ feedback the entrepreneur should switch to a different problem or a different solution for his/her business. (Blank & Dorf, 2012)

Osterwalder et al. (2015) describe the Customer Discovery Phase with the Value Proposition Canvas (chapter 1). The Customer Profile, as described in paragraph 2.1.4., should be defined first. In this Profile the customer pains and gains are indicated. Subsequently the values the entrepreneur can deliver (Value Map) are indicated. Based on first customer interviews it will be defined what the fit is between the Value Map and the Customer Profile.

Aulet (2013) pays attention to Customer Discovery in several steps (step 3, 4, 5, 6, 7, 8, 10, 11, 12 and 13). After the market selection it will be defined who the customer is and what can be delivered to the customer (similar to the Value Proposition of Osterwalder et al. (2015)). The Value Proposition is translated in the Life Cycle Case for the customer: what is the product price and what will the customer earn from your product? In additional steps the Core of the Business is defined and the product specifications are created on a high level. Aulet (2013) also focuses on the Costs to Acquire Customers. In his steps (Life Cycle Case, Core of the Business, Costs to acquire customers, etc.) assumptions are made about the business and the customer. These steps give the entrepreneur a good overview of all the choices that can be made at the start of a business.

In **Ries’** (2011) opinion there is a simple way to discover customers by simply talking with them. During these conversations it can be determined what the customers really want. (Ries, 2011) The 4 questions of Ries can be answered in these conversations. The outcome of these conversations could either be that the product solves a meaningful pain or that the customer has a different pain, than the entrepreneur should pivot. (Ries, 2011)

In the methodology of **von Hippel** (1988) the Lead User should be found as a form of Customer Discovery. Based on the market analysis and a survey in the market can be defined which potential users are Lead Users.

The Customer Discovery Phase in the *MSFF* is based on the definition of Blank & Dorf (2012). I **agree** the most on the definition of Blank and Dorf (2012). To get a better overview of the Customer Profile, the value-mapping tool of Osterwalder et al. (2015) can be used to structure the process of Customer Discovery. The steps of Aulet (2013) describe in a clear way which steps should be taken to discover the customer in an optimal way. By using the steps of Aulet

(2013) the Customer Discovery is supported by numbers, this makes things more clear. It is possible to go back from this phase to Phase 2, as shown in *Figure 2.2*. If in Phase 3 it is discovered that there is no business case or no Customer Profile Fit, the entrepreneur should go back to Phase 2 and select a different market.

2.2.4. Phase 4: Minimal Viable Product

The discussed authors use different definitions of a Minimal Viable Product (MVP) and prototypes. In the *MSFFs'* third step (Customer Discovery) the MVP is already used to get a better understanding of the customer. (Blank & Dorf, 2012).

According to **Ries** (2011) the entrepreneur should build a MVP as quickly as possible. *"The MVP is that version of the product that enables a full turn of the Build-Measure-Learn loop with a minimum amount of effort and the least amount of development time."* (Ries, 2011, p. 77) It is no problem if the MVP does not have all functions that it should have. However, the MVP should have enough functions to get a customer feedback in an effective way. An MVP can be a real product, but also a presentation in a movie, flyer, website, etc. (Ries, 2011).

"A MVP is a product with the smallest possible group of features that still solves the core problems of the customer and demonstrates the products' value". (Blank & Dorf, 2012, p.80)

The MVP cuts back the wasted engineering hours, be a strategy to get the product in use by early adopters as quick as possible and is a tool to get customer learning in a short amount of time. The MVP should be used to get better customer insights in the Customer Development Phase. (Blank & Dorf, 2012)

Instead of the MVP **Aulet** (2013) uses the MVBP definition (Minimal Viable Business Product). The MVBP is an MVP that will be sold. This sell will be used to test that the customer is willing to pay for the solution. Aulet (2013, p.237) states: *"the MVP of Ries is too limited and does not accurately describe a product"*. An MVPB should exist of three elements: *"(1) the customer gets value of the use of the products, (2) the customer pays for the product and (3) the product is sufficient enough to start the customer feedback loop"* (Aulet, 2013, p. 237). This last element is similar to the definition of Ries (2011).

Osterwalder et al. (2015) separates the prototype from the MVP. A prototype should be made in an early stage to test the functions with the potential customers. The definition they give for a prototype is: *"the practice of building quick, inexpensive, and rough study models to learn about the desirability, feasibility and viability of alternative Value Propositions and business models"* (Osterwalder et al., 2015, p. 76). A prototype should be a visualization of your ideas and can be used to explain your idea in a better way to the customers. The definition of an MVP is: *"a representation or prototype of a Value Proposition designed specifically to test the validity of one or more hypotheses"*. *The goal of an MVP is to conduct customer tests as quickly, cheaply and efficiently as possible to see if you really solve the problem of the customer. MVPs are mainly used to explore potential customers and partner interest."* (Osterwalder et al., 2015, p. 222). Osterwalder et al. (2015) use the MVP and the prototype to test the assumptions and to visualize the thoughts.

Von Hippel (1988) uses the term concept product instead of MVP. A concept product should be developed in collaboration with the Lead User. A concept product is a product that meets the needs of the Lead User. This can be seen as a type of co-creation. This is a really strong point, in contrast to the other authors where the MVP is used to validate the assumptions. A

co-creation with the customer will lead to more certainty from the customers' side. The entrepreneur can be sure that he/she will get customer feedback. In addition it will be more likely that the entrepreneur makes the product the customer wants.

Different definitions of MVP's are described. In **my opinion** selling a product is not necessary in this fourth Phase of *The MSFF*. The MVP is made after the Customer Discovery. In this Phase of a start-up it is interesting to show your ideas in a visible way. That is not necessarily a product that can be sold. That is more interesting after the Customer Validation Phase. The definition of a MVP that will be used in my new Framework (MSFF for start-ups) is the definition of Osterwalder et al. (2015). When the entrepreneur gets the possibility to co-create a product he/she should directly do this. This is an opportunity to gain more certainty about the function you deliver to the customer. The only remark is that the entrepreneur should be aware that he/she makes a product for more potential customers than only for the co-creation customer.

2.2.5. Phase 5: Customer Validation

The name of the fifth Phase, Customer Validation, is adopted from **Blank & Dorf** (2012). Their definition of Customer Validation is: *"Customer Validation proves that the business tested and iterated in Customer Discovery has a repeatable, scalable business model that can deliver the volume of customers required to build a profitable company"* (Blank & Dorf, 2012, p. 27).

During the Customer Validation the entrepreneur tests if the company has potential to scale. The validation is conducted by selling the product to customers. The best way to validate the business is by selling a product. (Blank & Dorf, 2012)

According to **Ries** (2011) in this Phase of the start-up it is important to test all assumptions. The MVP available should be used to learn from the potential customers as quick as possible. The first products sold do not have to be perfect. Ries (2011) gives several options to test the assumptions. In Ries' (2011) opinion the entrepreneur should use split testing to test the assumptions. *"A split-test experiment is one in which different versions of a product are offered to customers at the same time. By observing the changes in behaviour between two groups, one can make inferences on the impact of the different variations."* (Ries, 2011, p. 136). With split-tests it can be measured if the customers are going to use your product. Not the number of users is important says Ries (2011) but the number of new users. By using the split-test method it can be tested which version leads to more new (paying) customers. The focus for this model is mainly on IT start-ups where a freemium Business model is used. A freemium business model is a business model where the customer can get a version of the product with a small amount of functions for free. When the customer want to get all the functions a premium should be paid. The main vision of Ries (2011) for the Customer Validation is use the MVP to learn as quickly as possible which functions that are useful for the customer.

The Business Model Canvas book of Osterwalder & Pigneur (2010) provides the possibility to get a clear and structured overview of the business. In this Phase of a start-up (Customer Validation) the majority of the information used in the Business Model Canvas are assumptions. In the Value Proposition Design book of **Osterwalder et al.** (2015) different tools to test these assumptions are provided (chapter 3). First all the assumptions should be extracted from the Business Model Canvas. Next the entrepreneur has to prioritise the assumptions on the level of criticality to the business. The most critical assumptions should be tested first. For each assumption a hypothesis and a test should be defined. Possible methods

to test the assumptions are customer interviews, surveys, Minimal Viable Product tests, ad and link tracking, desk research, etc. Three outcomes are possible: (1) validated, your hypothesis was true and you are happy. You can test the next assumption (2) learn more, your hypothesis is not validated but you found that another problem is more important or that you have to change small things to get your business running and (3) Invalidated. If the assumption is invalidated you should change (pivot) things in your Business Model Canvas to get back into business. (Osterwalder et al., 2015). The methods discussed in the book by Osterwalder et al. (2015) are originally based on the book of Ries (2011), however Osterwalder et al. (2015) describe the tests and methods in a more clear way and in more depth.

In step 21 in the book of **Aulet** (2013) is described that assumptions formulated in the 20 previous steps should be tested. Aulet (2013) does not focus on the tests itself. The book by Aulet (2013) is not elaborated enough to obtain more understanding of the testing of assumptions.

Von Hippel (1988) states that the concept product created in the previous step should be tested in the market. It is possible that the product made for the Lead User is not suitable to act in the generic market. Sometimes slight changes should be made. In this Phase this is the most important step that should be taken.

Blank & Dorf (2012) offer a good definition for this Phase in **my opinion** because it describes clearly that you test here if the business can become a profitable one or not. I disagree on the earlier mentioned advice that you should sell the first product in this Phase. In my opinion selling is only an option when you are capable to deliver the product. This Customer Validation Phase is about testing assumptions. Selling the product can be a way to test assumptions, but should not necessarily be a goal of the Customer Validation Phase. Frameworks' Phase 7 (First Sales) is the Phase to focus on sales.

One of the ways to conduct customer tests is using the MVP. When is discovered in this Phase that the assumptions are not correct, the entrepreneur should go back to Phase 3 (Customer Discovery). Therefore a feedback loop to the Customer Discovery Phase is created and should define if he/she is solving the right customer pain.

2.2.6. Phase 6: Minimal Viable Business Product

In Phase 4 the Minimal Viable Product is explained. The used definition in this phase is based on the fact that the MVP is not necessarily sold. As **Blank & Dorf** state: *"A MVP is a product with the smallest possible group of features that still solve the core problems of the customer and demonstrates products values"*. (Blank & Dorf, 2012, p.80).

In the sixth phase it becomes important to build a Minimal Viable **Business** Product (MVBP) that is ready to sell. The MVPB will be sold in the 7th phase. The distinction between MVP and MVBP is made because it is hard for technology-based start-ups to produce a salable product in the initial phase of the start-up. A MVP can be build cheap and easy and can be used to conduct tests with customers. When you are sure that you can make the right product money can be invested to produce a MVBP.

The definition of **Aulet** (2013) is used as the definition for a MVBP. Aulet is the only author that explicitly states that the product should be sold in this stage. Aulets' (2013) definition of a Minimal Viable Business Product: *"MVBP is an MVP that will be sold. This sell will be used to*

test that the customer is willing to pay for the solution". An MVPB should exist of three elements: (1) the customer gets value of the use of the product, (2) the customer pays for the product and (3) the product is sufficient enough to start the customer feedback loop.

In **my opinion** the definition of Aulet (2013) fits best to this phase of the *MSFF*: make a product with a minimal amount of functions that can be sold. In the next Phase (7. First Sales) will be explained what is meant by selling the product. The reason that the MVBP is being manufactured after the Customer Validation Phase is because creating a MVBP is very time and cost consuming. After the Customer Validation Phase the entrepreneur is more certain about manufacturing the product the customer wants.

2.2.7. Phase 7: First Sales

The 23rd step in the book of **Aulet** (2013) shows that *"the dog will eat the food"*. This is the step after the creation of the MVBP. In this step the MVBP should be sold. Following Aulet the only way to explore if the customer is interested in the product is by selling it. *"The best way to learn from your customers is by selling your product to them and get a real customer feedback"* (Aulet, 2013, P.248).

Blank & Dorf (2012) indicate that the entrepreneur should sell the first product in the previous Phase, Customer Discovery (Phase 5, paragraph 2.2.5). After the first sales you can continue with the creation of the product. When the product is manufactured, Blank & Dorf (2012) design the next step: Customer Creation. This step is starts with selling products. The first sale is only intended to prove the business. This Phase is explained shortly in the book. They indicate that further explanation about this step will follow in the next version of the book.

The book by **Osterwalder et al.** (2015) does not give a clear vision on when to sell the first product. However, they do give different methods on how to sell the product. One way is by pre-selling the product. This is a good way to test the business potential of the start-up. According to the authors pre-sales can also be conducted in the previous Customer Validation Phase. Another possibility is selling the product for real. Osterwalder et al. (2015) state that you should try to validate your assumptions, (pre) selling your product could be one way to prove that your assumptions are correct.

According to **Ries** (2011) selling the product is a way to prove that you are right. Selling the product as quickly as possible is the best way to learn from your customers. The learned can be used to adapt the product in order to increase the sales. In chapter 9 Ries (2011) explains the advantages of selling in *"small batch sizes"*. When there an error should be detected in a small batch the costs to repair this will be much smaller. Also it is easier to monitor the experiences of the first customers when selling in small batches.

Von Hippel (1988) does not discuss first sales. According to this author you sell the product in an earlier stage to the Lead User.

In **my opinion** the best way to prove the business model of a start-up is by selling a product. It can also be done as a pre-sale in Phase 5 (Customer Validation). The first sale in this 7th Phase then is the 'real sell' of a 'real product'. This sale and delivery is still a validation. The first customers should be followed carefully to find good or bad functions of the product. The general rule is: the quicker the first sales the better. In my opinion the entrepreneur should be aware of the time period between sales and delivery. If there is a long development or manufacturing time necessary due to the difficulty of the product or regulations, other

validation methods might be more effective. Also the entrepreneur should pay attention to the batch size. Start with a small batch of products to learn quickly. After this small batch, scaling to more massive production is possible. When the entrepreneur does not succeed in selling the product, something went wrong in the previous Phases. Therefore, it is advised to go back to the Customer Validation Phase to pivot.

2.2.8. Phase 8: Growth

When the first products are sold the business is ready to grow and become a 'real' company. This thesis research will not elaborate further on this phase. **Ries** (2011) is the only author that discusses the companies' growth. In the third part of his book he explains how to accelerate from start-up to a real business. In the last step of their book **Blank & Dorf** (2012) pay attention to growth and company building. They indicate that this phase of the start-up will be explained further in the next version of their book.

3. Methodology

In this chapter the research method is introduced. Here is described how the first five phases of the new Market Selection and Feasibility Framework (MSFF) for start-ups (as introduced in paragraph 2.2) can be applied to the Business Case ‘Electrical Propelled Trailer’. This chapter starts with the research design (Chapter 3.1). Then the 5 methods that are used to conduct the research on the 5 phases of the MSFF are explained (3.2, 3.3, 3.4, 3.5 and 3.6)

3.1. Research Design

The new MSF Framework for start-ups will be tested on the Electrically Propelled Trailer. Overviews of all phases that will be tested are shown in Figure 3.1. is indicated in which methodology paragraph this phase is discussed. Also is indicated in which chapter the application of the phase is described.

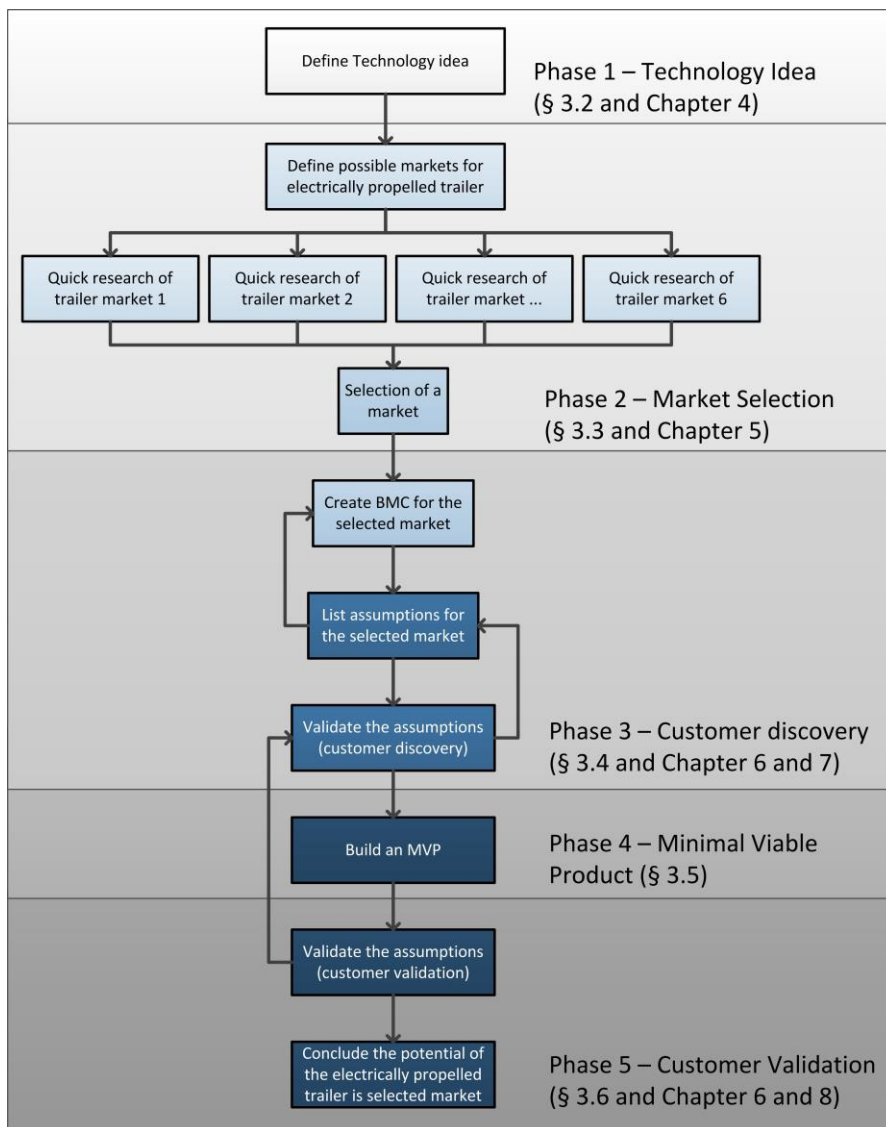


Figure 3.1 Flowchart of the research

Phase 1 Technology Idea (Chapter 3.2)

The research starts with the need for more sustainable transportation. One of the possible solutions for a more sustainable transportation sector is the Electrically Propelled Trailer (see chapter 1). In this research the market potential of an Electrically Propelled Trailer will be explored. Chapter 4 will give an overview of the technology of the Electrically Propelled Trailer.

Phase 2 Market Selection (Chapter 3.3)

In this Phase the selection for a specific market will be made. To further explore the technology of the Electrically Propelled Trailer different potential markets are investigated. Aulet (2013) states in his book that after defining a problem in the market, it is important to select 5 to 10 applications/markets for the technology and define quickly which of these markets is the most suitable. For each of these markets different Value Propositions can be determined. The book of Osterwalder et al. (2015) describes a method to design a Value Proposition based on Customer Profiles and the Values the start-up can deliver. Different Value Propositions are defined to get an overview of different propositions that can solve the customers' problem. These different Value Propositions are then reviewed with a multi-criteria analysis. The selection criteria for the multi-criteria analyses used in this research are based on the books of Osterwalder et al. (2015), Aulet (2013), Ries (2011), as stated in paragraph 2.2.2. The selection criteria will be discussed in chapter 3.3.1. In chapter 5 the most applicable market is selected.

Phase 3 Customer Discovery (Chapter 3.4)

In this Phase the Customer Discovery takes place and the Value Proposition is designed and tested. To get a good overview of all possible assumptions concerning the Value Proposition and the potential business a Business Model Canvas is made. All assumptions concerning the Customers and the Value Propositions are extracted from this Business Model Canvas. These assumptions are ranked according to their impact on the business. Those having the most impact are being tested through interviews with (potential) customers and through desk research. The customer discovery method will further be discussed in chapter 3.4. The customer discovery itself will be conducted in chapter 6 and 7.

Phase 4 Minimal Viable Product (Chapter 3.5)

A Minimal Viable Product (MVP) is built to get a better understanding of the Electrically Propelled Trailer. This MVP is used to get better customer feedback in Phase 5 (Customer Validation). The MVP created is an Electrically Propelled Trailer built on a caravan chassis. The MVP will be discussed in chapter 3.5.

Phase 5 Customer Validation (Chapter 0)

For the Customer Validation all assumptions of the Business Model Canvas are used. They are ranked according to their impact and tested through conducting interviews with (potential) customers, suppliers, distributors, market gurus, factories, etc. In addition a survey is conducted with 197 trailer owners to get a better understanding of the values of the customers. Only at the end of the Customer Discovery Phase it can be defined what the potential of the Caravan Market is for an Electrically Propelled Trailer. The Customer Discovery

method will further be discussed in chapter 0. The Customer Discovery itself will be conducted in chapter 6 and 8.

Phase 6, 7 and 8

These Phases are not executed in this thesis because they are not within the scope of the research. The research question is to determine the potential of a market. At the end of the Customer Discovery a founded conclusion can be drawn on this subject.

3.2. MSFF Phase 1: Technological idea

The first step of the research on the Electrically Propelled Trailer is the exploration of the technology. This exploration is conducted in chapter 4. Besides a description on the Electrically Propelled Trailer technology an overview of the current state of the regulations is given. The Electrically Propelled Trailer is an innovation that does not meet current regulations. Subsequently the potential benefits of the Electrically Propelled Trailer are discussed. Based on these benefits the Value Proposition will be defined.

3.3. MSFF Phase 2: Market Selection

The second step in this thesis research is to select the right market for the Electrically Propelled Trailer (Chapter 5). Paragraph 2.2.2 describes the authors' different opinions on the way to select a market. In this paragraph is explained what selection criteria I decided to use in this research and how the right market for the Electrically Propelled Trailer will be selected.

3.3.1. Selection criteria

My focus for the selection criteria has been on the 7 questions of Aulet (2013), the 8 criteria of Aulet (2013), the 4 questions of Ries (2011) and the 10 questions of Osterwalder et al. (2015). Occasionally I have changed their questions based on insights of the other authors discussed in chapter 2. Sometimes I combined criteria of the different authors to be as complete as possible. The criteria I finally decided to use in this research to select the right market for the Electrically Propelled Trailer are: (1) market size, (2) market growth, (3) willingness to pay, (4) cost price, (5) competition and (6) investments needed to get the technology to market.

- (1) The market size will be measured according to the amount of new sold trailers. It is possible to install the Electrically Propelled Trailer system in existing trailers, however the focus will be on new build trailers. Assumed is that an expensive system, like the Electrically Propelled Trailer will only be installed in new trailers.
- (2) The BOVAG publishes the number of new sold trailers in the Netherlands each year. Although the Electrically Propelled Trailer system can be sold all over the world the focus will be on the Dutch market for this market analysis. The reason is that the markets have only slight differences. The market growth will be defined by the difference of the number of sold trailers between 2013 and 2014.
- (3) The customers' willingness to pay will be defined by the savings the customers will make when they buy an Electrically Propelled Trailer and on different comparable solutions the potential customers currently buy. When customers save money annually a payback time of 2 years is assumed.

- (4) The cost price calculation of the electrically propelled system is based on the price of the batteries and the motors. An extra 20% is added for the costs of the other materials in the system and 50% for overhead, profit and distribution.
- (5) A short research is conducted on competition. Alternative technologies and their Value Propositions are named.
- (6) The investments needed means the money necessary to bring the technology to market.

The different markets will be reviewed based on these criteria. Based on the results of the review one of the markets will be selected. This market will be used for further research. The selection will be based on a multi-criteria analysis in 6 markets. For each criterion the best market gets a 6 and the worst market a 1. When all figures are added the market with the highest figure is the best market to select.

3.3.2. Data Collection

Desk research is conducted to collect data on the different markets. This is done to accelerate the process of market selection. These data are obtained from the Internet and from other previous executed researches. One of the main sources used for market data is the BOVAG (branch organization for Dutch car dealers and garages). In addition also literature and blogs on different types of trailers are used.

To get a better understanding of the different markets interviews with different factories and suppliers of trailers in different markets are conducted. An overview of the interviewees is given in *Table 3.1*. Interviews with the owners of different trailer factories and distribution companies are executed. The CEO and founder of Tevva Motors (Asher Bennett, 2015), the first hybrid truck company, is interviewed to get a better understanding of hybrid and electrical trucks. To gain extra knowledge of the truck sector, Joost Hoogstad (2016), sales director at Truckland, is interviewed. Truckland is one of the biggest distributors of trucks in the Netherlands. Interviewing Ruud Egas (2015), director and owner of Zwatra transport, gave additional information on the user side of the trucks. Zwatra transport is the biggest heavy transport company in the Netherlands. To gain a better understanding of the small trailer market an interview with Toine Crone (2015), caravan and trailer manager at BOVAG is being conducted. After that interviews are being conducted with two different trailer manufacturers: the caravan factories KIP Caravans and Adria. KIP is the only Dutch based caravan factory in the Netherlands. Interviews are conducted with two boat trailer factories (Marlin Boat Trailers and Weijer Trailers). Marlin Boat Trailers is the biggest boat trailer factory in the Netherlands and sells around 2.500 boat trailers per year. Weijer Trailers also sells horse trailers (100 – 150 per year) besides being a factory for boat trailers. This knowledge is used to get a better understanding of the horse trailer market. The last factory that is used to gather knowledge is Hapert Aanhangwagens, Netherlands biggest utility trailer factory. Finally is an interview is conducted with two trailer retailers. Both companies sell utility and refrigerator trailers. The first retailer that is interviewed is Edwin Fokkema, director and owner of Fokkema Aanhangwagens. The second trailer retailer that is interviewed is J.F. Boer Aanhangwagens.

Table 3.1 Overview of the interviewees for the Market Selection (Phase 2)

Name (function) interviewee	Name company	Type of company	Extra information company
Asher Bennett (CEO)	Tevva Motor	Manufacturer of hybrid trucks	British start-up that built the first hybrid trucks. Tevva sold their first truck to UPS.
Joost Hoogstad (sales director)	Truckland	Distributor of trucks in the Netherlands	Sells around 500 – 1000 trucks a year.
Ruud Egas (director and owner)	Zwatra Transport	Heavy transport company	Zwatra Transport is the biggest heavy transport company in the Netherlands.
Toine Crone (caravan and trailer manager)	BOVAG	branch organization for Dutch car dealers and garages	BOVAG helps car and trailer owners to lobby at the Dutch government. In addition to that supplies the BOVAG information about car and trailer service companies.
Olivier Sikking (Director and owner) & Ronald Verdergaal (purchase manager)	KIP Caravans	Caravan factory	KIP sells around 500 caravans per year.
Natasja Borghuis (sales and marketing manager)	Adria Caravans	Caravan factory	Adria sells around 300 caravans a year in the Netherlands.
Johnny Weijer (Director and owner)	Weijer trailer	Boat trailer factory and horse, utility and boat distributor	Manufactures 800 boat trailers per year. Sell 100 horse trailers per year.
Robert Hollander (Director)	Marlin Boat Trailers	Boat trailer factory	Biggest boat trailer factory in West-Europe, manufactures 2.500 trailers per year.
Ad Saris (Director and owner) and Henk Castelijns (purchase manager)	Hapert Aanhangwagens	Utility trailer factory	Biggest trailer factory in the Netherlands (20% market share). Hapert manufactures 12.000 trailers per year.
Edwin Fokkema (Director and owner)	Fokkema Aanhangwagens	Trailer retailer	Sells approximately 200 trailers per year.
John Boer (Director and owner)	J.F. Boer Aanhangwagens	Trailer retailer	Sells approximately 150 trailers per year.

3.4. MSFF Phase 3: Customer Discovery

The Customer Discovery for the Electrically Propelled Caravan contains the formulation of the assumptions by using the Business Model Canvas tool of Osterwalder and Pigneur (2010) as discussed in paragraph 2.1.4. Subsequently is explained how the assumptions are ranked (paragraph 3.4.2) and tested (paragraph 3.4.3).

3.4.1. The Business Model Canvas

For the selected market a Business Model Canvas will be made. A Business Model Canvas gives a good overview of the business model, suppliers, customers, revenue- and cost streams. The Business Model Canvas exists of 9 blocks: (1) customer-segments (2) Value Propositions, (3) channels, (4) customer relationships, (5) revenue streams, (6) key resources, (7) key activities, (8) key partnerships and (9) cost structure.

8. Key Partners	6. Key Activities	1. Value Proposition	4. Customer Relationships	2. Customer Segment
	7. Key Resources		3. Distribution Channels	
9. Cost Structure			5. Revenue Streams	

Figure 3.2 Business Model Canvas (Osterwalder & Pigneur, 2010)

The Business Model Canvas consists of a Customer Side (block 1-5) and a Resource Side (block 6-9). An overview of the blocks is given in Figure 3.2.

(1) The *Value Proposition* describes the products and services you will deliver to the customer described in the Customer Segment. It describes what problem you are trying to solve and what the needs of the customer are that has to be satisfied. The Value Proposition and the associated customer are very important: if there is no fit there is no business (Osterwalder et al., 2015).

(2) *Customer Segment* shows what group of people or companies is your business target. The more homogeneous the group customers the easier it is to target.

(3) The block *Distribution Channels* represent the channels by which the business delivers the Value Proposition to the customer. Is that online, via retailers or direct sales in a shop?

(4) This block represents the *Customer Relationships*. It will explain the relation between the company and the customer. This can be a short relation between a buyer and a seller but can also be a long-term relation including a maintenance contract.

(5) Block five converts the first four blocks in terms of *Revenue Streams*. This block explains what the customer is willing to pay for the value the company delivers. In addition in this block will be defined what the business model is. This can be for example an asset sale but also a licensing model.

(6) *Key Resources*: here the most important assets required to run the business are explained. These can be intellectual assets but also financial- or physical assets. These assets are the resources that are necessary to run the business.

(7) *Key Activities*: In this block is explained what activities are necessary to run the business. What activities should be performed to deliver the Value Proposition to the customers?

(8) *Key Partnerships*: explains which partnerships are essential to make the business model work. These can be suppliers of raw goods for example.

(9) *Cost Structure*: all costs to operate the business have to be incorporated. Goal is of course that the costs are lower than the revenues in order to create a profitable business.

When the whole Business Model Canvas is made, assumptions are drawn concerning Customer Pain, Value Propositions, Costs and Revenues. To define if the business will be a

profitable one it is important to validate these assumptions. In the next paragraph will be explained how the assumptions will be ranked and tested.

3.4.2. Rank and test the assumptions of the Business Model Canvas

On page 202 of their book Osterwalder et al. (2015) describe the importance to priority assumptions on their level of criticality. It is stated that not all assumptions are equally critical and that it is more important to validate the critical ones than the non-critical ones. Blank & Dorf (2012) state that the validation of the assumptions is one of the most important things to do when a new technology enters the market. Ries' (2011) Lean Start-up Book, the Value Proposition Design Book of Osterwalder et al. (2015) and the Start-up Owner's Manual of Blank & Dorf (2012) all describe methods to validate assumptions. Ries (2011) and Blank & Dorf (2012) both describe how you should first test peoples' interest in solving the problem and then test whether your solution is the right solution. The next and ultimate validation method is selling the product.

Based on the different methods of Osterwalder et al. (2015), Blank & Dorf (2012) and Ries (2011) I developed a new method, called *The Selection Method*, to rank the different assumptions. Like Osterwalder et al. (2015) the assumptions are ranked on impact on the potential of the business. An overview of a possible ranking of 12 possible assumptions is shown in Figure 3.3. The assumptions are not only ranked on impact. The assumptions are given 4 various colors: green, yellow, orange and red.

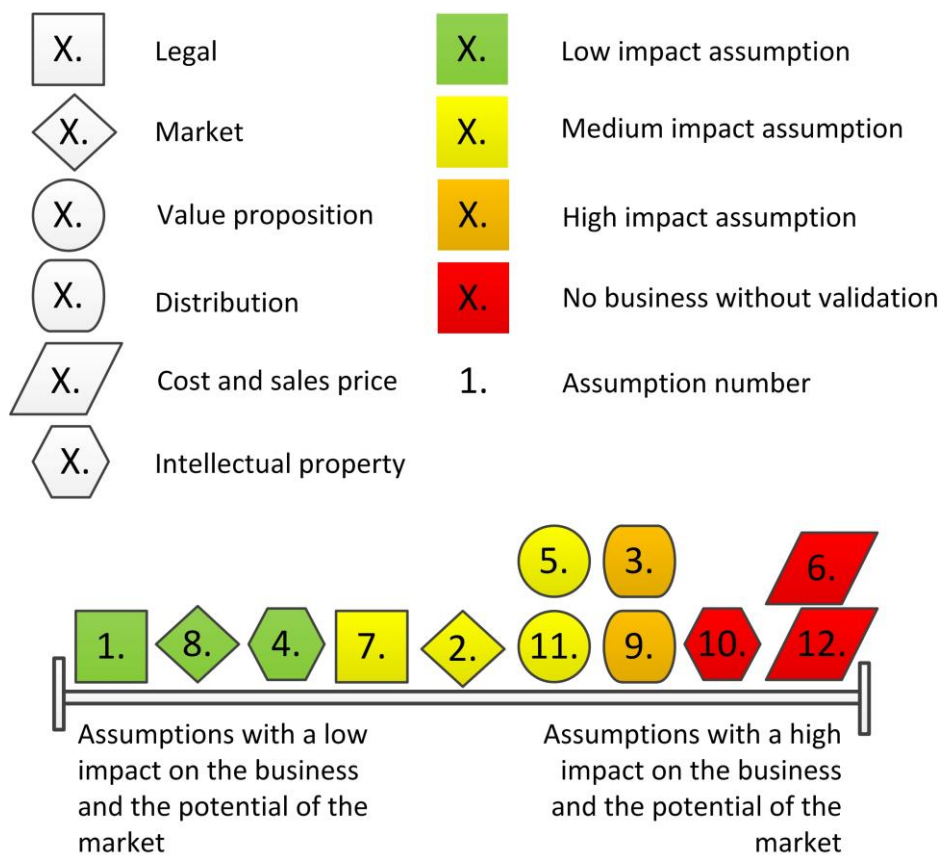


Figure 3.3 *The Selection Model: The ranking of Assumptions* (own production)

Assumptions that have a red color must be tested first, without the validation of this assumption no business potential exist at all. Orange assumptions should be tested as fast as possible because they have a high impact on the business. Yellow assumptions have a medium impact on the business; these assumptions should be tested but not necessarily very quickly. Green assumptions can be tested in the long term.

Assumptions are split in 6 different categories: Legal, Market, Value Proposition, Distribution, Cost and Sales Price and Intellectual Property. These categories provide a clear overview of the assumptions. I chose these categories because they cover all different types of assumptions on the business. The categories are based on the 9 blocks of the Business Model Canvas. The legal category in my opinion is underexposed in the Business model Canvas, so I added it to *Selection Model*.

The assumptions from the Business Model Canvas are based on the literature described in paragraph 2.1.4. The most important assumptions will be tested and validated (all red and orange ones and some of the yellow ones). I chose to combine the method of Osterwald, in which the assumptions are ranked on impact, and the method Blank & Dorf (2012) in which the assumptions are tested in 2 steps, Customer Discovery and Customer Validation. In this Phase of the *MSFF* only the assumptions on Customer Discovery are tested. The assumptions on the Customer Validation will be tested in Phase 5 (Paragraph 0).

Assumptions are tested in the following way. First, for an assumption a hypothesis will be formulated. This hypothesis is the assumption made in the business model. For each assumption is described what a good method is to test this hypothesis. This can be done by interviews, survey, desk research, page clicks etc. Then is described which measurement is chosen to measure the hypothesis, for example in % of people that have the problem you want to solve. It is also important to define when the hypothesis is validated. For example, the business can run properly if the variable is above X. To give a clear overview of the assumption that is tested *Table 3.2* is used. This table is based on the assumption overview metric of Osterwalder et al. (2015)

Table 3.2 Overview of the Assumption Test Table (Based on Osterwalder et al. 2015)

What	How
Assumptions	<u>We believe that ...</u>
Method	<u>To verify that, we will</u>
Metric	<u>We will measure:</u>
Criteria	<u>We are right if,</u>
Assumptions tested

The methods to test the assumptions are described in paragraph 3.4.3. There can be three outcomes (Osterwalder et al. 2015, p 207):

1. *“Validated, your hypothesis was true and you are happy. You can test the next assumption on the list.*
2. *Learn more, your hypothesis is not validated but you found that another problem is more important or that you have to change small things to get your business running.*

3. *Invalidated, if the assumption is invalidated you should change (pivot) things in your Business Model Canvas to get back into business.”*

3.4.3. Methods to test the assumptions

Ries (2011) and Blank & Dorf (2012) state that the most important thing to do if you are validating your assumptions is: *'get out of the building'*. They state that it is impossible to stay behind your desk if you want to validate the assumptions. You should meet potential customers, suppliers and distributors to test the assumptions. In this Phase interviews, a survey and desk research are conducted to get a proper understanding of the customer. To collect more numeric data on potential customers a survey is executed among approximately 200 caravan owners.

Desk research

Some assumptions can be tested behind a 'desk'. For example when you want to know what people currently pay for similar products the Internet can be a good starting point. In addition, the BOVAG publishes each year a lot of numbers on the caravan and trailer market. These numbers are used to get a better understanding of the market. Furthermore, articles from the two biggest blogs about caravans in the Netherlands are used. The Dutch magazine about caravans and camping, *De Kampeer- en Caravan Kampioen* (KCK, 2015), is also used to get a better understanding of the market. The KCK is a part of the ANWB, the Dutch Tourism Federation.

Interviews

Another way of testing assumptions is by conducting interviews. According to Blank & Dorf the most important part of the Customer Discovery is get out of the building and talk to potential customers. So, interviews with caravan owners are conducted to define their interests.

Fitzpatrick (2013) wrote a book (*The Mom Test*) about customer interviews for start-ups. The interview methods described in this book are used in this research. Fitzpatrick (2013) state that if you just ask a potential customer if he/she likes your product they will always say yes, because they want to be polite. You should ask a potential customer objective questions to find out what his problems are. By asking objective questions the customer doesn't know you are working on a product and they don't have the feeling that they have to be polite.

Interviews with several people are conducted, for this Phase 28 caravan owners are interviewed at Europe's biggest Caravan Expo in Dusseldorf and on the Caravan Expo in Leeuwarden. Chosen is to conduct the interviews at the Caravan Expo for two reasons: (1) these people are willing to buy a new caravan and (2) all people at the expo are interested in caravans. These caravan owners are addressed at the coffee corner of the Expo offering them a cup of coffee. The questions that are asked to the interviewees are questions like: type of caravan + mass of the caravan, type of car and maximum towing mass, reasons for the choice of their car and caravan, mover ownership, destination of their holiday with the caravan, experience with driving in the mountains with their caravan, tools that are used to define the car caravan combination. Based on these interviews is defined what the real customer pains, gains and jobs are (Customer Profile). Based on this Customer Profile and the Value Map from the Business Model Canvas can be decided if there is a customer fit.

Survey

To collect data on the customers a survey is created. Chosen is to perform a survey to get data of a lot of caravan owners in a relative short amount of time. People that filled in the survey are people that visited Netherlands' biggest Caravan Expo, the 'Caravan Jaarbeurs'. People that visited the KIP Caravans stand were asked to fill in the survey. People didn't know anything about the Electrically Propelled Trailer before they filled in the survey.

In the survey questions are asked based on the interview method of Fitzpatrick (2013). There is chosen to conduct the survey at an Expo where a lot of potential customers could be found. 197 people filled in the survey completely; all respondents are people that own a caravan or people that are willing to buy a new caravan within a year. The survey can be found in Appendix B. Questions are asked about: caravan type and brand choice, car type and brand choice, general information about traveling behavior with the caravan, sustainability, safety, accessories and personal information. Based on the results of the survey different assumptions can be validated. The data collected are analyzed with SPSS. The methods used to analyze the data are averages, variations and regression analyses.

3.5. MSFF Phase 4: Minimal Viable Product

Several Minimal Viable Products (MVP) are made to give a better understanding of the Electrically Propelled Trailer. The first MVP that was made was a landing page about the product (www.e-trailer.nl). In addition to that a flyer (Appendix A) is made to give the people a better understanding of the product. This flyer is used with all interviews and handed over to all the respondents of the survey.

Besides the landing page and the website a real caravan chassis is used to create a working Electrically Propelled Trailer. This MVP is shown in *Figure 3.4*. This MVP is used to test whether the technical principles and ideas could work in reality. Furthermore is this MVP used in all interviews of the Customer Validation Phase. Different people used this MVP during the interviews. The feedback of these test cases is used to finalize the product. This MVP is currently not road legal because there are no brakes integrated. Therefore the product cannot be sold.



Figure 3.4 Minimal Viable Product of the Electrically Propelled Trailer

3.6. MSFF Phase 5: Customer Validation

As described in paragraph 2.2.5 the term Customer Validation is adopted from Blank & Dorf (2013). This part of the *MSFF* focuses on the question whether the company has potential to scale or not. Therefore other assumptions are tested in this Phase than in the Customers Discovery Phase. To test the assumptions on scalability more interviews are executed with suppliers, distributors, factories and market gurus. These interviews are conducted mainly to get a better understanding of the distribution channels, regulations and customers. The data from the survey that is conducted in phase 3 is used in this phase to validate some assumptions. In paragraph 3.4 is described how the different assumptions are selected and ranked. In Phase 3, Customer Discovery, only the assumptions about the Value Proposition are tested and ranked. In this Phase all the other assumptions are tested.

Interviews

I decided to interview different parties in the value chain starting with interviews with different factories in the caravan industry. An overview of the interviewees is given in

Table 3.3. Interviews are conducted with 2 caravan factories (KIP Caravans and Adria). The KIP Caravan Factory is selected because it is the only Dutch based caravan factory. Adria is selected because it is a totally different brand than KIP Caravans. KIP Caravans is a more exclusive brand and Adria is a low cost brand.

To get a better understanding of the Distribution Channels of caravans 9 caravan retailers are interviewed. Different caravan retailers are selected throughout the Netherlands. We focused on the caravan retailers that sell the more expensive caravan brands. The reason is that they have a better understanding of the customer with a higher budget. Potential buyers of the Electrically Propelled Trailer are probably buyers with a higher budget, since the cost price of the product is rather high. Most caravan retailers are family owned businesses. At each retailer is spoken with 2 persons, (1) the owner/director and (2) the workshop manager for more technical feedback.

To get a better understanding of the Regulations, 2 employees of the Dutch Road Authority are interviewed, from the head of the innovation department to one of the employees of the workshop. In addition to that an interview is conducted with the Caravan and Trailer manager of the BOVAG (branch organization for Dutch car dealers and garages).

Two main blogs with more than 100.000 monthly followers are being written about caravans in the Netherlands ('Caravan en de Wet' and 'de Caravantrekker'). The authors of these blogs are interviewed to get a better insight of the whole market.

All interviews are executed in face-to-face. This is done for three main reasons. (1) Visiting a factory or retailer was it good to see the caravans in real life to get a better understanding of the market. (2) To show the MVP and ask for feedback on the MVP. (3) To see the reactions on the faces of the people gives extra information.

The results of these interviews are used to validate the assumptions of the Business Model Canvas. These interviews are mainly used to validate the customer relation, distribution channels and key partners.

Table 3.3 Overview of Interviewees for the Customer Validation Phase (Phase 5)

Name (function) interviewee	Name company	Type of company	Extra information company
Toine Crone (caravan and trailer manager)	BOVAG	branch organization for Dutch car dealers and garages	BOVAG helps car and trailer owners to lobby at the Dutch government. In addition to that supplies the BOVAG information about car and trailer service companies.
Olivier Sikking (director, owner) & Ronald Verdergaal (purchase manager)	KIP Caravans	Caravan factory	KIP sells around 500 caravans per year.
Natasja Borghuis (sales and marketing manager)	Adria Caravans	Caravan factory	Adria sells around 300 caravans a year in the Netherlands.
Caravan Retailers (9x)	Caravan Extra, Duijndam Caravans, Van Eijk Caravans, van Vliet Caravans, de Greeff Caravans, Reinders Recreatie, Zandvliet Caravns, Campolife and Martens Caravans	Caravan Retailers	9 different caravan retailers in the Netherlands. Mostly retailers that sell the more expensive caravan brands. These retailers sell between the 50 and 200 new caravans per year.
Allert Meurs (Innovatie manager) and Hans Wagenveld (Toelating en Toezicht voertuigen)	RDW	Dutch Road Authority	The RDW is the road authority in the Netherlands. Without an approval of the RDW it is not allowed to get a vehicle on the road.
Theo Gerrits (owner)	Caravan en de wet.nl	Caravan Blog	A caravan blog about the legal parts of trailers and caravans with approximately 100.000 visitors a month
Menno van der Heijden (owner)	Caravan trekker.nl	Caravan Blog	A caravan blog about the combination of the car and the trailer with approximately 100.000 visitors a month

3.7. (In)validated assumptions

When an assumption is validated the next assumption can be tested. When an assumption is invalidated it is important to understand why. When an assumption is not validated, an attempt is made to change assumptions in the Business Model to get the business running. If this is not possible in the available amount of time a recommendation is given to get the business running.

4. MSFF Phase 1: Technology Idea

In this thesis a new Market Selection and Feasibility Framework (MSFF) for start-ups will be applied to a real business case. This business case is the start-up of E-Trailer: a Dutch start-up working on the development of an Electrically Propelled Trailer. In the Introduction is defined that the Electrically Propelled Trailer can be one of the solutions for more sustainable transportation, more road safety and more user-friendliness in towing a trailer. This chapter presents the results of the first phase of the MSFF (Figure 4.1). In this chapter the technology of the Electrically Propelled Trailer is explained. First (4.1) an introduction of the literature on electrical vehicles is given. Then the regulations for the Electrically Propelled Trailer are explained (4.2). Subsequently the potential benefits of an Electrically Propelled Trailer are described (4.3). In paragraph (4.4) the size of the electrical motors and batteries are calculated. In paragraph 4.5 the Measurement Unit of the Electrically Propelled Trailer is explained. Finally an approximation of the cost price of the Electrically Propelled Trailer is calculated.

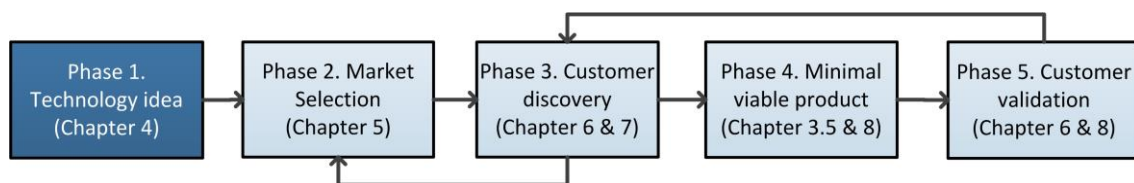


Figure 4.1 Overview of the research

4.1. Introducing the Electrically Propelled Trailer

Cars become smaller and lighter nowadays. Thereby drivers encounter many cons when towing a trailer: vehicles have reduced acceleration and power, show an increased fuel consumption, have longer braking distance, risk of overheated brakes, instable driving behavior and limitations in maximum trailer weight. The Electrically Propelled Trailer intends to eliminate the downsides of towing a trailer. Installing two electrical motors and a battery package in a trailer makes it possible to tow a heavy trailer with a smaller car. To get an Electrically Propelled Trailer, two electrical motors, a battery package and two computers are installed. Figure 4.2 gives an overview of an Electrically Propelled Trailer. The green parts in this figure are the parts that are added to make a normal trailer electrically propelled. In the figure can be seen that it is chosen to install 2 electrical motors in the wheels of the trailer. This is shown in more detail in Figure 4.3. The electrical motors will assist the towing car while driving. This makes it possible to drive the same trailer with a smaller and lighter car. Driving the trailer uphill becomes easier with the assistance of the electrical motors in the trailer. In the next paragraph the advantages of an Electrically Propelled Trailer are explained in more depth.



Figure 4.2 Render of the MVP (Own production)

Figure 4.3 Schematical drawing of the MVP (Haan, 2015)

4.2. Regulations for the Electrically Propelled Trailer

In 2007 the European Parliament and the European Council decided on a new directive for Road Legislation for vehicles (2007/46/EG). This directive is executed in the Road and Transport Law (Wegenverkeerswet (WVW), 1994) of the Netherlands. In the WVW (1994) the kind of vehicles that are allowed on the Dutch road is described. In addition is discussed what kind of regulations are necessary for these types of vehicles. Trailers are one of the vehicle types in the WVW 1994. Following article 3, paragraph 12 of the 2007/46/EG direction a trailer is a: *“not propelled vehicle on wheels that is designed and build to be towed by a motor vehicle”*. Following article 1, paragraph 1.d. in the WVW 1994 the definition of a trailer is: *“a vehicle that is intended to be propelled by a motor vehicle”*. An Electrically Propelled Trailer is propelled, that makes it difficult.

In the legislation implantation part of the WVW 1994 the regulation about trailers is further described. In this implementation part three types of trailers are described: (1) small trailer (mass <750 kg), (2) regular trailer (750 kg > mass <3.500 kg) and (3) big trailer (mass > 3.500 kg). Trailers with a mass < 750 kg are allowed to have no brakes. Trailers with a mass between the 750 and 3.500 kg and trailer with a mass above the 3.500 kg are trailers that should have brakes. The braking deceleration of these trailers should be minimal $5,0 \text{ m/s}^2$. Drivers with a car drivers' license can tow trailers with a mass below the 3.500 kg. Drivers with a truck drivers' license can tow trailers with a mass above the 3.500 kg. The maximum trailer mass that a car/truck is allowed to tow is stated in the registration papers of the car/truck. This maximum mass is mainly dependent on the mass of the car and the braking power of the car. (WVW, 1994)

4.3. The Benefits of the Electrically Propelled Trailer

Driving an electrical trailer has several advantages. It is possible to tow a trailer while driving a smaller car, it makes driving through a mountainous area easier, it saves fuel and you can accelerate faster. All benefits of the E-Trailer system are discussed in this paragraph. By installing two motors, a battery package and a 'measure and processing unit' in trailers five advantages can be achieved (Figure 4.4):

- (1) By towing a trailer **fuel consumption** will increase with approximately 40 to 60%. As an Electrically Propelled Trailer is electrically charged, both the fuel costs as well as the emission of polluting gasses will decrease. As less towing power is required, the consumer can drive a smaller and more sustainable car the entire year. This means saving fuel and other car costs the whole year and not only during the holidays.
- (2) With an Electrically Propelled Trailer one can drive easier and more relaxed in the mountains. The electrical system **assists when driving uphill** by giving a little push in the back. The system also assists when driving downhill by regenerating electricity from the engines and therefore preventing the problem of overheated brakes.
- (3) The Electrically Propelled Trailer makes sure that no matter the situation or the environment, you will be able to **maintain speed**. This is particularly interesting while overtaking or in a situation where fast acceleration, speed and deceleration are key.
- (4) Towing a trailer can be unsafe when you have to pull the brake hard or when the trailer is too heavy for your car. The Electrically Propelled Trailer can change the speed and the torque of the two electrical motors separately. This will **stabilize the swaying motion** of the trailer.
- (5) By using your smart-phone as a **remote control** it is possible to steer the trailer to the right location after arriving at the final destination. With a speed lower than 1 km/h the trailer will follow the owner to his favorite camping spot. This function replaces the so-called 'Mover'.

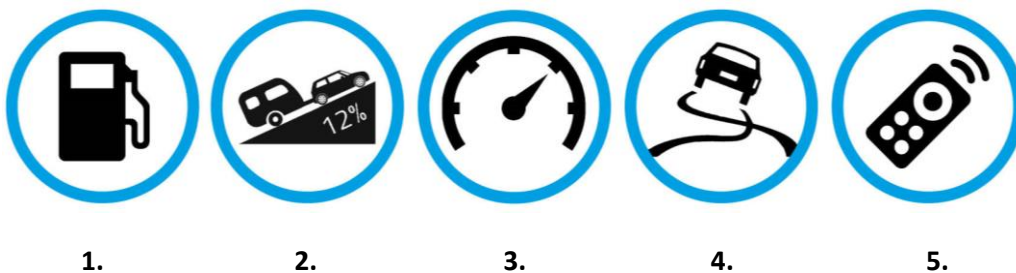


Figure 4.4 Overview of the 5 advantages of an Electrically Propelled Trailer

4.4. Technical Details of the Electrically Propelled Trailer

In this paragraph the size of the electrical motors and batteries are defined. The electrical motors should deliver enough power to compensate the whole caravan friction and mass. For this calculations an 'average' caravan of 1200 kg is used. In the Table 4.1 the constant variables that are used are shown. These variables and the values are based on interviews with Olivier Sikking (2015) (Director of KIP caravans) and van der Heiden (2015) (Founder of Caravantrekker.nl). Based on the calculation in this paragraph about a caravan, the size of the batteries and the motors for other trailer can be calculated.

Table 4.1 Used constants for the calculations of the scenarios

Data Trailer	Unit	Value	Unit
Radius wheel	L	0,3	m
Mass	m	1200	kg
Frontal area	A	4	m ²
Drag Friction Coefficient	C _w	0,4	-
Tyre Friction Coefficient	C	0,014	-
Air density	ρ	1,225	Kg/m ³

To calculate the size of the batteries and electrical motors different scenarios are defined. The scenarios describe the different circumstances in which the Electrically Propelled Trailer must achieve. These scenarios are:

- (1) Driving with a constant speed
- (2) Accelerate from 0 to 90 km/h
- (3) Driving with a constant speed (54 km/h) uphill
- (4) Mover function
- (5) Stabilising
- (6) Braking downhill

In the paragraph below the scenarios are explained further. For each scenario the power and torque of the motor is defined. In addition to that the size of the batteries is calculated. For the size of the batteries is assumed that the batteries should have enough power to propel the trailer for 3 hours without charging.

4.4.1. Scenario 1: Driving with a constant speed

For this scenario the power of the electrical motors is defined based on a trailer that drives 90 km/h (25 m/s). A speed of 90 km/h is chosen because the maximum speed of a trailer on the Dutch road with a maximum mass of 3.500 kg is 90 km/h (WVW, 1994). To keep the speed of the trailer constant the delivered power by the motors should be equal to total friction of the trailer.

To calculate the friction of a trailer with a speed of 90 km/h two different kind of frictions should be calculated (1) the mechanical friction and (2) aerodynamic friction. The mechanical friction can be calculated by the formula:

$F_{mech} = m \cdot g \cdot C$
 $F_{aero} = \frac{1}{2} \cdot \rho \cdot v^2 \cdot A \cdot C_w$. The
aero dynamic friction of the trailer is 613 N ($0,5 \cdot 1,225 \cdot 25^2 \cdot 4 \cdot 0,4$). The total friction of a
trailer with a speed of 90 km/h is 777N (165N + 613N)

[REDACTED]

To calculate the battery size for this scenario there is assumed that it is acceptable to charge the battery each 3 hours. The size of the battery for this scenario is 58 kWh (9716 W/motor * 2 motors * 3 hours).

4.4.2. Scenario 2: Accelerate from 0 to 90 km/h

More energy and torque is needed to accelerate a car in comparison with a constant speed. In this scenario is calculated what power and torque is needed to accelerate an average trailer from 0 to 90 km/h. It is assumed that it will take 25 seconds to accelerate from 0 to 90 km/h. First, the average speed during the acceleration will be calculated. This is 45 km/h (12,5 m/s). The acceleration can be calculated by the formula: $a = s / t$.

[REDACTED]

4.4.3. Scenario 3: Driving with a constant speed uphill

For this scenario is assumed that the maximum speed to drive uphill is 54km/h (15m/s). In addition, is assumed that a slope of 12% is a proper slope to base the calculations on (van der Heiden, 2015). In this calculation is assumed that the difference in height is 1.000m. To calculate the force that is needed to drive uphill the height energy should be calculated. The formula for height energy is

[REDACTED]

[REDACTED]

4.4.4. Scenario 4: Mover function

[REDACTED] of the existing caravans have a Mover. This is a remote control to drive with the caravan at the camping location without car. For the existing Movers the top speed is 1 km/h. The average Truma Mover can be used on a slope of 15%. The average Enduro Mover can be used on a slope of 18%. (Appendix C) For the calculations a slope of 15% is assumed. A Mover function could be one of the Value Propositions in the different markets. For the fact that a Mover should operate at a low speed, probably other motor and battery requirements are involved.

[REDACTED]

4.4.5. Scenario 5: Stabilising

To stabilize a trailer when a swaying motion occurs, the best option is to break the trailer. Several stabilizing systems exist. These systems use a brake power equal to 20% of road legal systems (Oostveen, 2016). The legal brake deceleration is 5 m/s^2 (Meurs, 2015). To stabilize the trailer with braking on the motor the motor power can be calculated. Assumed is a trailer that is driving 90 km/h (25 m/s).

[REDACTED]

4.4.6. Scenario 6: Driving downhill

One of the problems of the existing braking systems in trailers is that the brakes are braking when driving downhill; even when no braking power is needed. This is caused by the overrun braking system that is used in Europe. One of the solutions to overcome this problem is by braking on the electrical motor. This has two main advantages: (1) the brakes are not

overheated and (2) the braking energy is converted to electrical power in the batteries. The force needed to break the trailer with [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

4.4.7. Overview

The amount of torque and power per motor per scenario is presented in *Table 4.2*. To get the right motor for all of the 6 scenarios the motor should have a power of [REDACTED] and a torque [REDACTED] in all the scenarios assumptions for a battery package of 3 hours are assumed. The most costly scenario, in terms of battery power, is the first one: “driving with a constant speed of 90 km/h”. The third scenario is also very costly, however this amount of energy is mostly recovered when driving downhill (scenario 6).

Table 4.2 Overview of the scenarios

Scenario	Torque/motor (Nm)	Power/motor (W)	Battery size (kWh)
Scenario 1	[REDACTED]	[REDACTED]	[REDACTED]
Scenario 2	[REDACTED]	[REDACTED]	[REDACTED]
Scenario 3	[REDACTED]	[REDACTED]	[REDACTED]
Scenario 4	[REDACTED]	[REDACTED]	[REDACTED]
Scenario 5	[REDACTED]	[REDACTED]	[REDACTED]
Scenario 6	[REDACTED]	[REDACTED]	[REDACTED]

In paragraph 4.4 a trailer of 1200 kg is assumed. As has been demonstrated in Appendix D is the sizes of the batteries and the motors are linear related to the mass of the trailer. The size of the battery and the electrical motors for bigger and smaller trailers can be calculated very easily because the relation between the mass and the size of the motors and batteries is linear. Based on the percentage difference of the mass of the trailer you want to calculate and the assumed trailer in this paragraph (4.4).

So it can be concluded that [REDACTED] is enough to power an Electrically Propelled Trailer 3 hours at a speed of 90 km/hour. If the trailer is driving in the mountains extra battery power [REDACTED] kWh is necessary. The first scenario will lead to fuel savings while driving. Scenario 2 to 6 will support the car in more difficult situations. For scenario [REDACTED] a much smaller battery is needed than for scenario 1. For these scenarios a battery of [REDACTED] is enough. Therefore two different types of Electrically Propelled Trailers are distinguished: (1) the full supporting Electrically Propelled Trailer and the (2) partly supporting Electrically Propelled Trailer. The main difference between the first and the second type trailer are the fuel savings. Because the trailer does not assist the car during the whole journey no fuel savings are included in the second version. However, people can still drive the entire year with a smaller car because the second version helps the car when there is insufficient towing power.

The power (in W) of the electrical motor is roughly [REDACTED] times the weight (in kg) of the trailer. The size (in Wh) of the batteries is roughly [REDACTED] times the mass (in kg). As is proven in Appendix D is the mass of the trailer linear with the mass of the trailer. For the first scenario more battery power is needed than for the scenarios [REDACTED]. If scenario 1 is not included the size of the battery (Wh) it is sufficient to multiply the mass (in kg) with [REDACTED] (instead of [REDACTED] times).

4.5. The Measurement System

To steer the electrical motors and the batteries a measurement system is required. The force between the car and the trailer is measured. Based on this force the computers decide what kind of signal should be send to the motors. The measurement system basically works with three scenarios:

- (1) If there is a pulling force from the car to the trailer the motors should accelerate faster.
- (2) When the force is zero the motor power should stay equal
- (3) When the force between the car and the trailer become negative the computer should tell the motors to brake.

These three scenarios are the basis of the measurement system. The system will also measure the slope of the road. Based on the slope the signal given to the motors will change. The last variable that is measured is the swaying motion. This will be measured by installing an acceleration sensor at the end of the trailer. When this acceleration sensor measures a motion in horizontal position the motors should brake to overcome the swaying motion.

To protect the technology of the Electrically Propelled Trailer an intellectual property is currently pending. The intellectual property is based on the measurement system as described above.

4.6. Cost price of the Electrically Propelled Trailer System

In Appendix D it is proven that the size of the electrical motors and the size of the batteries are linear with the mass of the trailer. Two types of prices are calculated: (1) the cost price for the customer for all scenarios and (2) the cost price for scenario 2 up to 6. These scenarios are presented in paragraph (4.4). Scenario 1 is important for saving fuel when towing a trailer. However, when only scenario 2 to 6 are taken into account the Electrically Propelled Trailer is strong enough to drive with a 10 to 20% smaller car. The costs price of this partly propelled trailer is of 80 to 90% of the cost price of the fully propelled trailer.

For the calculation of the cost price first is calculated per mass class what the size of the batteries and the motors should be (appendix D). After this the formula's in appendix E and F are used to calculated the costs per mass of the batteries and the motors. In addition to the costs of the batteries and the motors 20% extra costs are added for cables and sensors etc. Than 50% is added to the costs for profit margin, distribution, marketing etc. Based on this the costs prices of the Electrically Propelled Trailer for different masses are calculated. (Appendix D) The costs prices are displayed in *Table 4.3*.

Table 4.3 Cost price of the Electrically Propelled Trailer per mass class

Mass trailer (kg)	Total cost price end user all scenarios (€)	Total cost price end user scenario 2 to 6(€)
1.000	██████	██████
2.000	██████	██████
3.000	██████	██████
3.500	██████	██████
10.000	██████	██████
20.000	██████	██████
30.000	██████	██████
40.000	██████	██████

5. MSFF Phase 2: Market Selection

This chapter focuses on the different market opportunities for the Electrically Propelled Trailer, Phase 2 of The Market Selection and Feasibility Framework (MSFF) for start-ups (Figure 5.1). For each of the potential markets data are gathered to fill the selection criteria discussed in chapter 3. Based on these data one of the Value Propositions is selected.

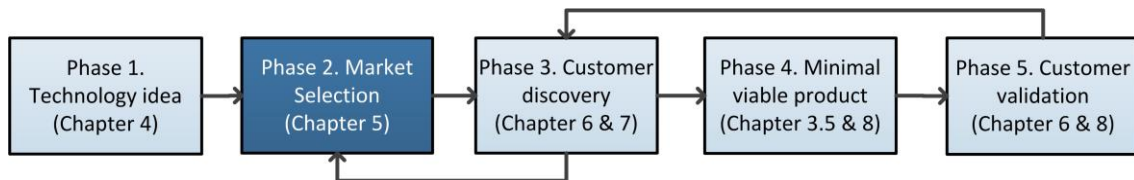


Figure 5.1 Overview of the Research

5.1. The Markets

The problem of insufficient towing power in modern cars can be solved in different ways:

- (1) Buy a stronger/ heavier car
- (2) Rent a stronger/more heavy car during the holidays
- (3) Buy a smaller/lighter caravan
- (4) Make the trailer electrically propelled
- (5) Buy a van or camper.

In this chapter the focus is on the market opportunities for the Electrically Propelled Trailer. To define the market possibilities for this technology, different possible markets are defined to apply the technology. There are different market opportunities for the Electrically Propelled Trailer. As shown in paragraph 4.2 three types can be distinguished:

- (1) Small trailer (mass <750 kg)
- (2) Regular trailer (750 kg > mass <3.500 kg)
- (3) Big trailer (mass > 3.500 kg).

The distinction in mass is chosen because of Dutch Law Regulations. Trailers below 750 kg don't need a brake and can be towed with a normal drivers licence. For trailers until 3.500 kg a car drivers licence can be used in addition with a small trailer licence. These trailers should have enough braking power to break it self. For a trailer heavier than 3.500 kg a truck driver licence is necessary. (Caravan en de Wet, 2016) (Rijksoverheid, 2016). For the small trailer market different types of trailers can be analysed: utility trailer, caravan, boat trailer, horse trailer, refrigerator trailer etc. Examples of big trailers are: heavy trailers, refrigerator trailers, heavy trailers, etc. According to the BOVAG (2015) different types of trailers are sold. The most frequently sold trailers are: utility trailers, closed trailers, open trailers, boat trailers and animal trailers. The goal of this chapter is to select a specific trailer market to explore further in order to find out if there is market potential. As explained in chapter 3 different criteria are used to select the right market. For each market a short analysis of the criteria is made. Based on this analysis for each of the criteria a score between 1 and 6 is given.

Six different markets are chosen:

(1) Normal trailers (< 3.500 kg) (Chapter 5.2)

- a. Utility trailers
- b. Horse and boat trailers

(2) Special trailers (< 3.500 kg) (Chapter 5.3)

- c. Caravans
- d. Refrigerator trailers

(3) Heavy trailers (> 3.500 kg) (Chapter 5.4)

- e. Heavy regular trailers
- f. Heavy refrigerator trailers

5.2. Normal Trailers (<3.500 kg)

Two basic types of trailers are distinguished, the utility and the horse trailer. Both trailers are normal trailers (mass between 750 and 3.500 kg) that are used to transport goods or animals. The only difference between the utility trailer and the horse trailer is the building on top of the chassis.

5.2.1. Utility Trailers

In the Netherlands the number of new sold trailers in 2014 in the category between 750 and 3.500 kg is 15.706. (BOVAG, 2015a) (Hollander, 2016) This is 12% more than in 2013. The main advantage of using an Electrically Propelled Trailer in this sector is that it becomes possible to drive a smaller car and tow the same trailer. Also employees in the construction industry can drive a smaller car. The question is; will these people do this? Assumed is that people will save 10–20 % of the purchase price of their car. (Saris & Castelijns, 2016) This will lead to savings of 3.000 to 6.000 Euros (BOVAG, 2013). In addition is assumed that people will save 10 to 20% on their car expenses. The average car expense in the Netherlands is 650–800 euro per month. (Lease Plan, 2016) Taken into account a payback time of 2 years these savings will lead to 1.560 to 3.840 euro (650 euro/month*10%*12 months*2 year to 800 euro/month*20%*12 months*2 year).

Besides the savings on the car itself, also fuel savings are taken into account. Assumed is that people drive on average 10.000 km per year with their trailer. An average car uses 8 litres of gasoline per 100 km (Leaseplan, 2016). Towing a trailer will increase the fuel consumption with 40 – 60%. (Fokkema, 2015) (Heijden, 2015) When the fuel consumption increases with 50% this will result in 12 litres of gasoline per 100 km. When using an Electrically Propelled Trailer 4 litres of gasoline per 100 km will be saved. This results in 400 litres gasoline per year. Using an energy density of 3,2 kWh/litre (Boer et al., 2015) this results in 1.280 kWh (3,2 kWh/litre*400 litre). With an electricity price of 0,28 euro per kWh (Boer et al., 2015) the costs for electricity are 358 (1.280 kWh*0,28 euro/kWh) euro per year. The 400-litre gasoline for the trailer we mentioned before costs 600 euro (400 litre * 1,50 euro/litre) per year. The cost savings, in sense of fuel reduction, are 242 euro/year. With a payback time of 2 years this results in a willingness to pay of 484 euro. In this example is assumed that people drive on average 10.000 km / year with their utility trailer. When a trailer owner drives for example 100.000 km per year, his willingness to pay will increase to 4840 euro. In total the willingness to pay for an Electrically Propelled Trailer is approximately 5.000 to 10.000 euro (3.000 + 1.560 + 484 to 6.000 + 3.840 + 484).

The cost price of an Electrically Propelled Trailer depends mainly on the power of the motors (which depends on the mass of the trailer) and the size of the batteries. In this example the average mass of the utility trailer is assumed at 2.000 kg. For an average trailer of 2.000 kg the cost price for an Electrically Propelled Trailer will be [REDACTED]). This is much more than the willingness to pay, however when the fuel savings are not included, the willingness to pay decreases with [REDACTED] Euro. Based on this argument is chosen to take only the partly supporting Electrically Propelled Trailer version into account (Chapter 4.4.7). The cost price of the partly propelled version is [REDACTED] euro. These costs are higher than the willingness to pay. However, the willingness to pay is an approximation and the cost price is based on several assumptions. Further research can prove if there is a business case.

The competition in this market the current available solution is: the bigger car. To get the technology to the market the whole product should be developed and the local road authority should approve and allow the technology on the road. The investment that is needed to get this technology to the market is approximately [REDACTED] euro.

5.2.2. Horse- and Boat Trailers

The size of the market for horse trailers is much smaller than the market for utility trailers. The amount of new sold horse trailers in the Netherlands in 2014 is 753. (Weijer, 2016) (BOVAG, 2015) This is a small but a growing market. The market growth is 12% per year. (BOVAG, 2015) The willingness to pay for the horse trailer owners could be a little bit higher than for utility trailer owners, since the Electrically Propelled Trailer will add more safety and horse owners are careful with their horses. The cost price will be approximately the same as for the utility trailers, since the average horse trailer is about 2.000 kg. Also the data on the investments needed and the competition will be very similar. The boat trailer market is a small market like the horse trailer market. The boat trailer market will show approximately the same numbers as the horse trailer market.

5.3. Special Trailers (<3.500 kg)

In this paragraph the caravan and the refrigerator trailer are explored. For the caravan and the refrigerator trailer market another Value Proposition can be distinguished. The batteries of the Electrically Propelled Trailer can be used in the caravan to camp 'of grid'. In addition the electrical motors can replace the existing Mover system. For the refrigerator market the electrical motors can be used to charge the batteries. The energy in the batteries can be used to refrigerate the trailer. The Value Proposition of these markets will be explained further on in this paragraph.

5.3.1. Caravans

43% of the caravans in the Netherlands have a Mover. (KCK, 2016) A Mover is a small electrically propelled wheel that people put on the caravan wheel at the camping spot. This Mover wheel can be operated with a remote control to place the caravan on the right spot without using the car. On average people pay 1.500–2.500 euro for a Mover system (Sicking, 2016) (Verdegaal, 2016) (Borghuis, 2015) (Appendix C). When people decide to buy an Electrically Propelled Trailer system they don't need a Mover. For this reason the Value

Proposition for caravan owners is better than the Value Proposition for the utility trailers. The number of new sold caravans in 2014 is 5.500. (BOVAG, 2015) This is a smaller amount than the utility trailers. However in 2014 and 2015 the number of new sold caravans has grown with 34% (BOVAG, 2015b). Toine Crone (2015) (Manager Caravan BOVAG) expects that: *“the number of new sold caravans will increase to 10.000 caravans per year, the extent before the financial crisis”*.

The willingness to pay due to the smaller car that people can drive is the same as for the utility trailer below the 3.500 kg (paragraph 5.2): [REDACTED]. However, the Electrically Propelled Trailer replaces the Mover, so the willingness to pay for a caravan owner with a Mover system is [REDACTED] euro. The mass of a caravan varies between 1.000 and the 2.000 kg. The cost price for an Electrically Propelled Caravan will be between the [REDACTED] [REDACTED] Euros based on the assumptions. In this case there could be a business case. Further research has to prove what the correct cost price and willingness to pay is.

The Mover market is a direct competitor for the Electrically Propelled Trailer. Other possible competitors are the camper, bigger cars, rental cars and smaller caravans are also competitors for the Electrically Propelled Trailer system. To bring the technology into the caravan market will need the same investment as for the utility trailer market.

5.3.2. Refrigerator Trailers

There are approximately 230.000 refrigerator trucks in Europe (Logistiek.nl, 2015). These refrigerator trucks can be trucks, trailers and heavy trailers. No specific market information is available on the deviation between these types of refrigerator trailers. The Value Proposition of these trailers can be calculated. There is assumed that the market for normal refrigerator trailers in the Netherlands is 500 per year.

CE Delft in collaboration with Nomad Power (Boer et al., 2015) conducted a research on cooling refrigerator trailers during rest periods with electricity instead of diesel generators. Currently 95% of the refrigerator trailers are cooled with diesel generators (Boer et al., 2015). These refrigerator trailers use an average of 2,5 litre diesel per hour to cool the trailer (Boer et al., 2015) (Fokkema, 2015). Based on a research of Delft University of Technology (Boer et al., 2015) can be concluded that the energy density of diesel is 3.2 kWh/litre. A refrigerator trailer uses in average 8 kW (2,5 l/h * 3,2 kWh/litre) to cool the trailer. By using an Electrically Propelled Trailer this cooling can be done by the batteries in the system instead of the diesel generators. In addition to that it is possible to generate electricity from the electrical brakes in the electrical motors. This electricity can be used to cool the trailer.

An average truck drives 1500 hours a year (Boer et al., 2015). This means that the amount of diesel needed to cool the truck is (2,5 litre per hour * 1500 hours) 3.750 litres. With a diesel price of 1,18 euro/litre (Boer et al., 2015) this means 4.425 euro a year. To cool the same trailer, 12.000 kWh (8 kW * 1500 hour) is needed. An electricity price of 0,28 euro per kWh (Boer et al., 2015) is assumed. The total costs per year to cool the refrigerator trailer with electricity are 3.360 euro. The real costs for electricity will be lower, since breaking the trailer will generate a part of the electricity. However with only the advantage of using electrical energy instead of diesel the trailer owner can save 1.065 euro per year. When a payback time of 2 years is assumed the willingness to pay for the refrigerator trailer owners is 6.500 to 11.500 euro. The cost price of this product will be higher than the cost price of the caravan and the utility trailer because more powerful batteries are needed. The energy needed to cool the

trailer 1 hour is 8 kWh. To cool the trailer for example 3 hours before the trailer charges the batteries, 24 kWh (8 kW * 3 hours) batteries should be added to the system. The cost price of 24 kWh batteries is [REDACTED] €. The total cost price for an electrically propelled refrigerator trailer of 2000 kg is [REDACTED] (Appendix E) The price is approximately twice as much as the willingness to pay. No business case is involved in this situation.

The competition in this market is comparable to the utility trailer market: the bigger car. In addition to that will this product compete directly to the diesel generators? The costs price of a diesel generator for a refrigerator trailer is approximately 500 euro (Fokkema, 2015). The price of the Electrically Propelled Trailer is much higher, but then there are also other advantages, like driving a smaller car. The investment that is needed for these kinds of trailers is approximately the same as for the utility trailer and the caravan.

5.4. Heavy trailers (>3.500 kg)

In this paragraph two types of heavy trailers are discussed. Heavy trailers usually drive more km/year. For these types of trailers it is assumed that fuel savings are more important. Two types of heavy trailers are discussed: the normal heavy trailer and the refrigerator heavy trailer.

5.4.1. Heavy Regular Trailers

In 2014 10.921 trailers are sold in the Netherlands with a mass above the 3.500 kg. The market growth is 7% per year. (BOVAG, 2015a) In this paragraph the trailers heavier than 3.500kg are discussed. The maximum mass of a truck in combination with a trailer is 50.000 kg. (RDW, 2012) (Egas, 2015) According to Hoogstad (2016) the majority of the trucks are able to tow 50.000 kg. The customers' Value Proposition to be able to tow the same trailer with a smaller truck is not interesting here because nearly all trucks are able to tow a trailer of 50.000 kg. However, fuel savings involved when using an Electrically Propelled Trailer are interesting enough. An average truck drives 150.000 km/year (Egas, 2015 & Hoogstad, 2016). When the truck is fully loaded, the truck uses 40 litres diesel per 100 km. A truck without a trailer uses an average 25 litres diesel per 100 km. Thus the truck consumes 15 litres per 100 km extra due to the resistance of the trailer. This means that an average trailer consumes 22.500 litres diesel per year (150.000 km / 100 km * 15 litre/100 km). The energy density of diesel is 3,2 kWh/litre (Boer et al., 2015). This means that an electrical propelled truck uses 72.000 kWh per year (22.500 litre * 3,2 kWh/litre). With an electricity price of 0,28 euro per kWh (Boer et al., 2015) the costs for electricity are 20.160 euro per year. The 22.500 litre diesel for the trailer we mentioned before costs 26.550 euro per year. This means that a truck company can save 6.390 euro per year by using an Electrically Propelled Trailer. With a return on investment of 2 years this means that truck companies are willing to pay 12.780 euro for a system that will reduce their fuel expenses. In the Netherlands the regulation in city centres for trucks become stricter over the years. This regulation can lead to a higher customers' willingness to pay. Trailers that are towed by trucks are usually between the 30.000 and 40.000 kg because the total mass of the combination cannot mass more than 50.000 kg and the mass of the truck itself is usually between the 10.000 and 20.000 kg. (Egas, 2015) (Hoogstad, 2016). The cost price for an Electrically Propelled Trailer for a truck company would be between [REDACTED] [REDACTED] (Appendix D). In this case the version with fuel savings is used. Competitors in

this field are: DAFs', Mercedes' and Tevvas' hybrid trucks. Other competitors are fuel savings programs like driving on natural gas. (Truck van de Toekomst, 2016) To bring an electrically propelled heavy trailer on the market asks for a bigger investment than for the less heavy ones. Forces, masses and powers are much higher. To develop the first Tevva hybrid truck an investment of 4,25 million Euros was needed (Bennett, 2015). This investment was needed to make a truck. To produce a hybrid trailer in this mass class an investment is assumed between th [REDACTED]

5.4.2. Heavy Refrigerator Trailers

The heavy refrigerator trailers have, like the heavy trailers, the same advantage of fuel savings. There is assumed that the Dutch market for heavy refrigerator trailers is approximately 500 trailers per year. In addition to that is the truck owner willing to pay an extra amount of 2.000 Euros for the system due to the savings on the cooling fuel. (Paragraph 5.3.2) The willingness to pay for a heavy refrigerator trailer is than [REDACTED]. As is shown in paragraph 5.3.2 is there no business case for a refrigerator trailer. Paragraph 5.4.1 shows that there is no business case for a heavy trailer. The combination of both, the heavy refrigerator trailer shows also does not have a business case. The batteries that are necessary to cool the trailer will increase the cost price with [REDACTED]. (Paragraph 5.3.2) To produce a hybrid trailer in this mass class an investment between the 1 and 2 million Euros is needed, the same amount as the heavy trailer.

5.5. Market Selection

Based on the selected criteria in chapter 2 the different markets are analysed in this chapter. The results of this analysis are shown in *Table 5.1*.

Table 5.1 Selection Criteria per market

Criteria\Market	Utility trailer	Horse trailer	Caravan	Refrigerator trailer	Heavy trailer	Heavy refrigerator trailer
Market Size	15.706	753	5.500	500	11.921	500
Market Growth	12%	12%	34%	-	7%	-
Willingness to Pay	€5.000- €10.000	€5.000- €10.000	€6.000- €11.000	€6.500- €12.500	€12.000	€ 14.000
Cost price	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Competition	Bigger car, smaller trailer	Bigger car, smaller trailer	Bigger car, smaller trailer, Mover	Bigger car, smaller trailer, diesel generator	Fuel reduction programs, hybrid trailers	Fuel reduction programs, hybrid trailers, diesel generator
Investment needed	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

Chosen is to rephrase scores between the markets for each criterion. The best market for that specific criterion scores a 6 and the least market a 1. The caravan market is the best market to enter with the Electrically Propelled Trailer. However, the utility trailer and the horse-trailer market follow this market. Good to mention is that these markets are quite similar in sense of mass and regulations. Based on the results in this table it can be concluded that if the caravan market is profitable there is also a good potential in the utility and horse trailer market. The caravan market is chosen because the caravan market had the highest scores in the research due to its slightly better Value Proposition and because the caravan market is more a gadget market. A sensitivity analysis can prove how strong the number one position is for the caravan market. For this research is decided to conduct a normal analysis and no sensitivity analysis. This can be done in future research. The reason that the sensitivity analysis is not included in this research is that the market selection table is created to get a good insight in the market selection. The scores as presented in Table 5.2 are clear enough to make the decision. In addition further research is necessary to define which sensitivity analysis is needed to get a better conclusion.

Table 5.2 Market Selection

Criteria\Market	Utility trailer	Horse trailer	Caravan	Refrigerator trailer	Heavy trailer	Heavy refrigerator trailer
Market size	6	3	4	1,5	5	1,5
Market Growth	4,5	4,5	6	1,5	3	1,5
Willingness to pay	1,5	1,5	3,5	3,5	5	6
Cost price	4,5	4,5	6	3	2	1
Competition	5	5	5	3	1	2
Investment needed	4,5	4,5	4,5	4,5	1,5	1,5
Total score	26	23	29	17	17,5	13,5

The outcome of the market selection is different than expected in advance. My expectation was that, because of the fuel savings, the electrically propelled trailer would suit better to heavy trailers because they drive much more kilometers per year. However, the cost price of the batteries is much higher than the fuel savings. Before the start of this market research I decided beforehand I wanted to go for the normal trailer market and not for the heavy trailer market. Maybe I was a bit biased. This is because regulations on heavy trailers are much stricter. Besides that, forces are much bigger in the heavy trailers and investments may be too big for a startup.

That the caravan market scored higher than the other normal trailers was not a surprise for me. This for two reasons (1) I identified the market need for an electrically propelled trailer based on the caravan market and (2) due to the high mover ownership rate the value proposition for the caravan market is slightly better.

In this market selection model the willingness to pay and the cost price are split in two criteria. If the business case is negative (costs higher than the willingness to pay) you can stop the research. This can be judged as a go-no-go moment. Regulations are not involved in this

market selection. When the innovation is not allowed you can stop the research. Also a go-no-go moment. It is possible the product is allowed in another market what means you can move on.

6. MSFF Phase 3 and 5: Customer Discovery

Following the Market Selection and Feasibility Framework (MSFF) for start-ups introduced in Chapter 2 (2.2) the Business Model Canvas for the Electrically Propelled Trailer in the selected market is described in this chapter. In my research I focus on the caravan market for further investigation (Chapter 5). All nine blocks of the Business Model Canvas are being filled in for the caravan market (paragraph 6.1 up to 6.9). The methodology of the Business Model Canvas is explained in chapter methodology (3.4.1). The blocks are filled in with assumptions concerning the caravan market. In section 6.10 an overview of all assumptions is given. Based on the method described in chapter 3.4.3 the assumptions are being ranked and selected. The selected assumptions will be tested in chapter 7 and 8. Therefore this chapter is the basis for the Customer Discovery and the Customer Validation because in this chapter the assumptions are set and tested for these phases. (Figure 6.1)

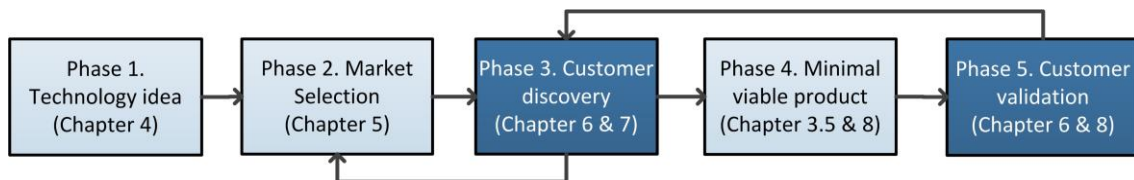


Figure 6.1 Overview of the research

6.1. Customer-segments

As explained in chapter 5 (market selection) the caravan market is selected as the best market to start the introduction of the Electrically Propelled Trailer. In this paragraph (6.1) the customer segments in the caravan market are further investigated. It is assumed that the best market to introduce the Electrically Propelled Trailer is the Dutch caravan market. Considering the total number of caravans in use (460.000) the Netherlands ranks fourth. (European Caravan Federation, 2015) Only, Germany (880.000), France (845.000) and UK (550.000) rank higher (European Caravan Federation, 2015). When the number of caravans is compared with the number of inhabitants the Netherlands scores rather high. Assumed is that the Netherlands is a good market to start with the introduction of the Electrically Propelled Trailer.

Besides the geographical market segmentation, it is also important to segment the potential market considering the type of customer. In chapter 4.6 the potential cost price of the Electrically Propelled Trailer is assumed. A price between the 9.500 and the 11.500 Euros is defined. This is a high price compared with other gadgets in the caravan market. For example, the price of a Mover is between 1.500 and 2.500 Euros. (Appendix C) For the Electrically Propelled Trailer people with higher incomes and expensive caravans are target customers. The price of an average new caravan is between the 15.000 and the 25.000 Euros. (ANWB, 2016) Brands as Dethleff, LMC, Kip, Kabe and Polar are brands in the higher segment. The prices of an average new caravan in these brands are between the 20.000 and 50.000 Euros. (ANWB, 2016) Assumed is that customers that buy these types of caravans are also customers for the Electrically Propelled Trailer. In addition it is assumed that people that can afford these types of caravans are also higher educated, have a higher income and age 60 years or more.

This because I assume that higher educated and elderly people are generally more interested in contributing to the preservation of the environment. Probably these people are interested in sustainable innovations. People with a high income also can afford these more expensive caravans brands with expensive extras. Older people are also interested in comfort that they find in the Electrically Propelled Trailer: it provides more comfort while driving.

The number of systems that can be sold is also important. People that will buy an Electrically Propelled Trailer are probably the same people that would buy a Mover (43% of the caravan owners have a Mover) or an anti-swaying system (28% of the market) (KCK, 2015). The Electrically Propelled Trailer makes these two gadgets unnecessary.

BOVAG (2015c) gives an overview of the new sold cars per category. The categories are from A – N, where A is a small car and N a big van. Assumed is that cars in category A and B are not able to tow a caravan. This is 40,2% of the total number of new sold cars. Assumed is that people owning a caravan do not buy a car in this category. With an Electrically Propelled Trailer people can do this. This brings the total market of potential users for the Electrically Propelled Trailer in the Netherlands to 22.264 users ($460.000 * 43% * 28% * 40,2%$). This is approximately 5% of the market.

Assumptions

The assumptions made on the customer segments are:

- The Netherlands is a good market to introduce the Electrically Propelled Trailer.
- Caravan owners that own an expensive caravan brand are willing to spend more money on accessories.
- The target group consists of people that are higher educated, have higher incomes and an age above the 60 years.
- 5% of the total amount of caravan owners in the Netherlands is interested in an Electrically Propelled Trailer.

6.2. Value Proposition

Figure 6.2 shows what products the Electrically Propelled Trailer delivers. As can be seen in the figure are 2 electrical motors installed in the wheel of the caravan. Also a battery package is added to the caravan. In this paragraph is first the customer profile shown, subsequently the value map is presented. Finally the value proposition is discussed.

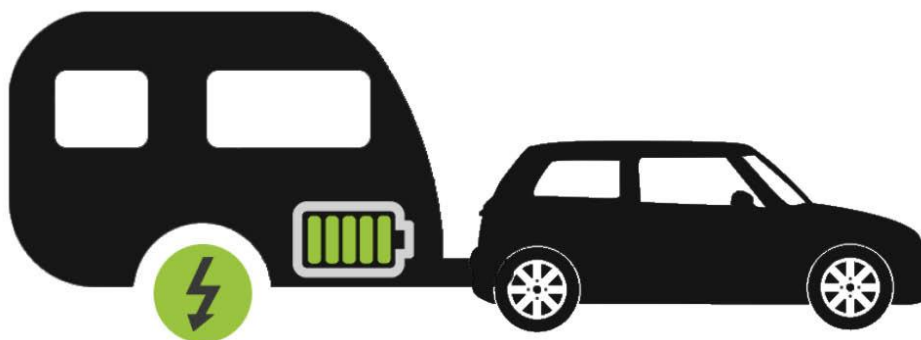


Figure 6.2 Drawing of the Electrically Propelled Trailer (Caravan)

6.2.1. Customer Profile

In this paragraph (6.2.1) the different customer pains, gains and jobs assumed are shown.

Customer Pains

A pain that caravan-owners encounter is that they have to drive a big (and more expensive) car the whole year to make it possible to tow their caravan in the few weeks when they go on holiday with the caravan. A different pain that is assumed is that fuel expenses when towing a caravan are important to the caravan-owner. The swaying motion of the caravan while driving is another pain that is assumed. Driving uphill sometimes is difficult with a big and heavy caravan behind the car. The last pain assumed is the translocation of the caravan at the holiday location. Removing the caravan from the car and bringing it to its final spot is a heavy job.

Customer Gains

The main gain for customers is the possibility to drive a more sustainable car while owning the same caravan. This more sustainable car can be a smaller and lighter one, or even a hybrid/electric car. Another gain is that customers can drive their caravan easier in the mountains. The swaying motion of the caravan is almost absent. An extra customer gain is that the Mover is no longer necessary when owning an Electrically Propelled Trailer.

Customer Jobs

The main customer job is to have a nice holiday. Another is: having a safe journey to the destination and back home. An additional customer job is that caravan owner wants to have the newest gadgets, look trendy and wants to camp in a sustainable way.

6.2.2. Value Map

In this paragraph the Value Map is shown. The value map shows the product, pain relievers, gain creators and its services.

Product

In chapter 4 is explained that the Electrically Propelled Trailer consists of 3 parts: electrical motors, batteries and the Measurement Unit. In chapter 4 is assumed that a motor of approximately 13 kW and a battery of 8 kWh are necessary to propel the caravan.

Pain Relievers

The electrical motors in the Electrically Propelled Trailer will solve the problem of the need of a big and unsustainable car. Fuel expenses increase slightly when towing a trailer. As explained in chapter 5 the cost price of electrical energy is somewhat lower than the price of gasoline. The Electrically Propelled Trailer will decrease the fuel costs but not very much.

Other pain relievers are the fact that electrical motors will assist the caravan while driving uphill. The electrical regenerative brakes compensate the swaying motion of the caravan when a swaying motion is detected. Finally the electrical motors can be used to steer the caravan on the holiday location to the right camping spot.

Gain Creators

The Electrically Propelled Trailer makes it possible to drive a smaller car around the year and tows the same caravan during the holiday. The electrical motors will assist the car in the mountains and a Mover is no longer needed.

6.2.3. Value Propositions

As explained in the two previous sections (6.2.1 and 6.2.2) there are different customer pains that can be solved with the Electrically Propelled Trailer. Also there are several gains for the customer. Five different values can be delivered to the customer as explained in chapter 4.3. Numbers, in sense of money, will be given to each of the 5 benefits. The five benefits are: (1) driving a smaller/more sustainable car, (2) drive easier in the mountains, (3) accelerate better, (4) overcome the swaying motion of the caravan and (5) the Mover function. These 5 values are explained more in depth in this section (*Figure 6.3*).

1. Drive a smaller/more sustainable car

As discussed in chapter 5.2 an Electrically Propelled Trailer will decrease the need for big and fuel consuming cars. In chapter 5.2.1 a customer saving due to the use of an Electrically Propelled Trailer of € 4.500 to € 9.000 Euros is assumed. This saving is caused by the fact that people can drive a smaller and cheaper car throughout the year.

2. Drive easier in the mountains

Currently people go on holiday with their caravan, also in mountainous areas. The Electrically Propelled Trailer will support the car when driving uphill. It is assumed that people buy a bigger car to tow their caravan during holidays. The extra car expenses for a bigger car were already taken into account in benefit 1. Assumed here is that the problem of driving and accelerating in the mountains is a real problem for caravan owners. It is assumed that solving this problem is worth € 500 to € 1.000.

3. Accelerate easier

Assumed is that accelerating with a caravan is difficult and that it will take a while to accelerate from 0 to 90 km/h. The Electrically Propelled Trailer will support the car when accelerating. Assumed is that people do buy a bigger car to get a good acceleration when towing a trailer. This bigger car will result in extra car expenses. These extra car expenses are taken into account already in point 1 (drive a smaller/more sustainable car). Assumed is that this problem of accelerating is a problem for caravan owners. In addition to that it is assumed that solving this problem is worth € 500 to € 1.000.

4. Overcome the swaying motion of the caravan

Currently 28% of the caravan owners buy an anti-swaying system (KCK, 2015). Assumed is that people prefer to have an integral system with all solutions included. People currently pay € 500 to € 2.200 Euros for an anti-swaying system. These systems have different types of anti-swaying and sometimes these systems also provide other solutions like overcoming overheated brakes.

5. Mover function

Currently 43% of the caravans have a Mover. A Mover is a remote control to move the caravan at the location without a car. The prices of Movers including installation are between the € 1.500 and € 2.500. Assumed is that people preferred to have one solution that solves different problems. So it is assumed that people prefer to have a Mover implemented in the Electrically Propelled Trailer.

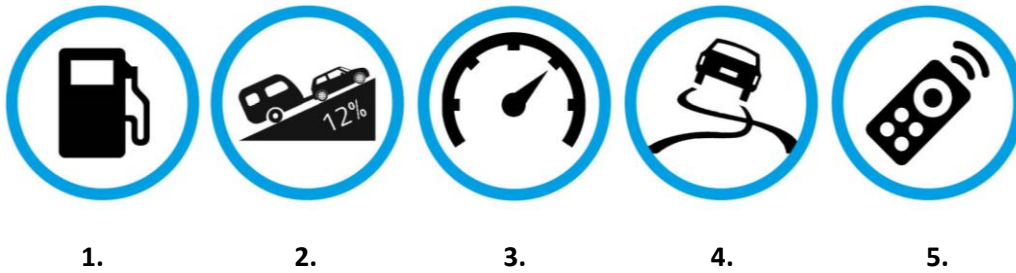


Figure 6.3 The 5 advantages of an Electrically Propelled Trailer

6.2.4. Assumptions

The assumptions made on the Value Propositions are:

- People buy a bigger car especially for their caravan.
- Fuel expenses when towing a caravan are a real problem for caravan owners.
- The swaying motion of a caravan is a problem for caravan owners and at least 28% of them is willing to pay more than € 800 for an anti-swaying-system.
- Driving uphill is a problem for caravan owners and they are willing to pay € 1.000 - €2.000 for a solution to solve this problem.
- 43% of the people are willing to pay more than € 1.500 for a Mover.
- It is (or can become) road legal to drive with an Electrically Propelled Trailer.
- It is (or can become) road legal to drive with a smaller car when using an Electrically Propelled Trailer.

6.3. Distribution Channels

In this paragraph (Paragraph 6.3) the possible distribution channels are discussed. The value chain of the caravan market is assumed as follows: raw material providers → components manufacturers → caravan factories → distributors of caravans (caravan retailers) → caravan owners (Figure 6.4). Assumed is that the caravan factory manufactures the caravans and sells the caravans through distributors/retailers. These retailers sell the caravans to the end users. Assumed is that the retailers also perform the maintenance of the caravans. Assumed is that the Electrically Propelled Trailer system mainly will be installed in new caravans. Therefore it is assumed that the focus in the distribution channel will be on caravan factories.

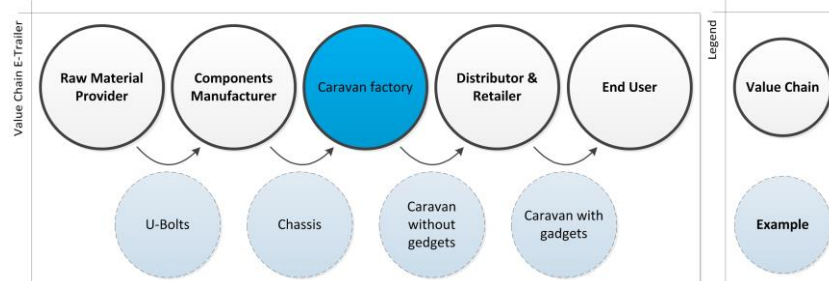


Figure 6.4 Possible distribution channel (own production)

The Electrically Propelled Trailer consists of three main components; batteries, motors and Measurement Unit. It is assumed that the batteries will be bought in factories in China with a battery management system in the battery. The motors can be bought at an electrical motor factory. It is assumed that buying the electrical motors in China will be the cheapest option.

For the Measurement Unit more knowledge is needed. Assumed is that this Measurement Unit should be developed together with a sensor factory in Europe because this is easier in terms of language. Assumed is that these three different parts will be packaged together and will be sent to the caravan factories. These factories can install the system in the caravans.

Assumptions

The assumptions made on the channels are:

- The caravan factories are the customers of the Electrically Propelled Trailer.
- The retailers of the caravans conduct the maintenance of the caravans and are able to maintain the Electrically Propelled Trailer.
- The batteries and electrical motors can be bought as a ready product in China.
- The measurement unit can be purchased, designed and fabricated in Europe.

6.4. Customer Relationships

It is assumed in paragraph 6.3 that the Electrically Propelled Trailer will be sold to the caravan factories. Therefore three different customer relationships can be distinguished: (1) the relationship with the caravan factories, (2) the relationship with the caravan retailers and (3) the relationship with (future) caravan owners (the end users).

The caravan factories can be interested in the Electrically Propelled Trailer by explaining to them that more car owners are able to buy a caravan when using an electrically propelled one. Assumed is that the Electrically Propelled Trailer will be sold to the caravan factories as a final product. Assumed is that the factories should be trained how to install the system.

The caravan retailers should sell the Electrically Propelled Trailer to the final customers. These retailers should be convinced to sell the product. In addition it is assumed that these retailers should be trained to conduct the maintenance for the Electrically Propelled Trailer.

The caravan owners should be informed on the advantages of an Electrically Propelled Trailer. They should also be aware of the fact that they can buy an Electrically Propelled Trailer. Assumed is that end user marketing in caravan magazines, blogs and expo's is enough to attract customers.

Assumptions

The assumptions made on the customer relationships are:

- The caravan factories are willing to install an Electrically Propelled Trailer in their caravans.
- The caravan factories can be trained and have the skills to install an Electrically Propelled Trailer.
- The caravan retailers are willing to sell the Electrically Propelled Trailer to their customers.
- The caravan retailers can be trained and have the skills to maintain the Electrically Propelled Trailer.
- The end users can be attracted via caravan blogs, magazines and expos.

the market is interested in the Electrically Propelled Trailer. This totals the market per year for the Netherlands [REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

6.5.3. Assumptions

The assumptions made on the revenue streams are:

- The caravan owner is willing to pay between the € 6.500 and € 13.700 for an Electrically Propelled Trailer.
- The VAT for this type of goods in the Netherlands is 21%.
- The margin for the caravan factory and the caravan retailer is [REDACTED]
- The installation costs for the Electrically Propelled Trailer is 4 to 8 hours at a labor rate of € 50 per hour.
- The Electrically Propelled Trailer can be sold to [REDACTED] of the assumed European market
- 5% of the new sold trailer owners are willing to buy an Electrically Propelled Trailer.

6.6. Key Resources

The Key Resources can be split in four main categories: Physical-, Intellectual-, Team and Financial Resources. The main Physical Resources are the components needed to build the Electrically Propelled Trailer (batteries, motors and Measurement Unit). Talking about components means deciding on the amount of stock needed. The value of the stock is dependent on the level of stock. It is assumed that 3 months of stock is necessary to deliver in a good and direct way. This time interval prevents a surplus on stock but still gives economies of scale on the purchasing prices. This will result in [REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]

Intellectual Resources are the way in which the business manages its intellectual property. An intellectual property protection (IP) will be necessary to protect the Electrically Propelled Trailer. Currently the IP is pending for the Electrically Propelled Trailer system. The IP pending is a patent on the Measurement Unit. In this IP it is described how the force between the car and the trailer is measured to steer the motors. The technology of the measurement unit is described in section 4.5. Assumed is that this IP will protect the technology enough. In addition to that it is assumed that the technology of the Electrically Propelled Trailer will not break the IP of other inventors.

The Team Resources refer to the kind and amount of employees needed to start and run the business. To engineer the whole Electrically Propelled Trailer it is assumed that 5 engineers are needed for a year. To get the sales on going it is assumed that two sales people and two marketing employees are needed on a full time bases.

The Financial Resources are based on the investment that is needed to kick-off the start-up. In section 5.5 an investment between [REDACTED] is assumed. This will be used to

finance the development of the Electrically Propelled Trailer. To scale up the sales another investment will be necessary. This is not included in the scope of this research because the research focuses on the starting phase of the start-up.

Assumptions

The assumptions made on the key resources are:

- It is affordable to have a stock of 3 months.
- It is necessary to have a stock of 3 months.
- It is possible to patent the technology for the Electrically Propelled Trailer.
- The current IP for the Electrically Propelled Trailer is strong enough.
- The technology of the Electrically Propelled Trailer will not break the IP of other inventors.
- 5 employees are needed to finalize the product in technical way.
- 4 marketing and sales employees should be hired to get the sales going.
- An investment between € [REDACTED] is needed to finish the products' technology.

6.7. Key Activities

The Electrically Propelled Trailer consists of 3 main elements: motors, batteries and the Measurement System. Assumed is to buy the first two parts at external factories. Assumed is to further develop the Measurement unit together with a European partner. Assumed is that the components will be packed in a warehouse and send to the caravan factories.

Assumptions

The assumptions made on the key activities are:

- Motors and batteries can be bought externally.
- The measurement system will be developed together with an external party.
- The company will only buy, package and sell the parts.

6.8. Key Partnerships

Different partnerships are necessary to bring the Electrically Propelled Trailer to the market. In this paragraph (6.8) is described which partnerships are interesting when developing the business.

The first partnership is a partnership with the RDW. The RDW is the Dutch Road Authority. Without a permission of the RDW for the Electrically Propelled Trailer it is not allowed to drive the trailer on the road. The partnership with the RDW is necessary to get the driving approval for the Electrically Propelled Trailer. Another important partnership is with the in-wheel motor factory. In-wheel motors for cars are already available. These motors have to be changed slightly to make them compatible with trailers. This adjustment to the motors should be developed in cooperation with the motor-factory. Also a partnership with a Sensor producing Company is necessary. In collaboration with this company a Sensor Unit has to be made to implement in the trailer.

Assumptions

The assumptions made on the key partnerships are:

- The RDW is willing to approve the Electrically Propelled Trailer on the road.
- It is possible to enter into a partnership with a motor factory and make in-wheel motors compatible for trailers.
- A partnership with a sensor company can be found to develop the sensor/measurement unit for the Electrically Propelled Trailer.

6.9. Cost Structure

Two types of costs can be distinguished in the business: (1) the purchase price of the goods (variable costs) and (2) the overhead costs (constant costs). First, assumptions are made about the purchase price of the goods. Subsequently the overhead costs will be calculated.

In chapter 4.6 assumptions are made on the cost price of the system. Assumed is that the cost price for the motors for a 1.000 kg caravan should [REDACTED]. In addition to that it is assumed that the price of the batteries should be € [REDACTED]. These prices depend mainly on two factors: (1) the size of the motors/batteries and (2) the price per size (€/kW(h)). The motor size assumed is [REDACTED] and the battery size [REDACTED]. Besides the price for the motors and batteries there is a margin of [REDACTED] for the other parts assumed in chapter 4.6 (cost price of the system).

Subsequently the overhead costs are assumed. In chapter 4.6 the overhead costs are assumed as a percentage of the cost price. This percentage is assumed at [REDACTED] of the cost price. In reality the overhead costs are constant cost, so these costs should be calculated as a percentage of the cost price. It is important to calculate the overhead costs thoroughly. When these costs are divided by the number of sales it is possible to estimate this percentage. The assumed amounts of sales are [REDACTED] Electrically Propelled Trailers per year (Chapter 6.5).

Assumptions

The assumptions made on the cost structure are:

- Size of the motors is [REDACTED] kg caravan.
- Size of the batteries is [REDACTED] for a 1.000 kg caravan.
- [REDACTED] The price of the motors is [REDACTED]
- [REDACTED]
- The price of the other parts of the system can be calculated by adding 20% on the cost price.
- The amount of sales is assumed at 1.625 Electrically Propelled Trailers per year.
- The overhead is at the assumed amount of sales is 50% of the cost price.

6.10. Selection of the Assumptions

In this paragraph (6.10) all assumptions are ranked. Based on this ranking it will be defined which assumptions are being tested and in which order. As explained in chapter 3.4.2 the assumptions will be ranked according to their impact on the business. The assumptions are divided in two: assumptions for the Customer Discovery and assumptions for the Customer

Validation. All assumptions that are defined in paragraph 6.1 to 6.9 in this chapter are shown, ranked and selected per Phase (Discovery or Validation Phase) in paragraph 6.10.1 and 6.10.2.

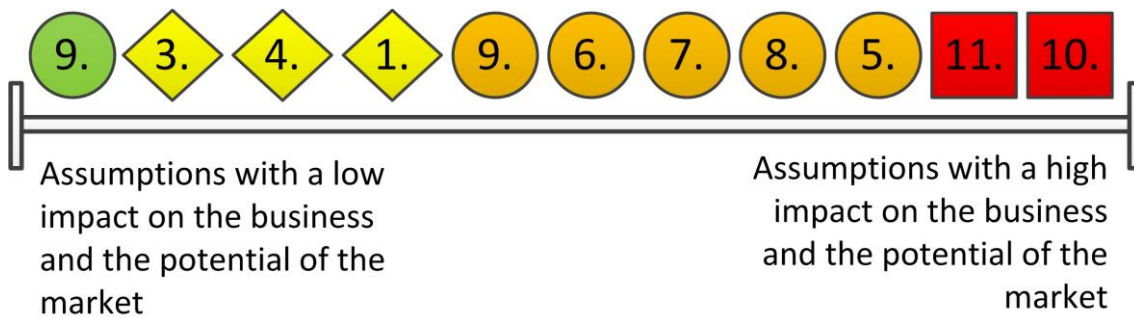
6.10.1. Ranking and Selection of the Assumptions for the Customer Discovery

Table 6.2 gives an overview of the assumptions of the Customer Discovery Phase. The order of the assumptions and their numbers are equal to the order in which the assumptions are discussed previously in this chapter. In Figure 6.5 the assumptions are ranked according to their impact on the business.

Table 6.2 Overview of the Customer Discovery assumptions

1	The Netherlands is a good market to start with the Electrically Propelled Trailer	7	Swaying motion of a caravan is a problem and at least [redacted] people is willing to pay more than [redacted] for such a system
2	Caravan owners of expensive brands are willing to spend more money on accessories	8	Driving uphill is a problem for caravan owners and these owners are willing to pay [redacted] for a solution to solve this problem
3	The target group are people that are well educated, have a high income and an age above the 60 year.	9	[redacted] of the people are willing to pay more than € 1.500 for a Mover
4	[redacted] of the market is interested in an Electrically Propelled Trailer.	10	It is (or can become) road legal to drive with an Electrically Propelled Trailer
5	People buy a bigger car specially for their caravan	11	It is (or can become) road legal to drive with a smaller car when using an Electrically Propelled Trailer
6	Fuel expenses when towing a caravan is a real problem		

This ranking is based on the argumentation that is given later in this paragraph. The assumptions are also classified in different categories. Assumptions on the right side of the scale are assumptions with a high impact on the business and potential of the market. Assumptions on the left side are assumptions with a low impact on the business and the potential of the market. The orange and red assumptions will be tested in the Customer Discovery Phase (Chapter 7) because these assumptions have the most impact on the business in this phase. The other assumptions (green and yellow) will be ranked in the Customer Validation Phase (chapter 8) to see if it is necessary to test them. As can be seen in Figure 6.5 most of the orange assumptions are related to Value Propositions assumptions. This is logical because the Customer Discovery is about validating the Value Proposition. Two red assumptions are involved; these are the assumptions on the road legality. When it becomes clear that the Electrically Propelled Trailer cannot become road legal no Value Proposition can be delivered. Therefore these assumptions are tested in this phase and are marked red.



Legend

X.	Legal	X.	Low impact assumption
X.	Market	X.	Medium impact assumption
X.	Value proposition	X.	High impact assumption
X.	Distribution	X.	No business without validation
X.	Cost and sales price	1.	Assumption number
X.	Intellectual property		

Figure 6.5 Selection of the Customer Discovery assumptions

Assumption 10 and 11 are the most important assumptions, because without a permission of the Dutch Road Authority it is illegal to drive on the road with the Electrically Propelled Trailer. Without this permission there is no Value Proposition at all. These assumptions are not about customer pain; therefore they are tested in the Customer Validation Phase. The Customer Discovery is about distinguishing the customer pains and defining how to solve these pains (Chapter 3.4). Keeping this in mind assumption 5 is the most important. Currently people buy bigger cars especially for towing their caravan. As assumed in paragraph 5.2 the willingness to pay for an Electrically Propelled Trailer depends on the assumption that people will buy a smaller car. This assumption is strongly correlated with assumption 8: the possibility to drive their caravan in the mountains. It is assumed that this is one of the reasons that people buy a bigger car. In addition to that it is assumed that people will replace their accessories like the Mover and the anti-swaying system by the Electrically Propelled Trailer. That is the reason that assumption 6, 7 and 8 are the next assumptions in line.

Assumption 1 and 4 are about the number of sales. Which country is the best to start and which percentage of caravan-owners will buy an Electrically Propelled Trailer? These assumptions are very important for the calculation of the potential of the business. Since they are not about customer pain, they will be tested in the Customer Discovery Phase. The same counts for assumptions 2 and 3.

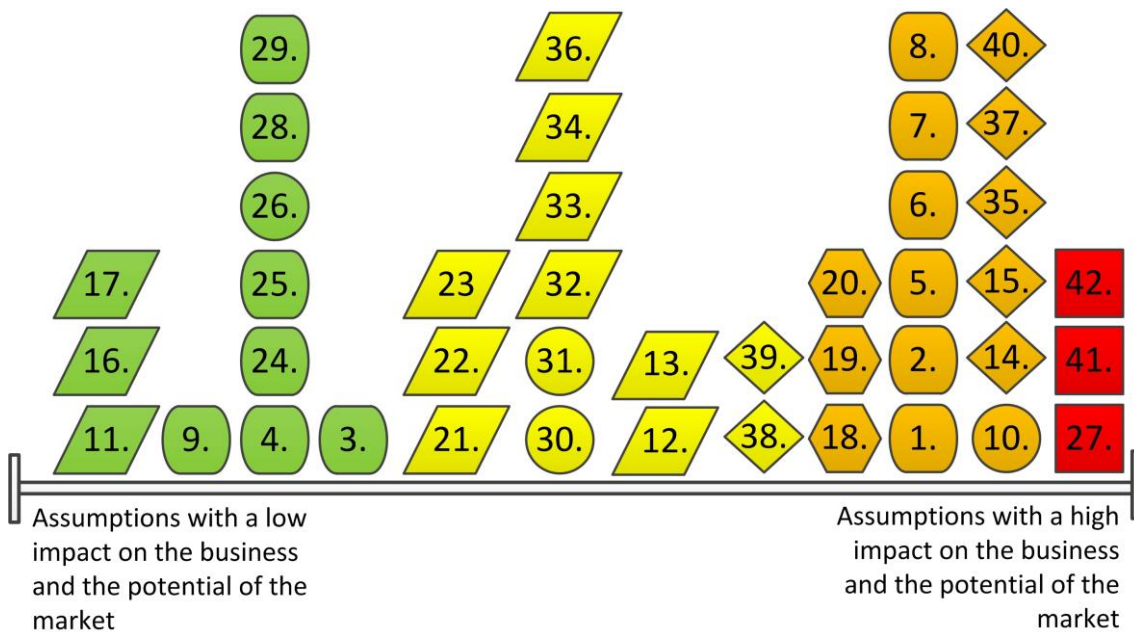
6.10.2. Rank and Select the Assumptions for the Customer Validation

Table 6.3 gives an overview of the assumptions of the Customer Validation Phase. The order of the assumptions and their numbers are again equal to the order in which the assumptions are discussed previously in this chapter. The assumptions that were not tested in the Customer Discovery Phase are added to this Phase (assumption 37 – 42) to define if it is necessary in this Phase to validate these assumptions in this Phase. In Figure 6.6 the assumptions are ranked

according to their impact on the business. This ranking is based on the argumentation that is given later in this paragraph. Again the assumptions on the right side of the scale are assumptions with a high impact on the business and the potential of the market. Assumptions on the left side are assumptions with a low impact of the business and the potential of the market. The yellow, orange and red assumptions will be tested in the Customer Validation Phase (chapter 8) because these assumptions have the most impact on the business in this phase. The other assumptions (green) will not be tested in this research. The red and orange assumptions will be tested first. Subsequently the yellow assumptions will be tested. The red assumptions are all about road legality. The orange assumptions are mainly about the market and the distribution channels.

Table 6.3 Overview of the Customer Validation Assumptions

1	The caravan factories will be the customers of the Electrically Propelled Trailer	23	An investment of € [REDACTED] is needed to finish the technology
2	The retailers of the caravans conduct the maintenance of the caravans and are able to maintain the Electrically Propelled Trailer	24	Motors and batteries can be bought externally
3	The batteries and electrical motors can be bought as a ready product in China	25	The measurement system will be developed together with an external party
4	The measurement unit can be purchased, designed and fabricated in Europe	26	The company will only buy, package and sell the parts
5	The caravan factories are willing to install an Electrically Propelled Trailer in their caravans	27	The RDW is willing to approve the Electrically Propelled Trailer on the road
6	The caravan factories can be trained and have the skills to install an Electrically Propelled Trailer	28	It is possible to enter into a partnership with a motor factory and make the inwheel motors compatible for trailers
7	The caravan retailers are willing to sell the Electrically Propelled Trailer to their customers	29	A partnership can be made with a sensor company to develop the sensor/measurement unit for the Electrically Propelled Trailer
8	The caravan retailers can be trained and have the skills to maintain the Electrically Propelled Trailer	30	Size of the motors [REDACTED]
9	The end users can be attracted via caravan blogs, magazines and expo's	31	Size of the batteries [REDACTED] caravan
10	[REDACTED]	32	The price of the motors is [REDACTED] kg caravan
11	[REDACTED]	33	The price of the batteries is [REDACTED]
12	The margin for the caravan factory and the caravan retails is 20%	34	The price of the other parts of the system can be calculated by adding 20% on the cost price
13	The installation costs for the Electrically Propelled Trailer is [REDACTED] hours at an labour rate of € 50 per hour	35	The amount of sales is assumed at [REDACTED] Electrically Propelled Trailers per year
14	The Electrically Propelled Trailer can be sold in 50% of the European market	36	The overhead is at the assumed amount of sales is [REDACTED] of the cost price
15	[REDACTED] of the new sold trailer owners is willing to buy an Electrically Propelled Trailer		Customer Discovery
16	It is affordable to have a stock of 3 months	37	The Netherlands is a good market to start with the Electrically Propelled Trailer
17	It is necessary to have a stock of 3 months	38	Caravan owners of expensive brands are willing to spend more money on accessories
18	It is possible to patent the technology for the Electrically Propelled Trailer	39	The target group are people that are well educated, have a high income and an age above the 60 years.
19	The IP for the Electrically Propelled Trailer is strong enough	40	[REDACTED] of the market is interested in an Electrically Propelled Trailer.
20	The technology of the Electrically Propelled Trailer will not breach the IP of other inventors	41	It is (or can become) road legal to drive with an Electrically Propelled Trailer
21	5 employees are needed to finalize the product in technical way	42	It is (or can become) road legal to drive with a smaller car when using an Electrically Propelled Trailer
22	4 marketing and sales employees should be hired to get the sales on-going		



Legend

X.	Legal	X.	Low impact assumption
X.	Market	X.	Medium impact assumption
X.	Value proposition	X.	High impact assumption
X.	Distribution	X.	No business without validation
X.	Cost and sales price	1.	Assumption number
X.	Intellectual property		

Figure 6.6 Selection of the Customer Validation Assumptions

Assumption 27, 41 and 42 are the most important assumptions, because without a permission of the Dutch Road Authority it is illegal to drive on the road with the Electrically Propelled Trailer. Without this permission no Value Proposition will exist at all.

The willingness to pay is the next assumption that should be tested (assumption 10). If the willingness to pay is not high enough there is no business case. This willingness to pay can be tested by using the results of the conducted survey. Assumption 40 and assumption and 15 assume that 5% of the market is interested in the Electrically Propelled Trailer. In assumption 14 is assumed that the Electrically Propelled Trailer can be sold in 50% of the European market. After that it can be tested which country is the best to start and it can be decided what the potential market size is (assumption 37). Based on the conclusion of assumptions 40, 15 and 37 it can be calculated what amount of sales could be expected in the future (assumption 35).

The assumptions about the market are really important to test in an early stage. It is important to be aware in an early stage that the market is too small and there is no viable business case. Assumption 1, 5, 6, 7 and 8 are assumptions on distribution channels. These are very important because based on the distribution channels it can be defined who the customer is for the Electrically Propelled Trailer. Based on the interviews with caravan factories and

distributors it can be distinguished how the value chain looks like. When it is known whom the customer is a calculation on the margins in the value chain can be conducted.

Assumption 18, 19 and 20 are about the intellectual property of the Electrically Propelled Trailer. It is important to define what the patent status is of the IP that is currently pending. In addition to that will be explored if the technology of the Electrically Propelled Trailer will not break the IP of other inventors (assumption 20). If the technology breaks other IP's, court cases might occur in the future. To overcome these court cases, it is important to know which IP's could be breached because it can be chosen in advance to slightly change the technology or to collaborate with the IP owner.

To target the right customers it is important to define the right customer segment. When it is known what the customers are willing to pay and what the right distribution channels are it is necessary to distinguish what the customer characteristics are. This will be defined by the validation of assumption 38 and 39.

Assumption 12 and 13 are assumptions about the margin of the caravan retailer/factory. It is important to know what these margins will be to calculate the cost price in a proper way. However, these margins will probably not break the business model. That is why these assumptions are placed in the middle. Also it is assumed that the caravan retailers are able to conduct the maintenance of the Electrically Propelled Trailer (assumption 2). A part of the margin of the retailer will also depend on the revenues they can earn from the maintenance, that's why these assumptions will be tested together with assumption 12 and 13. In addition to the margin of the retailer in this Phase it is also important to define what the margin for the overhead costs will be (assumption 36).

Assumption 30, 31, 32, 33 and 34 are assumptions on the size and the cost price of the motors and the batteries. Based on customer insights it is important to define which size of the motors is necessary in order to solve the customer pain. In addition it is important to know the cost price of these products to calculate the profit margins. Based on the research in chapter 4.6 (cost price of the system) it is explored what the approximate cost price will be. Based on research the cost price can be further specified. This assumption is not the most important because the cost price is already defined. However, this assumption can become important when the cost price is too high, then there is no business case. Because these reasons it is decided to place these assumptions in the middle of the priority list.

Assumption 21, 22 and 23 are assumptions about the amount of investment that is needed to get the Electrically Propelled Trailer to the market. It is interesting to know how much money is needed to get the product to market.

Assumption 3 is about the batteries. It is assumed that the batteries can be bought at the level required. There are a lot of battery factories around the world. That is why this assumption will not be tested in this research.

Assumptions 4, 24, 25, 26, 28 and 29 are assumptions on the purchase of the raw materials and sub goods. These assumptions will not be tested for the same reason as assumption 3: there are a lot of suppliers that can produce these types of goods. In addition to that this is not within the scope of this research because these suppliers have nothing to do with the potential of the market.

Assumption 9 is about the marketing channels for the Electrically Propelled Trailer. It is important to know what is a good way to target potential customers through marketing channels. However this has nothing to do with the calculations of the potential of the market.

Therefore it is decided to neglect this assumption in this research. Assumptions 16 and 17 are about the size of the stock. From a business perspective it is important to keep the stock as low as possible. However, to determine the potential of the market this is not an important issue. Therefore this assumption will not be validated in this research. The VAT is assumed at 21% in the Netherlands (assumption 11), this assumption will not be validated because it can be said that this is the correct VAT in the Netherlands for luxury products like the Electrically Propelled Trailer.

7. MSFF Phase 3: Test of the Assumptions

The assumptions of the previous chapter (Chapter 6.10.1) are tested in this chapter. This is done in the following order: description of the assumptions, explanation of the method of testing, defining the metric and the criteria, showing the results of the tests and concluding whether the assumption is validated or not. After this phase (Phase 3) the minimal viable product will be build and the customer validation will be conducted (Chapter 8) (Figure 7.1). The assumptions are mainly tested based on a survey with caravan owners (197) and on desk research. Criteria that will be tested in the Customer Discovery Phase are: car-caravan combination, driving uphill, swaying movement, fuel expenses and Mover ownership.

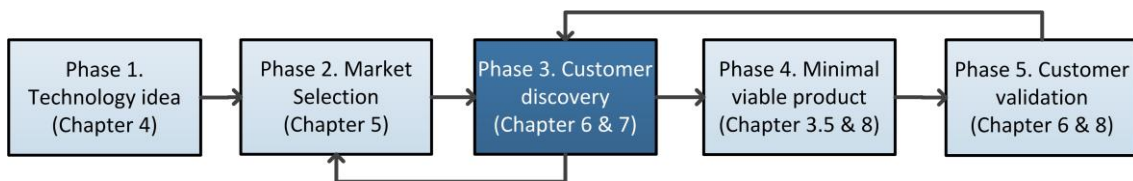


Figure 7.1 Overview of the research

7.1. Assumption 1: Car-caravan combination

What to test

In Table 7.1 an overview is given of the first assumption that will be tested. This assumption is about the car-caravan combination. What are the reasons for people to buy their car and their caravan and what is the correlation between them? The criterion is set at █ because this size is necessary to get a market share of █ (Chapter 6.1).

Table 7.1 Overview of Assumption 1

What	How
Assumptions	<u>We believe that</u> people buy a bigger car especially for their caravan.
Method	<u>To verify that, we will</u> interview 28 caravan owners at a Caravan Expo.
Metric	<u>We will measure:</u> the percentage of people that buy their car especially for their caravan.
Criteria	<u>We are right if,</u> █ of the people buy their car especially for their caravan.
Assumptions tested	Customer Discovery 5

Result of the test

Based on the interviews with the 28 caravan owners I concluded that █ of the caravan owners buy their car especially for their caravan. Three situations are distinguished based on the interviews. The first group buys a new car and a new caravan at the same point in time. The second group buys a new caravan and decides to buy a new car after about a year because the engine of the car turns out not to be strong enough to tow the caravan. The third group wants to buy a bigger caravan, but was not able to do so because they wanted to keep their present car. █ of the interviewed people fell into one of these groups, █ in the first group, █ in the second group and █ in the third group. I found out that people pay a lot of attention to the car-caravan combination when buying one of these products. This is because it is not allowed to tow a heavier caravan than your vehicle registrations indicates

was willing to pay more than [REDACTED]. Based on the survey can be concluded that it is actually [REDACTED] is willing to pay more than € [REDACTED] euro to drive easier in the mountains.

7.3. Assumption 3: Swaying movement

What to test

Swaying movement of caravans is a serious problem (KCK, 2016). Table 7.3 gives an overview of the test to validate the caravan owners' willingness to pay to solve the problems of the swaying movement of their caravan.

Table 7.3 Overview of Assumption 3

What	How
Assumptions	<u>We believe that</u> the swaying motion of the caravan is a real problem for caravan owners.
Method	<u>To verify that, we will</u> interview 28 caravan owners at a Caravan Expo. We will use the results of a survey with 200 caravan-owners to define their willingness to pay.
Metric	<u>We will measure:</u> the percentage of people that encounter problems with the swaying motion of the caravan. Also we measure their willingness to pay expressed in Euros.
Criteria	<u>We are right if,</u> [REDACTED] of the people encounter problems with the swaying movement of the caravan and [REDACTED] of these people are willing to pay more than [REDACTED]. This will result that [REDACTED] of the caravan-owners is willing to pay more than [REDACTED] for an anti-swaying system (KCK, 2015)
Assumptions tested	Customer Discovery 7

Result of the test

Based on the interviews with the 28 caravan owners I concluded that [REDACTED] of the people encounter problems with the swaying movement of their caravan. To confirm the willingness to pay the survey from the Customer Validation Phase is used. Based on the survey it is concluded that [REDACTED] of the people experience problems with the swaying movement of their caravan. Caravan-owners currently pay on average [REDACTED] Euro on anti-swaying accessories. These people are on average willing to pay [REDACTED] to overcome the swaying movement. Based on the survey, [REDACTED] of the people paid more than [REDACTED] euro for their anti-swaying system. [REDACTED] of the people is willing to pay more than [REDACTED] euro to overcome the swaying movement of their caravan.

Validated or not

The assumption that [REDACTED] of the people encounter problems with the swaying movement of their caravan is not validated. Based on the surveys this [REDACTED] and based on the interviews [REDACTED]. However, it can be concluded that [REDACTED] of the caravan owners paid more than 800 euro for their anti-swaying system. This is very close to the [REDACTED] of the research of the ANWB (KCK, 2015). For new caravans people are willing to pay more ([REDACTED]). It is concluded that the assumption is validated because the values are rather positive and very close to the expected values.

7.4. Assumption 4: Fuel expenses

What to test

In this paragraph is tested what the fuel expenses are of caravan owners when towing their caravan. In addition is tested if people see the increase of fuel consumption as a problem when they tow their caravan. (Table 7.4)

Table 7.4 Overview of Assumption 4

What	How
Assumptions	<u>We believe that</u> the increase of the fuel consumption when towing a trailer is a real problem.
Method	<u>To verify that, we will</u> interview 28 caravan owners at a Caravan Expo.
Metric	<u>We will measure:</u> the percentage of people that see fuel consumption as a problem.
Criteria	<u>We are right if,</u> [redacted] of the caravan owners see fuel consumption as a real problem.
Assumptions tested	Customer Discovery 6

Result of the test

For [redacted] the 28 respondents fuel consumption was a problem. On average people drive [redacted]/year with their caravan (survey). When these people drive 1 litre fuel to 12 km, their fuel consumption is approximately [redacted] L. When the fuel consumption increases with 40 to 60% it leads [redacted] litre extra fuel consumption per year. With a fuel price of €1,50 per litre this results in [redacted] per year. People did not encounter this as a problem.

Validated or not

The criterion is not validated. This is not a direct problem for the Electrically Propelled Trailer because it does not really focus on the fuel savings. The focus is more on the possibility to drive with a more sustainable car during the whole year, which is validated in assumption 2 (car-caravan combination).

7.5. Assumption 5: Mover Ownership

What to test

A research of the KCK (2015) showed that [redacted] of the caravan owners owns a mover. In this assumption will be tested what percentage of people own a mover and what they have paid for their mover. (Table 7.5)

Table 7.5 Overview of Assumption 5

What	How
Assumptions	<u>We believe that</u> [redacted] of the caravan-owners own a Mover and [redacted] of them paid more [redacted] for their Mover.
Method	<u>To verify that, we will</u> interview 28 caravan owners at a Caravan Expo. We will also use the results of a survey with 200 caravan owners to define their willingness to pay.
Metric	<u>We will measure:</u> the percentage of people that own a Mover and the amount of money people paid for their Mover.
Criteria	<u>We are right if</u> [redacted] of the caravan owners own a Mover [redacted] of them paid more than [redacted] euro for their Mover.
Assumptions tested	Customer Discovery 9

Result of the test

Based on the interview I concluded that █% of the caravan owners own a Mover and that █% of the people that want to buy a new caravan is willing to install a Mover. Based on the survey █% of the caravan owners own a Mover. These people paid on average €█ (standard deviation is █) for their Mover █% of the Mover-owners paid more than █% paid more than €█.

Validated or not

The assumption that █% of the caravan owners own a Mover is validated. That █% of these people is willing to pay more than €█ (%). However, based on the assumption there is assumed that █% of the caravan-owners) paid more than €█ for their Mover. Based on the survey this percentage is █ Therefore it is concluded that the assumption is validated.

7.6. Validation of the Assumptions

Assumption 1,2,3, and 5 are validated. Assumption 4 is not validated. Assumption 4 is not seen as important enough to stop the research for the business case at this point in time. The goal of this Phase (Phase 3, Customer Discovery) was to see if there is a Value Proposition. Almost all assumptions being part of the Value Proposition are validated. For that reason it is chosen to go on to Phase 4 of the *Market Selection and Feasibility Framework (MSFF) for start-ups: Minimal Viable Product* and phase 5 Customer Validation.

8. MSFF Phase 5: Customer Validation

The assumptions that will be tested in this chapter are the assumptions of chapter 6. This is done in the following order: description of the assumptions, explanation of the method of testing, defining the metric and the criteria, showing the results of the tests and concluding whether the assumption is validated or not.

The assumptions are mainly tested based on a survey with caravan-owners (197) and on interviews with stakeholders in the industry and caravan-owners. During the interviews the Minimal Viable Product (Phase 4) is used to show the potential of the Electrically Propelled Trailer (Figure 8.1). The criteria that will be tested in this Customer Validation Phase are: road legality (8.1), starting country (8.2), willingness to pay (8.3), amount of sales (8.4), distribution channel via factories (8.5), distribution channels via retailers (8.6) IP protection (8.7), target group (8.8), installation costs (8.9), motor size and price (8.10), battery size and price (8.11), profitability (8.12) and investment needed (8.13).

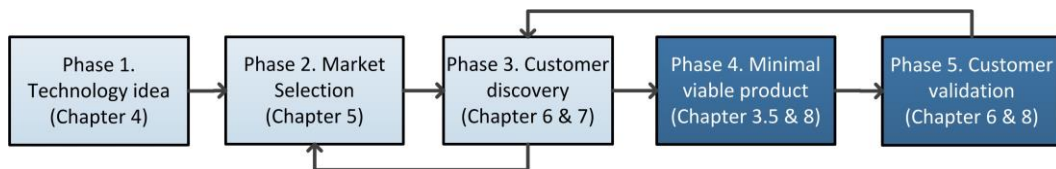


Figure 8.1 Overview of the research

8.1. Assumption 1: Road Legality

What to test

As can be seen in Table 8.1 are 2 assumptions made about the road legality. These assumptions are based on the 2 types of Electrically Propelled Trailers in chapter 4.6. It is necessary to get the Electrically Propelled Trailer road legal. If the first assumption is validated than there is a good business case. The second assumption makes the business case stronger, but if customers cannot have this function at the beginning it is not a big problem. However in the long term it is important that it will become legal to drive a smaller car when using an Electrically Propelled Trailer. In chapter 4.6 two types of Electrically Propelled Trailers are distinguished, (1) the full Electrically Propelled Trailer and (2) the Electrically Propelled Trailer that only assist when the car has insufficient towing power. These two types of Electrically Propelled Trailer will be tested separate for the road legality in this paragraph.

Table 8.1 Overview of Assumption 1

What	How
Assumptions	(1) <u>We believe that</u> it is (or can become) road legal to drive with an Electrically Propelled Trailer & (2) <u>We believe that</u> it is (or can become) road legal to drive with a smaller car when using an Electrically Propelled Trailer
Method	<u>To verify that, we will</u> interview the innovation manager and the permission manager vehicle of the Dutch Road Authority (RDW).
Metric	<u>We will measure at</u> a four points scale: 1. It is currently possible, 2. It can become road legal very easy, 3 it can become road legal with long procedures, 4 it can't become road legal.
Criteria	<u>We are right if,</u> assumption 1 is measured at scale 2 or higher and if assumption 2 is measured at scale 3 or higher.
Assumptions tested	Customer Discovery 10 and 11 & Customer Validation 27, 41 and 42

Result of the test

In conversations with the RDW it became clear that it is possible to get the Electrically Propelled Trailer road legal. The RDW stated that it is very important to show the advantages of the new technology. The RDW wants to stimulate innovation on the road, however at the same time the RDW is also responsible for safety on the road. Therefore it has to be proved that the Electrically Propelled Trailer is at least as safe as a regular caravan. When this can be proved an Article 20 Procedure can be started. In the Direction 2007/46/EG chapter VIII, article 20 is stated which procedures should be followed to introduce a new road technology. When these procedures are followed and the results are positive the Electrically Propelled Trailer can become road legal throughout Europe.

Following article 20 of the Direction 2007/46/EG a dossier has to be compiled. In this dossier should be made clear why the new road technology does not fit in the existing regulations (Article 20.2.a), should give an explanation of the undertaken safety actions (Article 20.2.b) and has to give results of tests that prove the new technology being is at least as safe as the existing technology (20.2.c).

According to the RDW it is easy to explain that the Electrically Propelled Trailer does not fit in the existing regulations (Article 20.2.a). Following the current legislation a trailer is a towed and non-propelled vehicle (chapter 4.2). The Electrically Propelled Trailer is still towed and also propelled. The first point of Article 20 is fulfilled. The Electrically Propelled Trailer promises that safety will increase due to the fact that the caravan is assisted driving uphill and during acceleration. Downhill the overheated brakes are no longer a problem and the chances for swaying motion are decreased. Because there are promises for more safety Article 20.2.b is also achieved. Looking at the last point of Article 20.2. (Paragraph c) the Electrically Propelled Trailer should be tested. No test results are available yet. In order to get assumption (1) approved test results should be positive, in sense of safety. The technical testers of the RDW gave the Electrically Propelled Trailer a good chance when the first assumption is achieved. According to the RDW it is almost impossible to prove the second assumption to be safer. When the Trailer has more weight than the car the trailer can tow the car from the road and this is very dangerous. The score for the first assumption is a 2 because when the tests are positive it can become road legal to drive with the Electrically Propelled Trailer. For the second assumption the score is a 4 because it is technically almost impossible to get this proven.

Validated or not

The first assumption is validated. It will take time to test the Electrically Propelled Trailer in a proper way. However, when the test results are positive the product can become road legal quite easy. The second assumption is not validated yet. Probable it is impossible to get this done, but tests have to demonstrate this.

8.2. Assumption 2: Starting Country

What to test

For the business case it is important to know in which countries the Electrically Propelled Trailer can be sold. In this paragraph will be tested which countries are possible countries to sell the product. In addition will be tested which country is best to start with. (Table 8.2)

Table 8.2 Overview of Assumption 2

What	How
Assumptions	<u>We believe that</u> The Netherlands is a good country to start with the introduction of the Electrically Propelled Trailer.
Method	<u>To verify that, we will</u> use numbers of the European Caravan Federation
Metric	<u>We will measure:</u> the amount of existing caravans in each country (and per inhabitant) and the number of new sold caravans in each country (and per inhabitant).
Criteria	<u>We are right if,</u> the Netherlands scores best on the score of caravan ownership and number of new sold caravans per inhabitant.
Assumptions tested	Customer Discovery 1 and Customer Validation 37

Result of the test

In Table 8.3 the number of new sold and existing caravans are shown. The new sold caravans are based on the numbers from the European Caravan Federation (2015). The five most promising numbers per column are bold. The five countries with the most new sold caravans are: France, Germany, Netherlands, Sweden and UK. The five countries with the most existing caravans are: France, Germany, Netherlands, Spain, and UK. In this study the number of new sold and existing caravans is compared with the number of inhabitants in the specific countries. The five countries with the highest number of new sold caravans per inhabitant are: Denmark, Netherlands, Norway, Sweden and UK. The five countries with the highest number of existing caravans per inhabitant are: Denmark, Finland, Netherlands, Norway and Sweden. Based on these numbers a new table is made. For each of the columns the countries are given a score between 0 and 100. The country with the lowest number scores a 0 and the country with the highest number scores a 100. The scores of the other countries are linear between the 0 and the 100 based on their numbers. For example the score for the Netherlands for the number of new sold caravans per year is calculated by: $((\text{Number of new sold caravans per year in the Netherlands} - \text{Number of new sold caravans in Portugal (lowest number)}) / (\text{number of new sold caravans in the UK (highest number)} - \text{number of new sold caravans in Portugal (lowest number)})) * 100$. So: $((5.785 - 100) / 23.000) * 100 = 25$. These scores are calculated for each of the four columns. When the scores of each of the four columns are added, the country score can be calculated. The country scores are shown in

Table 8.4.

Validated or not

Based on the country score it can be concluded that the best countries, in sense of number of new sold and existing caravans, to entre with the Electrically Propelled Trailer are: Denmark, France, Germany, Netherlands, Norway, Sweden and UK. The score of the Netherlands is rather high, 238. Only Germany and UK score slightly better. Because of the fact that the Electrically Propelled Trailer is a Dutch invention with Dutch inventors and because the score of the Netherlands is one of the highest scores the Netherlands is a good country to start with the introduction of the Electrically Propelled Trailer.

Table 8.3 Overview of caravan ownership and new sold caravans per EU country (European Caravan Federation, 2015)

Country	Number of new sold caravans per year	Number of existing caravans (x 1.000)	Number of inhabitants (x 1.000.000)	Number of new sold caravans per 1.000.000 inhabitants	Number of Existing caravans per 1000 inhabitants
Austria	817	36,5	8,6	95	4,2
Belgium	1.087	60,0	11,3	96	5,3
Denmark	2.297	141,0	5,7	403	24,7
Finland	597	67,7	5,5	109	12,3
France	7.920	845,0	66,4	119	12,7
Germany	18.795	880,0	81,3	231	10,8
Italy	922	59,3	60,9	15	1,0
Netherlands	5.785	462,0	16,9	342	27,3
Norway	2.597	80,0	5,2	499	15,4
Portugal	100	17,3	10,3	10	1,7
Slovenia	148	10,9	2,1	70	5,2
Spain	1.609	330,0	43,3	37	7,6
Sweden	3.167	281,3	9,8	323	28,7
Switzerland	1.806	34,5	8,3	218	4,2
UK	23.000	550,0	65,1	353	8,4
Other	1.549	41,2	450,9	3	0,1
Total	72.196	3.896,7	851,6	85	4,6

Table 8.4 Score table of caravan ownership and new sold caravans per EU country

Country	Number of new sold caravans per year	Number of existing caravans (x 1.000)	Number of new sold caravans per 1.000.000 inhabitants	Number of Existing caravans per 1000 inhabitants	Country score
Austria	3	3	17	12	35
Belgium	4	6	17	16	43
Denmark	10	15	79	86	189
Finland	2	6	20	41	69
France	34	95	22	42	193
Germany	82	99	44	36	260
Italy	4	6	1	0	10
Netherlands	25	51	67	95	238
Norway	11	8	98	52	169
Portugal	0	1	0	3	3
Slovenia	0	0	12	15	28
Spain	7	36	5	24	72
Sweden	13	31	63	100	207
Switzerland	7	3	42	11	63
UK	100	61	69	27	257

8.3. Assumption 3: Willingness to pay

What to test

Based on surveys will be tested in this paragraph what the willingness to pay is for an Electrically Propelled Trailer of people that own a caravan. (Table 8.3)

Table 8.5 Overview of Assumption 3

What	How
Assumptions	<u>We believe that</u> the willingness to pay for the Electrically Propelled Trailer is between the € 6.500 and the € 13.700
Method	<u>To verify that, we will use</u> the results of the Survey with 197 caravan-owners.
Metric	<u>We will measure:</u> the willingness to pay based on the sum of the following numbers: <ul style="list-style-type: none"> - Current paid price for the Mover - Willingness to pay for anti-swaying systems - Willingness to pay for driving easy in mountains - Willingness to pay to accelerate faster - Willingness to pay for a smaller car
Criteria	<u>We are right if,</u> the willingness to pay for the Electrically Propelled Trailer is at least is [REDACTED]
Assumptions tested	Customer Discovery 4 and Customer Validation 10, 15, 40

Result of the test

Based on the Survey the willingness to pay is defined. The willingness to pay is defined based on the sum of the following five factors: (1) current paid price for the Mover, (2) willingness to pay for anti-swaying systems, (3) willingness to pay for driving easy in mountains, (4) willingness to pay to accelerate faster and (5) willingness to pay for a smaller car. The average of the sum is [REDACTED]. [REDACTED] respondents did not fill in any of the 5 factors. When only the people

that filled in the questions about willingness to pay (at least 1) are taken into account the average willingness to pay for the Electrically Propelled Trailer is [REDACTED]. [REDACTED] of the 197 respondents are willing to pay more than €[REDACTED], this corresponds to [REDACTED]% of the respondents. [REDACTED] of the 197 respondents are willing to pay more than €[REDACTED]. In *Figure 8.2* the number of people for a category of willingness to pay is shown. There can be seen that [REDACTED] of the respondents are willing to pay more than [REDACTED] for the Electrically Propelled Trailer.

Figure 8.2 Willingness to pay for the Electrically Propelled Trailer

Validated or not

The average willingness to pay is less than the [REDACTED], however more than [REDACTED] of the caravan owners is willing to pay more than €[REDACTED]%. Therefore the assumption is validated.

8.4. Assumption 4: Amount of Sales

What to test

In chapter 6 assumptions are made on the % of caravan owners that is willing to buy the Electrically Propelled Trailer. In this paragraph the amount of sales is calculated based on the % of caravan owners that is willing to buy the Electrically Propelled Trailer. This percentage is validated in this paragraph based on the results of the Survey. (*Table 8.6*)

Table 8.6 Overview of Assumption 4

What	How
Assumptions	<u>We believe that</u> the Electrically Propelled Trailer can be sold [REDACTED] of the EU countries and that the market size is [REDACTED]5 Electrically Propelled Trailers per year.
Method	<u>To verify that, we will use</u> the sales numbers of the European Caravan Federation and the results of the Survey with 197 caravan owners.
Metric	<u>We will measure:</u> the amount of new sold caravans in different countries and use the % of caravan owners that is willing to pay more than [REDACTED] (Paragraph 8.3) to calculate the expected amount of sales.
Criteria	<u>We are right if,</u> the Electrically Propelled Trailer can be sold [REDACTED] of the EU countries and if the total amount of Electrically Propelled Trailers per year is more than [REDACTED]
Assumptions tested	Customer Validation 15 and 35

Result of the test

Countries with a country score higher than 100 in paragraph 8.2 are considered as countries with a market that is big enough. Countries with a score higher than 100 are: Denmark, France, Germany, The Netherlands, Norway, Sweden and UK. The total number of existing caravans in these countries is: 3.239.000, this is 83% of the caravans in Europe. The number of new sold caravans in these countries is: 63.561, this is 88% of the number of new sold caravans in Europe. The market that will be served is bigger than [REDACTED] of the EU market.

In paragraph 8.3 it is defined that [REDACTED] of the market is willing to pay more than [REDACTED] for the Electrically Propelled Trailer. There is assumed that in the beginning only people that buy a

new caravan are customers. This because the willingness to pay is composed from the willingness to pay of an anti-swaying system and the price that people paid for their Mover. When these people already own a Mover and an anti-swaying system the probability that they will buy an Electrically Propelled Trailer will drop. Therefore it is assumed to start with new sold caravans. █ of the market (█ new sold caravans in the selected countries per year) will lead to a potential market █ Electrically Propelled Trailers per year.

Validated or not

Both assumptions are validated. More than █% of the EU market is in the selected countries, namely 88% for new sold caravans and █% for existing caravans. In addition to that is the market for Electrically Propelled Trailers is much bigger than expected, █ per year instead of █.

8.5. Assumption 5: Distribution Channels; factories

What to test

Table 8.7 gives an overview of the assumption that is tested in this paragraph. In this paragraph is validated if the caravan factories are the right distribution channels.

Table 8.7 Overview of Assumption 5

What	How
Assumptions	<u>We believe that</u> the caravan factories are willing and able to install the Electrically Propelled Trailer system in their caravans.
Method	<u>To verify that, we will</u> conduct interviews with two caravan factories: KIP caravans and Adria.
Metric	<u>We will measure:</u> their interest in the product and the willing to implement the Electrically Propelled Trailer system in their caravans.
Criteria	<u>We are right if,</u> at least one of the factories is willing to implement the Electrically Propelled Trailer system in their caravans.
Assumptions tested	Customer Validation 1, 4 and 5

Result of the test

During the interviews with the caravan factories (KIP Caravans and Adria) the Minimal Viable Product of the Electrically Propelled Trailer was used to show its potential. KIP Caravans was very interested in the Electrically Propelled Trailer. In the past KIP was one of the most innovative caravan brands. Unfortunately the KIP factory went bankrupt in 2009. The current (new) owners of the KIP factory try to recover the innovative image. That is the reason they are interested to implement the Electrically Propelled Trailer system in their caravans. To demonstrate their interest they facilitate the E-trailer inventors with the development of the system. They provide advice and give admittance to their network. In addition they promised to buy the first Electrically Propelled Trailer systems when they are fully developed. According to Olivier Sikking (2016), Director and Owner of KIP caravans, KIP currently does not have the technical knowledge to implement an Electrically Propelled Trailer. However, in due time being trained by specialists the factory employees will be capable to implement a system like this. Seen through the eyes of Von Hippel (1988) KIP caravans can be labelled as a co-creator. This cooperation can have a high potential for the future.

Adria was not as enthusiastic as KIP caravans. Adria made clear that they only want to implement an Electrically Propelled Trailer when the product is finished and proven. This can

be explained by the problems they had in the past with innovative products. Adria is not a brand that wants to be innovative; they want to deliver good caravans for a fair price. In addition to that they stated that it might be a better to implement the Electrically Propelled Trailer system in the aftermarket, as is currently done with Movers and anti-swaying systems.

Validated or not

Based on the interview with KIP there is it a good option to install the Electrically Propelled Trailer in their caravans. This interest is mainly based on their interest in innovative products. The interest of Adria was almost zero. However, based on the interview with Adria it can be concluded that there is a potential to install the Electrically Propelled Trailer in the aftermarket. That is the reason why I will be explore in the next paragraph if there is a potential to install the system in the aftermarket through a retailer network. The assumption that the caravan factory will be the customer for the Electrically Propelled Trailer is partly validated. KIP is interested, but further research on the potential of the aftermarket is necessary.

8.6. Assumption 6: Distribution Channels; retailers

What to test

Table 8.8 shows the test for this paragraph. There is tested if the caravan retailers are the right distribution channels.

Table 8.8 Overview of Assumption 6

What	How
Assumptions	<u>We believe that</u> caravan retailers are willing to sell, install and maintain the Electrically Propelled Trailer.
Method	<u>To verify that, we will</u> conduct interviews with 9 caravan retailers in The Netherlands.
Metric	<u>We will measure:</u> the numbers of caravan retailers that are willing to sell, install and maintain the Electrically Propelled Trailer.
Criteria	<u>We are right if,</u> [redacted] of the retailers is willing to sell, install and maintain the Electrically Propelled Trailer.
Assumptions tested	Customer Validation 2, 7 and 8

Result of the test

During all the interviews with caravan retailers the Minimal Viable Product was used to show the possibilities of the Electrically Propelled Trailer. [redacted] of the eleven caravan retailers were very interested in the concept of the Electrically Propelled Trailer. In these interviews it became clear that the potential of the Electrically Propelled Trailer is big in the aftermarket. The caravan retailers install almost all add-ons in the aftermarket. The caravan retailers are currently not able to install an Electrically Propelled Trailer due to a lack in electronically knowledge. Sever out of the nine retailers agreed on the fact that the Electrically Propelled Trailer is the future and they were willing to invest in trainings to learn their employees how to install such a system. All interviewed retailers conduct the maintenance of the caravans that they sell. These retailers were also willing to conduct the maintenance for the Electrically Propelled Trailer.

Validated or not

The assumption is validated. The caravan retailers are willing to sell, implement and maintain the Electrically Propelled Trailer. The assumption was that minimal [redacted] of the retailers should be interested to do so, however based on the interviews with these retailers is shown [redacted]

8.7. Assumption 7: Intellectual Property

What to test

An Intellectual Property (IP) can be used to protect the Electrically Propelled Trailer technology. In this paragraph is tested if the IP is strong enough to protect the Electrically Propelled Trailer technology. (Table 8.9)

Table 8.9 Overview of Assumption 7

What	How
Assumptions	<u>We believe that</u> it is possible to file an intellectual property protection (IP) right for the Electrically Propelled Trailer and that this IP is strong enough to protect the technology.
Method	<u>To verify that, we will</u> apply for an IP at a patent lawyer.
Metric	<u>We will measure:</u> if it is possible to apply for the patent.
Criteria	<u>We are right if,</u> it is possible to apply the patent
Assumptions tested	Customer Validation 18, 19, 20

Result of the test

Following a research of the Patent Lawyer (Raimond Haan at Arnold + Siedsma Lawyers), conducted before the application for the IP for the Electrically Propelled Trailer, the chance that the IP will be filed is rather high. The IP is applied on the Measurement Unit for the Electrically Propelled Trailer. Two other big companies TNO (Dutch Organisation for Applied Scientific Research) and KNAUS (a big caravan factory) posted an article and a short movie about the potential of an Electrically Propelled Trailer (Knaus, 2010) (TNO, 2016). It was not possible to apply for a patent on the Electrically Propelled Trailer itself caused by the articles and the movie. The reason is that because of these articles the Electrically Propelled Trailer was already common knowledge. Therefore it is decided to apply for an IP on a specific technology that is applied in the Electrically Propelled Trailer; the measurement unit. Parts that could be used for a patent are the electrical motors, the batteries and the Measurement Unit. The IP is applied on the way this Unit measures the forces and/or acceleration between the towing vehicle and the trailer. In chapter 4.5 is explained how the Measurement Unit works. Based on the research by the Patent Lawyer no other patents on the measuring of force and acceleration of a trailer exists. In August 2016 the results of the novelty researches of the European Patent Office will be presented. Then we know with a higher certainty that the IP is novel and can be fulfilled. By then we have to decide in which countries in the world the IP should become active.

The IP for the Electrically Propelled Trailer is probably strong enough to hold. Other possible competitors will not be able to measure the right data to steer the electrical motors. Without these data it is impossible to steer the motors. The only option to steer the electrical motors is by measuring the forces in the car. This leads to two main disadvantages (1) people have to

change their car and (2) you can only use your own car to tow your trailer. Measurement Units in cars are currently used for Electrical Brake Systems, these systems are commonly used in the USA and Australia. People have to install a Measurement Unit in their car; this is placed on the dashboard. European people do not like these units attached to their car. This is the main reason why electrical brake systems are not implemented in the EU. (Saris, 2016 and Sikking, 2016) The second disadvantage is that you can only tow the Electrically Propelled Trailer with a car that has a Measurement Unit. You are no longer able to exchange Trailer and towing car freely.

Validated or not

The IP is applied. Based on the research by the IP office and own research on the IP status it was not possible to protect the whole concept of the Electrically Propelled Trailer. This assumption is not validated at first sight, however it was possible to apply for an IP on the Measurement Unit. This Measurement Unit will probably be novel and it will be possible to file the IP this year. The reaction on the novelty study of the EU Patent Office will be published in August 2016. Based on the study of the IP office and own study no other IPs are found that are infringed by the IP that is applied. It is assumed that the IP applied is strong, has a big potential and will block competitors. For this assumption the IP position for the IP that is applied is explored.

In this research is explored what the IP position for the existing IP is. No research is conducted on the other parts of the system. There is known that the measurement unit is known and that the chances are rather high that the IP will be approved. However, no IP research is conducted on the other parts of the Electrically Propelled Trailer: the electrical motors and the batteries. Further research should show if to IP rights of other IP owners is infringed.

8.8. Assumption 8: Target Group

What to test

In this paragraph will be tested what the characteristics are of the Electrically Propelled Caravan customer. Table 8.10 gives an overview of the characteristics that are validated (age and income).

Table 8.10 Overview of Assumption 8

What	How
Assumptions	We believe that people that show interest in the Electrically Propelled Trailer are people with a higher age (60+) and have a high income.
Method	To verify that, we will use the results of the survey with 197 caravan owners.
Metric	We will measure: the average age of people and the income of people with a willingness to pay above the [redacted]
Criteria	We are right if, [redacted]
Assumptions tested	Customer Validation 38, 39

Result of the test

In the survey the gross family income was asked. The numbers of respondents per income group are shown in Figure 8.3. In Figure 8.4 the age of the respondents is shown. The average

age of the respondents is [redacted] years old. It can be seen that [redacted] of the respondents have a gross income above the [redacted] per year.

Figure 8.3 Number of respondents per income group

Figure 8.4 Number of respondents per age group

The people that are willing to pay more than [redacted] are assumed as target group. (see paragraph 8.3) In Figure 8.5 and Figure 8.6 the number of respondents per age group and per income group with a willingness to pay above the [redacted] are shown. It is remarkable that 0 of the respondents in the highest income group (income > [redacted]) does belong to the target group. It is questionable if people with an income below the [redacted] can afford an expensive system like the Electrically Propelled Trailer. In matter of income the target income group are people with an income between the [redacted] and [redacted]. The best age group to target are people with an age of [redacted] year and older.

Figure 8.5 Respondents per income group with willingness to pay above € 6.500

Figure 8.6 Respondents per age group with willingness to pay above € 6.500

Validated or not

The assumption on the income group is not validated. This is not a direct problem, only the target customer focus should slightly be changed. The assumption about the age of people in the target group is validated.

8.9. Assumption 9: Installation Costs

What to test

To define the right cost price of the product it is important to define the installation costs of the product. Therefore different technical employees of caravan factories and retailers are interviewed. The test for this assumption is shown in *Table 8.11*.

Table 8.11 Overview of Assumption 9

What	How
Assumptions	<u>We believe that</u> the margin for the caravan factory and the caravan retailer is approximately [redacted] and that the installation costs are approximately [redacted] hours at a labor rate of €50 per hour.
Method	<u>To verify that, we will</u> interview two caravan factories and 9 caravan retailers
Metric	<u>We will measure:</u> the margins of the different parties in the distribution channel and the installation costs.
Criteria	<u>We are right if,</u> the margins are below [redacted] and if the installation costs are below the [redacted] per Electrically Propelled Trailer.
Assumptions tested	Customer Validation 12 and 13

Result of the test

Based on the interview with the Adria caravan factory no margins and installation costs are distinguished because this factory was not interested in the concept and was not willing to share this information. Based on the interviews with KIP both the installation time and costs sound reasonable. The margin KIP makes on their products is between the [REDACTED]%, depending on the product. Difficult and cheap products mostly have high margins. Following Sicking (2016) is a margin of [REDACTED] reasonable.

Not all caravan retailers were willing to show their margins. Only [REDACTED] out of the 9 confirmed their margins. These margins were mostly between [REDACTED]%. The statement that difficult and cheap products have a higher margin was confirmed. Following the interviewed retailers a margin of 20% was reasonable. Seven out of the eleven retailers agreed on the installation method and agreed on the fact that it would [REDACTED] hours. The labour rate was quite different between the retailers. Most of the retailers had a labour rate between [REDACTED] [REDACTED]. It can be concluded that a rate of € 50 per hour is reasonable.

Validated or not

The assumptions on the margins for the caravan factories and the caravan retailers are validated. The assumption on the installation time also. The assumption on the labour rate to install the Electrically Propelled Trailer system in caravans is validated as well. We should be aware that the labour rate might be slightly higher.

8.10. Assumption 10: Motor Size and Price

What to test

Table 8.12 shows the assumption about the motor size and price. In this paragraph is validated what the right motor size and price will be. This is important to know because approximately [REDACTED] of the cost price of the Electrically Propelled Trailer is based on the cost of the motors.

Table 8.12 Overview of Assumption 10

What	How
Assumptions	We believe that the motor size should be [REDACTED]
Method	To verify that, we will recalculate the motor size based on tests with the Minimal Viable product and collect offers of different electrical motor factories.
Metric	We will measure: the size and price of the motors
Criteria	We are right if, the motor size for a [REDACTED]
Assumptions tested	Customer Validation 30, and 32

Result of the test

Based on tests with the Minimal Viable Product (MVP) it is shown that a motor with a power of [REDACTED] is enough to deliver all functions. The MVP is used to test all scenarios in real life. For each scenario it is tested what the minimal motor size should be to deliver the functions for each of the scenarios. In these tests is proven that the motor size can be approximately [REDACTED] lower than assumed. This is mainly caused by the fact that the car still had extra power to tow the trailer. The Electrically Propelled Trailer only assist the car when the car insufficient towing

power. So, the extra available power in the car lead to the fact that the motors in the trailer can be smaller.

In addition to this new motor size more offers are requested at motor factories. These offers can be more specific because of the knowledge from the MVP. We have an offer from [REDACTED] when [REDACTED] motors are bought at once.

Validated or not

The motor size can be smaller than first expected; namely [REDACTED]. These motors are cheaper than the motors in the first calculations, namely [REDACTED]. The assumptions are validated.

8.11. Assumption 11: Battery Size and Price

What to test

Table 8.12 shows the assumption about the battery size and price. In this paragraph is validated what the right motor size and price will be. This is important to know because approximately 40% of the cost price of the Electrically Propelled Trailer is based on the costs of the batteries.

Table 8.13 Overview of Assumption 11

What	How
Assumptions	We believe that the battery size should be [REDACTED]
Method	To verify that, we will recalculate the battery size based on tests with the Minimal Viable Product and collect offers of different electrical motor factories.
Metric	We will measure: the size and price of the batteries
Criteria	We are right if, the battery size for a [REDACTED]
Assumptions tested	Customer Validation 31, and 33

Result of the test

Based on the results of the tests with the MVP it is concluded that a battery of [REDACTED] is big. This has two reasons, (1) the size of the motors had become smaller, so the size of the batteries can also be smaller and (2) the car can deliver more power than expected. Based on the research with the MVP a battery size [REDACTED] is enough to deliver the requested functions for the scenarios.

In addition to the new battery size more specific offers at the battery factories are requested. The offers can be made more specific based on the knowledge from the MVP. We chose to for lithium ion batteries because these are the lightest batteries and because these batteries have the same charge and uncharged powers. This is necessary to charge the batteries when the trailer brakes. An offer for a lithium ion battery with the required size is received for [REDACTED]

Validated or not

The battery size can be smaller than expected at first, namely [REDACTED]. These batteries are cheaper than the batteries in the first calculations, namely [REDACTED] for a battery. The assumptions are validated.

8.12. Assumption 12: Profitability

What to test

The research question of this research is “How can the feasibility of the market introduction of the Electrically Propelled Trailer be judged and which market has the best potential?”. To define the potential of a market the profitability plays an important role. In this paragraph is validated what the profitability of the business case can be. (Table 8.14)

Table 8.14 Overview of Assumption 12

What	How
Assumptions	<u>We believe that</u> the cost price for the Electrically Propelled Trailer is below the willingness to pay of [REDACTED]. Based on the cost price it is possible to build a sustainable business.
Method	<u>To verify that, we will</u> recalculate the cost price of the product
Metric	<u>We will measure:</u> the cost price and the potential net profit.
Criteria	<u>We are right if,</u> the cost price of the Electrically Propelled Trailer is below th [REDACTED]
Assumptions tested	Customer Validation 34, and 36

Result of the test

In Table 8.15 the gross margin is calculated. The gross margin is calculated based on the cost price calculation in chapter 6.5. The difference between this calculation and the calculation in the chapter 6.5 is that the validated assumptions are processed. The caravan manufacturer is not taken into account in this model because it is chosen to deliver the Electrically Propelled Trailer directly to the caravan retailers. The installation costs are set on [REDACTED]. The price of other parts such as cable, sensors, shell, board computer etc. is assumed [REDACTED]. Based on the new battery and motors prices that are validated in chapter 8.9 and 8.10 a gross margin [REDACTED] per Electrically Propelled Trailer can be calculated (Table 8.15).

Table 8.15 Gross margin for the Electrically Propelled Caravan

What?	Margin in %	Price
Willingness to pay caravan owner		[REDACTED]
VAT	[REDACTED]	[REDACTED] -/-
Price ex VAT		[REDACTED]
Margin caravan retailer	[REDACTED]	[REDACTED]
Installation costs		[REDACTED] -/-
Purchase price caravan retailer		[REDACTED]
Price motors		[REDACTED]
Price battery		[REDACTED]
Price other parts		[REDACTED] -/-
Gross margin		[REDACTED]

The total market for the EU is estimated at [REDACTED] Electrically Propelled Trailers per year as is shown in paragraph 8.4). A total gross margin per year can be made of [REDACTED] per year.

Costs that are included in the business are marketing and sales costs, salaries for factory employees of the Electrically Propelled Trailer business, engineers to update the Electrically Propelled Trailer, rent of the office etc.

Assumed is that there [redacted] employees needed. In addition to that it is assumed that the sales employees need [redacted] with a retailer before they sell the Electrically Propelled Trailer. For each meeting a time of [redacted] is reserved (travel time + preparation time and the meeting itself). This leads [redacted] per retailer. When a success rate of [redacted]% is assumed (so [redacted] of the sales meetings will really lead to sales) [redacted] hours of sale time to sell to one retailer. In the Netherlands there are 157 caravan retailers (Caravans, 2016). The potential market in the Netherlands is [redacted] % of the market). This means on average [redacted] Electrically Propelled Trailers per retailer. Assumed is that only the bigger retailers will be served. This leads to [redacted] Electrically Propelled Trailers per retailer per year. A labour rate for sales people is assumed at € [redacted] per hour. So, the costs of sales for an Electrically Propelled Trailer are [redacted] per year ([redacted] per year / [redacted] retailer). For the marketing [redacted] employees are assumed with an employee cost of [redacted]. This leads [redacted] per year. In addition to that a marketing budget of [redacted] is needed to attend expos and publish advertisements in meaningful magazines and on social media.

Assumed is that [redacted] are needed to pack Electrically Propelled Trailer. A labour rate (including social security) of [redacted] per hour is assumed. This will lead to yearly costs of [redacted]

Four engineers are assumed to update the product and to build new products. The salary costs are assumed at [redacted] per year. This leads to € [redacted] per year on engineering employee salaries. A budget of [redacted] is added to buy test products.

An office can be rented for around [redacted] per square meter. An office of [redacted] square meter is assumed. This will lead to rental costs of [redacted] per year.

All mentioned costs are shown in *Table 8.16*. The assumptions and figures in the previous assumptions are based on the experiences of KIP caravans. These costs are added with [redacted] for other costs, like accounting, juridical advice, representation etc. This makes the net profit potential for the company: [redacted]. Overhead costs per product will be approximately [redacted]. The potential profit seems to be big enough to build a stable and profitable business.

Table 8.16 Forecast of the net profit for the Electrically Propelled Trailer

Gross profit	[redacted]	
Sales costs		[redacted]
Marketing costs		[redacted]
Package costs		[redacted]
Engineering costs		[redacted]
Rent		[redacted] +
Total overhead costs	[redacted]	
Other costs	[redacted]	-/-
Net profit	[redacted]	

Validated or not

The business can become a profitable business. The costs price of the product is below the willingness to pay of people. The gross margin per product will be [REDACTED] euro. The net profit margin on each sold Electrically Propelled Trailer will be approximately [REDACTED], based on the assumptions.

8.13. Assumption 13: Investments Needed

What to test

The last assumption that is tested is the assumption about the investment that is needed. In this paragraph will be validated what the size of this investment is. (Table 8.17)

Table 8.17 Overview of Assumption 13

What	How
Assumptions	<u>We believe that</u> an investment [REDACTED] is enough to kick off the business.
Method	<u>To verify that, we will</u> calculate which costs should be made to sell the first Electrically Propelled Trailer.
Metric	<u>We will measure:</u> investments needed.
Criteria	<u>We are right if,</u> the investment needed is below the [REDACTED]
Assumptions tested	Customer Validation 21, 22, 23

Result of the test

In

Table 8.18 an overview of all the costs needed to start the business are given. The RDW (Meurs, 2016) approximates the testing costs at [REDACTED]. To finish the product [REDACTED] months of engineering and testing are necessary. Salaries for the two founders and for [REDACTED] [REDACTED] After [REDACTED] the marketing becomes more and more important to get the first sales done. Therefore a marketing employee is calculated for [REDACTED] onths. For the overhead the costs for the prototype are calculated, which will be used for tests. Also an office will be rented and transport costs are involved. In addition there are costs for marketing (f.i website, flyers, stand Caravan Expo). For other expenses a reservation of [REDACTED] is made. The total amount of money necessary to get the Electrically Propelled Trailer to the market is [REDACTED]. During the research two investors showed interest in the Electrically Propelled Trailer. One of them is one of the biggest suppliers of movers in Europe. The other one is the biggest trailer factory in Canada, Africa and Australia. Conversations with both companies currently take place to see if they can fund the investment. When one (or both) of the parties is willing to invest in the project the Electrically Propelled Trailer can be produced to get it to the market. With the trailer factory a MOU is signed already.

Table 8.18 Investments needed to get the Electrically Propelled Trailer to the market

What	Amount	Costs per month	Number of months	Fixed costs	Total costs
RDW					
Employees					
Overhead					
Other					
Total					

Validated or not

The assumption is not validated, the investment costs are approximately € [redacted] higher than assumed. However, this forecast of the costs is based on several assumptions. Probably it is possible to finish the product with an investment [redacted].

8.14. Validation: Conclusions

Almost all assumptions are validated and therefore it can be concluded that there is a strong business potential for the Electrically Propelled Trailer. Advised is to start as quickly as possible with the tests with the RDW. Which tests should be conducted and on which criteria the results of the tests will be reviewed is not known yet. This should be defined in a later stage. The market is bigger than thought on first sight. The willingness to pay was slightly lower, but high enough to create a reasonable business case. A change in the business model can be that the retailers are able and willing to install the Electrically Propelled Trailer instead of the factories. This makes the distribution channels quite different. However also caravan factories are interested in the system. A lower price can be achieved when the system is installed at the factory. More research is necessary to distinguish what the best strategy is for the distribution channels. The chance that the IP protection is good enough is rather high. However, the IP is only applied on the Measurement Unit. No research is conducted yet on the fact if other technological parts of the Electrically Propelled Trailer infringe other IPs. This research should be conducted in a later Phase. The target group is clearer now, although detailed information of the target group is not available; this should be explored further. Different offers of battery and motor factories were requested to define the cost price of the product. This information was enough to define the cost price of the system. In the future these batteries and motors should be ordered in order to test the quality of the products. The business opportunity is high; a good margin can be made on the Electrically Propelled Trailer. However a quite large investment is still needed to finance the project. It is very important for the project to find an investor. There can be focussed on the two companies that are currently very interested to invest in the Electrically Propelled Trailer.

9. Conclusion and Discussion

In the introduction of this thesis I started with the substantiated statement that there is a need for a safer, more sustainable and more user-friendly transportation sector. High tech innovations are promising to contribute to this need. However it is often complicated to get these (innovating) technologies to the market. Needless to say that when there is no business case, the innovation will not make it to a real product. My co-founder, Rick Lenssen and I, Boy Trip, invented a technical innovation for the transport sector: the Electrically Propelled Trailer (business name E-Trailer). This trailer has several advantages: it is more sustainable, it gives more road safety and it is user-friendly.

This thesis describes the research undertaken on the process of judging the business case for the Electrically Propelled Trailer. To define feasibility a *Market Selection and Feasibility Framework (MSFF) for start-ups* is developed to describe the process necessary to test the feasibility of the E-Trailer business case. The research question of the research is:

How can the feasibility of the market introduction of the Electrically Propelled Trailer be judged and which market has the best potential?

9.1. Conclusions of the research

9.1.1. Market Selection and Feasibility Framework

The first sub question stated in this research was to find a useful method to assess a business case for a technology based innovation. In this research the focus is on start-ups. A start-up is a promising and flexible way trying to bring a new technology to the market. In research for an answer to this question several books on starting-up a business are analysed. The books are: Lean Start-up – Erik Ries (2011), The Start-up Owner’s Manual – Blank & Dorf (2012), Disciplined Entrepreneurship – Aulet (2013), Value Proposition Design – Osterwalder et al. (2015) and The Sources of Innovation – Eric von Hippel (1988). All books describe a method to get from a technology idea into a scaled business. Some books are more focused on the start of a business, others on more on the validation and others on customers and first sales. Having studied these various methods I concluded that no book presented me an integral method on how to get from a technological idea to a feasible business. Therefore I designed a new Model, I called it “*Market Selection and Feasibility Framework (MSFF) for start-ups*” that describes the eight Phases that should be followed. These eight Phases are: (1) technological idea, (2) market selection, (3) Customer Discovery, (4) minimal viable product, (5) Customer Validation, (6) prototype, (7) first sales and (8) growth. *The MSFF* is used in this research to define the market potential for the Electrically Propelled Trailer. *The MSFF* could be validated applying it to the business case E-Trailer.

9.1.2. MSFF Phase 1: Technological Idea

In this first Phase the second sub-question on the technology of the Electrically Propelled Trailer is answered. The Electrically Propelled Trailer is a trailer with two electrical motors, a battery package and a measurement unit added. The installation of an electrically propelled system in a trailer leads to 5 main advantages, (1) decrease of fuel consumption (2) easy driving in the mountains, (3) better acceleration, (4) decreasing swaying movement and (5)

remote control to steer the trailer at the final destination. Six scenarios are described to define the necessary size of the batteries and the electrical motors: (1) driving with a constant speed, (2) accelerate from 0 to 90 km/h, (3) driving with a constant speed (54 km/h) uphill, (4) mover function, (5) stabilizing and (6) driving downhill. Calculations indicate that the size of the batteries and the electrical motors are linear with the weight of the trailer. The power (in W) of the electrical motor is roughly [REDACTED] times the weight (in kg) of the trailer. The size (in Wh) of the batteries is roughly [REDACTED] times the mass (in kg). For the first scenario more battery power is needed than for the [REDACTED]. If [REDACTED] is not included the size of the battery (Wh) it is sufficient to multiply the mass (in kg) [REDACTED]). Therefore two types of Electrically Propelled Trailers are distinguished: (1) an Electrically Propelled Trailer that supports the towing vehicle during the entire journey and (2) an Electrically Propelled Trailer that supports the trailer only during the moments where the power of the towing vehicle is not sufficient.

The price of the electrical motors can be calculated with the formula: [REDACTED]
[REDACTED] The price of the batteries can be calculated by the formula: price of the [REDACTED] Based on these formulas and the formulas used to calculate the size of the batteries and motors, estimation can be made on the cost- and sales price of an Electrically Propelled Trailer.

9.1.3. MSFF Phase 2: Market Selection

The second Phase of *The MSFF* is focussed on the investigation of the most suitable market for the Electrically Propelled Trailer. This Phase matches with the third sub-question of the research: which market is the most suitable for the technology of the Electrically Propelled Trailer? Six different markets in three categories are distinguished: (Category 1) normal trailers (< 3.500 kg) consisting of (A) utility trailers and (B) horse and boat trailers, (Category 2) Special trailers (< 3.500 kg) consisting of (C) caravans and (D) refrigerator trailers and (Category 3) heavy trailers (> 3.500 kg) consisting of (E) heavy regular trailers and (F) heavy refrigerator trailers. These markets are analysed by using 6 criteria: (1) market size, (2) market growth, (3) willingness to pay, (4) cost price, (5) competition and (6) investments needed. Based on the research on the 6 markets and the results on the 6 criteria the Electrically Propelled Trailer turned out to be the most suitable for the utility trailer and the caravan market. I chose to explore the caravan market further (and not the utility trailer market) because the caravan market had the highest scores in the research due to its slightly better Value Proposition and because the caravan market is more a gadget market.

9.1.4. MSFF Phase 3: Customer Discovery

To get a better understanding of the caravan market interviews with 28 caravan owners were conducted. In addition I also did a survey with 197 caravan owners. The data collected in the survey and the interviews were used to define whether the Electrically Propelled Trailer had a good Value Proposition in the caravan market. The Value Proposition was based on several assumptions; with the collected data these assumptions were tested. All assumption for the caravan market were formulated in this chapter and tested in this 3rd Phase and in Phase 5: Customer Validation. To decide which assumptions had to be considered important for the business case research I designed a second new Model. This Model makes the impact of an assumption on the business case clear and transparent. The Model makes it easier to define

which assumption should definitely be tested and which assumption can wait. Based on this model the most impact full assumptions were selected and tested. These assumptions were assumptions about (1) the combination of the car and the caravan, (2) driving uphill, (3) problems with the swaying movement of the caravan, (4) fuel expenses and (5) mover ownership. Based on the results of the interviews and the survey 4 of the 5 assumptions were validated. These were (1) For the car-caravan combination is proven that people buy their car specially for their caravan (■■■■% of the caravan owners do so). (2) ■■■■ of the respondents is willing to pay more than ■■■■ to solve their problem with driving their caravan in the mountains. (3) ■■■■ of the caravan owners is willing to pay more than ■■■■ for a system that decreases the chances for swaying movement. (5) ■■■■ of the caravan owners paid more than ■■■■ for their mover. Only the assumption about the fuel expenses (4) ■■■■■■■■■■. It was assumed that people were worried about their fuel expenses when towing a caravan. Actually they did not care about their fuel expenses because the amount of extra fuel per holiday was not very big. Despite this invalidated assumption, is decided that the Value Proposition was strong enough to explore the business case for the Electrically Propelled Trailer further. Therefore a Minimal Viable Product (MVP) (MSFF Phase 4) was built to show the potential of the Electrically Propelled Trailer. In addition is decided that it was useful to explore the future customer in the fifth Phase: the Customer Validation.

9.1.5. MSFF Phase 5: Customer Validation

In this phase the last sub-question about the potential of the market is answered. The assumptions were tested based on the survey with 197 caravan-owners and 19 interviews with important people in the caravan branch. During the interviews the MVP is used to show the potential of the Electrically Propelled Trailer. The assumptions tested in this Phase were: (1) the legality on the road (2) starting country, (3) willingness to pay, (4) amount of sales, (5) distribution channels, (6) intellectual property, (7) target group, (8) installation costs, (9) motor size and price, (10) battery size and price, (11) profitability and (12) investments needed. Only 1 out of the 12 assumptions tested in this Phase was not validated.

(1) It is possible to get the Electrically Propelled Trailer road legal, but it has to be proven that the system is more safe than the current available system. (2) Based on our research The Netherlands is considered to be good country to start with the sales of the Electrically Propelled Trailer. Other interesting countries were: Denmark, France, Germany, Norway, Sweden and UK. (3) ■■■■ of the caravan-owners is willing to pay more than ■■■■,- for the Electrically Propelled Trailer (4) It is expected possible to sell ■■■■ Electrically Propelled Caravans per year throughout Europe in the future. (5) The Electrically Propelled Trailer can be distributed via retailers and via the caravan-factories. Further research should turn out what the best distribution channel is. Nine out of the eleven retailers that were interviewed were interested to sell and install the Electrically Propelled Trailer. Both, the factories and the retailers were able to install and maintain the Electrically Propelled Trailer. (6) The result of the research of the European Patent Office will follow later this year. The outcome of this research will show the strength of the intellectual property. (7) The assumption about the target group was not validated: people with a willingness to pay above the ■■■■ were mainly people with a yearly gross income between ■■■■■■■■■■. More people with an income above the ■■■■ were expected. It is not a problem that this assumption is not validated. The

people with a willingness to pay above the [REDACTED] were mainly people with an age above the 61. (8) The installation costs for the Electrically Propelled Trailer are between the [REDACTED] and the € [REDACTED] 9 & 10) Both the batteries and the motors can be smaller than was calculated. The tests with the MVP showed that these smaller batteries and motors have sufficient power to deliver the needs for the Value Proposition. Smaller battery and motor power will decrease the cost price of the product. This lower price will make the profitability of the project better. (11) Based on the assumptions used in the research the net profit of the product will be [REDACTED]. Based on a sales level of [REDACTED] Electrically Propelled Trailers per year, the total potential net profit is between the [REDACTED] (12) The investments needed to finalize the product and get it to the market is approximately € [REDACTED].

9.1.6. General Conclusion

A new model called *Market Selection and Feasibility Framework (MSFF) for start-ups* was developed to assess the feasibility of the Electrically Propelled Trailer. This Framework consisted of 8 steps. Five of the eight steps were applied to the E-Trailer business case to define the potential of the market. Within the *MSFF* a selection model is developed to select the most suitable market. In addition a second new Model is designed that can be used to define which assumptions are more important than others and should be tested first.

Based on the *MSFF* is explored what the Electrically Propelled Trailer is (Phase 1). Then the caravan market is selected as the most suitable market (Phase 2). In Phase 3,4 and 5 the feasibility of the market introduction is tested. The caravan market has a strong potential and has the possibility to become a profitable market for the Electrically Propelled Trailer. The future will show whether the expectations about the Electrically Propelled Trailer in the caravan market will come true.

9.2. Recommendations for further research

Several recommendations for further research can be given. This research was the first research in the field of Electrically Propelled Trailers. Much further research can be conducted on this topic.

9.2.1. The Framework

The first recommendation for further research is on the new developed Framework (*MSFF*). This Framework is only tested on one business case: the Electrically Propelled Trailer. The *MSFF* has shown a strong potential in this case. To prove if the *MSFF* is also applicable to other cases, more cases should be tested.

In this research only the first five steps of the *MSFF* are applied on a realistic business case. The last three phases are not applied because this was not within the focus of the research. Further research should define in more depth what the content of the last 3 Phases should be.

As a part of the *MSFF* a method is developed to select a specific market. This tool should be tested further to define if the six selected criteria are suitable enough. For the market selection two key points can be explored further. (1) Lots of start-ups went through the process of market selection and pivoted after a while to another market because the market they

initially chose was not suitable enough. Research can be conducted on how start-ups select their starting market and what criteria they use to decide to change their market. Based on the experience of these start-ups can be defined what a suitable market selection method can be. (2) Besides this research it can be important to involve uncertainty in the selection model. Currently the model only shows hard facts. However, a sensitivity analysis can be added to the market selection to see what the key factors are.

In addition a method is developed to rank the assumptions. In this research the selection method was a good method to get a clear overview of the assumptions and to see which assumptions should be tested first. Based on the use of the selection method in this research I advise to combine the IP and the legal category to 1 legal category. A more in-depth research on this tool can prove the potential of the tool. Therefore the tool should be tested on more business cases.

9.2.2. The Electrically Propelled Trailer

The next recommendation for further research is on the validation of the business case of the Electrically Propelled Trailer. In this research is shown that there is a good business potential for the Electrically Propelled Trailer. Further research on market introduction is necessary to define how the product can be marketed. This will (hopefully) lead to the first sales. As stated by Ries (2011) and Blank & Dorf (2012) sales are the best way to prove the business model.

In this research only the business potential of the caravan market is explored. More in depth research should be conducted to define the potential of the other possible markets. The same methodology can be used to define the potential of these remaining markets.

Only some small real life test cases are conducted with the available Minimal Viable Product. To prove the potential of the Electrically Propelled Trailer more tests should be conducted. These tests can prove the extra safety, the fuel savings and the extra user-friendliness.

In this research is assumed that the extra safety and the help of the Electrically Propelled Trailer during acceleration and in the mountains will lead to a better user experience. Further research can show if and how much the customer rating increases when using an Electrically Propelled Trailer instead of a regular trailer.

This research was the first research in the field of Electrically Propelled Trailers. This was a start to show the potential of the innovation. Much more research can be conducted on all parts of the Electrically Propelled Trailer, on technical but also on market aspects.

The last point that could be explored is the IP position. The research of the European patent office will prove if the IP of the measurement unit will not infringe other IPs. However a research should be conducted if the other parts of the Electrically Propelled Trailer (electrical motors and batteries) do not infringe IPs of other IP owners.

9.2.3. The Market Introduction

This study shows that there is a profitable business case and that there is a good market potential for the Electrically Propelled Trailer. To get the product to the market, it is important to get the approval of the Dutch Road Authority (RDW). The focus should be on conducting the tests at the RDW. To conduct the right tests it is also important to finish the product technically. The current MVP is not good enough to conduct all tests at the RDW. To finance the tests with the RDW and to finance the ongoing development of the Trailer an investor

should be found to finance this development phase. We have to explore if the investors that are currently interested are really willing to fund the project. It is also important to explore the distribution channels and the customer specifications. It is not clear yet if the best way to sell the Electrically Propelled Trailer is via retailers or via caravan factories. Also there is not enough data available on the characteristics of the customer. More data have to be collected to conduct a focussed marketing campaign. When the development of the product can be continued and it is known when the approval of the RDW will come it is important to start with the pre-sales of the product as quick as possible.

9.3. Research limitations and discussion

9.3.1. Limitations

Following Ries (2011) and Blank & Dorf (2012) the best way to prove a business case is by selling the product. A limitation of this research is that no efforts are done yet to sell the product. A limitation of *the MSFF* is that the first sales (Phase 7) are made after the development of the prototype (Phase 6). Since the product development time and the time to get the product approved by the Road Authority is long, we chose not to sell the product yet. Preselling the product could have been an option, but the time between pre-order and delivery is quite long; the customer probably will become impatient.

Another limitation of this research is that the *MSFF* is only tested on one case. No real conclusions can be drawn based on one case. Although the *MSFF* did fit well to this business case it is not proved that the *MSFF* will work with other business cases as well. In addition: experts in the field did not validate the *MSFF*.

A different limitation of this research is that the interviews with the caravan-owners as well as the survey are conducted at a Caravan Expo. It is possible that people visiting such an Expo are not representative for the average caravan-owner. Maybe it would have been better to conduct a part of the interviews on different sites such as camping's. The interviews with caravan-factories and caravan-distributors were conducted with people willing to listen to the story. Probably these people were already interested in the Electrically Propelled Trailer. This could have had an influence on the results. For the interviews and the survey only Dutch respondents were questioned. These data were extrapolated to the rest of Europe. It is possible that these conclusions were deviated.

Not all assumptions were tested in this research. Only the most important assumptions were tested according to the new developed selection method. Maybe we missed some assumptions using this selection method.

This was the first study in the field of Electrically Propelled Trailers. Therefore technological assumptions were made. No technical data were available about the results and the effects of the Electrically Propelled Trailer. Therefore it is hard to draw conclusions about the advantages of the Electrically Propelled Trailer.

The last limitation of the research is that it is a market study. It is always hard to predict the choices of people in the future based on the results of a research. The future will show if this study was right or not.

9.3.2. Discussion

The developed *Framework* (MSFF) has shown a strong potential in this research. First of all the *MSFF* was useful to get a better understanding of the technology. In the Market Selection Phase it was difficult because the technology has to be slightly different for each of the markets. The 6 market selection criteria were useful, however more focus on the Value Proposition can be implemented in the model. *The Selection Model* I developed to structure the assumptions was very useful. In this research the researcher ranked the assumptions. Maybe it is better to rank the assumptions together with people in the chosen market. The way in which the assumptions were tested was effective; talking to people in the market does increase the network but also learned us a lot about the customer needs.

The potential of the Electrically Propelled Trailer is proven in this research. The best market to start is the caravan market. However, the utility trailer market is still an option that should be explored further. The potential shown in this research is based on assumptions and on extrapolation. The most impact-full assumptions were tested, however it remains difficult to predict the market potential.

The MSFF is mostly applicable on technology-based start-ups, because a difference is made between MVP and MVBP. For hardware start-ups most of the time it is difficult to produce salable product in the first phase. Most of the start-up theories have a lack in this because these theories focus on software start-ups. With the MSFF I tried to overcome this limitation. Based on the application of the MSFF on the E-Trailer case I conclude that the model is very useful for start-ups. I can recommend people with an innovative technology idea that want to start their own start-up to use the Framework to test the business potential for their idea. In a maximum of 6 months you can conclude if there is a business case for the technology. If so, just start! If not, you saved a lot of time and money you can invest in another business idea.

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Appendix A: Flyer

In this appendix the flyer that is used as the MVP is shown. *Figure A.* shows the flyer. This flyer is used in all interviews with potential customers and experts in the field to quickly explain the Electrically Propelled Trailer.

Wat is E-Trailer?

De techniek van het E-Trailer systeem komt voort uit onderzoeken bij de Technische Universiteit Delft en is gebruikt in de snelste zonneauto van het Nuon Solar Team. E-Trailer bestaat uit twee in de wielen ingebouwde elektromotoren, innovatieve lichtgewicht batterijen met lithium-ion technologie en een slim aansturingssysteem. E-Trailer weegt zelf maar 60 kg.

Wat doet E-Trailer?

E-Trailer maakt de caravan elektrisch aangedreven en lost een aantal problemen van het caravan rijden op. Het beperkte trekvermogen van de moderne energiezuinige auto is bijvoorbeeld geen probleem meer. E-Trailer maakt gebruik van ingebouwde elektromotoren en batterijen die voldoende sterk zijn om de hoogste bergen van Europa te bedwingen. Bij het omhoog rijden assisteert E-Trailer de auto met extra vermogen, bij het omlaag rijden worden de batterijen opgeladen. Daarnaast stabiliseert het systeem de caravan zodat scharen onmogelijk wordt. Eenmaal aangekomen op de plaats van bestemming wordt het manoeuvreren eenvoudig omdat gebruik gemaakt wordt van het vermogen van de E-Trailer. Een mover is niet meer nodig. Kortom: E-Trailer maakt het caravan rijden makkelijker, veiliger en goedkoper.

Waarom E-Trailer?

E-Trailer is de grote innovatie voor de caravanrijder. Met een ingebouwde E-Trailer kunt u de caravan trekken met elke auto, ook de moderne en energiezuinige typen. Het caravan rijden wordt aanzienlijk veiliger, voordeliger en makkelijker. E-Trailer wordt geïnstalleerd door uw eigen onderhoudsmonteur en is voor de caravanrijder zeer eenvoudig in gebruik. De krachtige batterijen van het E-Trailer systeem zijn ook te gebruiken voor de elektriciteitsvoorziening in de caravan.



E-TRAILER

Comfortabeler caravan rijden

Het E-Trailer systeem verhoogt uw comfort en draagt daardoor bij aan een prettige en ontspannen reis. Met E-Trailer komt u sneller, veiliger en goedkoper aan op uw eindbestemming.



We wensen u een ontspannen reis... en een fijne vakantie!

Heeft u vragen over het E-Trailer systeem? Neemt u dan contact met ons op.

E-Trailer
Molengraafsingel 12
2629 JD Delft

+31 (0) 6 45 61 21 99
info@e-trailer.nl
www.e-trailer.nl

E-Trailer partners:



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E-Trailer: Maakt uw caravan elektrisch aangedreven

Met een in uw caravan ingebouwde E-Trailer gaat u makkelijker, veiliger en goedkoper rijden!



E-TRAILER



E-TRAILER

Geïnteresseerd?

Bent u geïnteresseerd in een veilige, brandstofbesparende caravan die u en uw auto ook tijdens het rijden ondersteunt? Gaat u de volgende keer met een E-Trailer op reis? Neemt u contact met ons op voor nadere informatie en het bespreken van de mogelijkheden.



Blijf op de hoogte van E-Trailer!

Wilt u op de hoogte blijven van alle ontwikkelingen, zoals wanneer de eerste E-Trailer besteld kan worden? Of bent u de eerste die een test rit maakt met de E-Trailer? Meldt u zich dan aan voor onze nieuwsbrief en ontvang 1 keer per kwartaal alle nieuwe E-Trailer fetten!

www.E-Trailer.nl/nieuwsbrief

N naast de nieuwsbrief, kunt ons ook volgen via social media!

 @E_Trailer  Facebook.com/yourE.Trailer
 E-Trailer.nl  LinkedIn.com/company/e-trailer

Vijf E-Trailer voordelen

Gaat u graag op reis met de caravan? Dan geniet u vast ook van het gevoel van vrijheid die een caravan biedt. Maar het rijden ermee is helaas niet zo eenvoudig. Door het gewicht van de caravan gaat de auto zich anders gedragen en ook het remmen is anders. Om over het rijden in de bergen maar niet te spreken... en het manoeuvreren en inparkeren! E-Trailer is een innovatie op het gebied van caravan rijden en neemt genoemde nadelen weg. Bovendien bespaart u met de E-trailer op uw brandstofkosten!

- 1. Veiliger**
30% van alle ongelukken met de caravan gebeurt door slingeren en scharen. E-Trailer voorkomt dat uw caravan slingert of schaarst. Door een ingenieus en gepatenteerd meebesysteem in combinatie met de speciale E-Trailer motoren wordt het slingeren voorkomen.
- 2. Mover**
Met de E-Trailer beschikken beide wielen van uw caravan over een geïntegreerde elektromotor. Deze elektromotoren zijn afzonderlijk te besturen. Dit maakt de aanschaf van een mover overbodig. De E-Trailer kan uw caravan gedurende 30 minuten een hievel oprijden van 12%.
- 3. Sneller**
De elektromotoren van het E-Trailer systeem ondersteunen de auto bij het rijden. Met een ingebouwd E-Trailer systeem kunt u voortaan accelereren alsof u zonder caravan rijdt. Zowel vanuit stilstand als vanuit een snelheid van bijvoorbeeld 70-90 km per uur.
- 4. Soepeler**
Caravan rijden in de bergen is altijd lastig. E-Trailer assisteert uw auto bij het heuvel-op rijden en laadt de batterijen op bij het remmen en het heuvel-af rijden. U zal nooit meer last hebben van oververhitte remmen.
- 5. Goedkoper**
Door het inbouwen van het E-Trailer systeem bespaart u brandstof tijdens het rijden. Door de E-Trailer kunt u toe met een auto met minder vermogen die bovendien goedkoper is. Hierdoor vermindert uw brandstof verbruik en kunt u toch met gemak uw caravan trekken.

Figure A.1 The MVP Flyer

Appendix B: Survey Caravan Jaarbeurs

In this appendix the survey that is conducted at Dutch biggest caravan expo, the Caravan Jaarbeurs, is presented. The survey is in Dutch because the respondents and the visitors of the expo were mainly Dutch people. The survey exists of 3 pages. In the survey different categories of questions are asked. These categories are: general information, sustainability, safety, accessories and personal information. Figure B.1, B.2 and B.3 shows the questions of the survey.

Enquête E-TRAILER



Wat is E-Trailer?

E-Trailer maakt uw caravan elektrisch aangedreven en lost een aantal problemen van het caravan rijden op. Het beperkte trekvermogen van de moderne energiezuinige auto is bijvoorbeeld geen probleem meer. Bij het omhoog rijden assisteert E-Trailer de auto met extra vermogen, bij het omlaag rijden worden de batterijen opgeladen. Daarnaast stabiliseert het systeem de caravan zodat scharen onmogelijk wordt. Eenmaal aangekomen op de plaats van bestemming kan de E-Trailer ingezet worden als een krachtige mover. Kortom: E-Trailer maakt het caravan rijden makkelijker, veiliger en goedkoper.

Momenteel werken wij aan de ontwikkeling van de E-Trailer en horen graag uw mening over dit innovatieve systeem. Uw antwoorden zijn voor ons van grote waarde. De verstrekte gegevens blijven anoniem. Dit onderzoek wordt uitgevoerd in samenwerking met de Technische Universiteit Delft en de Haagse Hogeschool. Hartelijk dank voor uw moeite!

Algemeen

Waar let u op bij het kopen van een caravan? Geef uw top drie aan door middel van cijfers, waarbij nummer één de belangrijkste keuze is.

- Prijs
- Lengte/ grote van de caravan
- Laadruimte
- Gewicht
- Duurzaamheid
- Design/ uiterlijk
- Veiligheid
- Anders, _____

Wat voor een type auto heeft u en wat is het maximale geremde trekgewicht van uw auto?

Merk: _____ Type: _____ Trekkraft: _____ kg

Deze vraag a.u.b. alleen invullen als u momenteel in het bezit bent van een caravan.

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens?

Het leeggewicht van mijn huidige caravan is _____ kg . Het volgewicht van mijn huidige caravan is _____ kg . Ik heb voor mijn huidige caravan € _____ betaald.

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens?

Ik ben wel/niet* van plan om binnen 1 jaar een nieuwe caravan aan te schaffen. Ideaal zou ik een caravan willen hebben met een leeggewicht van _____ kg en met een volgewicht van _____ kg. Het budget voor mijn nieuwe caravan is _____ . Ik ga _____ keer per jaar en _____ dagen per jaar op vakantie met mijn caravan. Ik rijd gemiddeld _____ km per jaar met mijn caravan. Op een reisdag rij ik gemiddeld _____ km per dag. Tijdens het rijden pauzeer ik gemiddeld _____ keer. Een pauze duurt gemiddeld _____ minuten.

* Doorhalen wat niet van toepassing is

Figure B.1 Survey page 1



Duurzaamheid

Waarom rijdt u in uw huidige auto?

- Ik heb doelbewust voor deze auto gekozen.
- Ik heb deze auto gekozen in verband met mijn caravan.
- Deze auto heb ik toegewezen gekregen. (bijvoorbeeld leaseauto van het werk).

Zou u voor een duurzame** auto kiezen als u hiermee ook goed met een caravan zou kunnen rijden?

- Ja
- Nee

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens?

Door de installatie van het E-Trailer systeem is het mogelijk om met een duurzame** auto een caravan te trekken. Deze duurzame auto is in veel gevallen voordeliger (afschrijving, bijtelling, brandstof, etc.). De voordelen van het rijden in een duurzame auto zijn mij € _____ waard bij aanschaf van een caravan.

Veiligheid

Van welk van de onderstaande problemen heeft u weleens last gehad met uw caravan? Meerdere antwoorden zijn mogelijk.

- Slingeren
- Scharen
- Te lange remweg
- Onvoldoende snelheid in de bergen
- Te langzaam optrekken
- Oververhitte remmen
- Botsing
- Caravan niet goed op de trekhaak vastgezet
- Onveilige inhaalactie door te weinig vermogen
- Geen van alle

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens

Ik heb voor mijn huidige caravan € _____ uitgegeven aan accessoires om slingeren en scharen tegen te gaan. Met E-Trailer is scharen niet meer mogelijk. Dit is mij € _____ waard.

Rijdt u wel eens in de bergen?

- Ja
- Nee (ga op de volgende pagina verder naar het onderwerp accessoires)

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens

Met E-Trailer behoren oververhitte remmen tot de verleden tijd, dit is mij € _____ waard. Met E-Trailer kunt u heuvel opwaarts snelheid behouden, dit is mij € _____ waard.

** Een duurzame auto is een auto die minder brandstof verbruikt dan uw huidige auto. Dit kan zijn door het bezit van een efficiëntere motor. Ook zijn elektrische of hybride auto's duurzaam. Een duurzame auto heeft dus minder CO₂ uitstoot dan uw huidige auto.

Accessoires

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens

Mijn budget voor accessoires bovenop de aanschafprijs van een caravan, dank aan een mover, chiquere bekleding etc. voor de caravan is € _____. In totaal heb ik voor _____ kg aan accessoires in mijn caravan.

Bent u in bezit van een mover voor uw caravan?

- Ja
- Nee (ga verder naar het onderwerp persoonlijk)

Kunt u de volgende zinnen invullen met de op uw situatie van toepassing zijnde gegevens

De accu van mijn mover gaat _____ minuten mee. Het zou ideaal zijn als, de accu van mijn mover _____ minuten zou werken. Mijn mover weegt inclusief accu's _____ kg. Voor mijn mover heb ik inclusief installatie € _____ betaald. Ik gebruik de accu's van mijn mover wel/niet* voor andere elektrische apparatuur in mijn caravan.

Heeft u wel eens problemen met uw mover gehad?

- Ja, namelijk: _____
- Nee

Persoonlijk

Wat is uw geslacht?

- Man
- Vrouw

Wat is uw geboortjaar? 19_____

Wat is uw bruto gezinsinkomen per jaar?

- 0 tot 30.000 euro
- 30.000 tot 60.000 euro
- 60.000 tot 90.000 euro
- Meer dan 90.000 euro

Heeft u verder nog opmerkingen voor E-Trailer?

Als u interesse heeft in E-Trailer, kunt u hier uw contactgegevens achterlaten. Deze contact gegevens zullen niet in combinatie met de enquête worden gebruikt. U kunt uw contact gegevens ook op een apart formulier invullen.

Naam: _____

E-mail: : _____

- Ik wil eens per kwartaal op de hoogte worden gehouden over de ontwikkelingen van E-Trailer

Wij danken u hartelijk voor uw moeite!

* Doorhalen wat niet van toepassing is

Figure B.3 Survey page 3

Appendix C: Movers

In Table C.1 an overview of different movers is shown. For different brands quotations are requested to get the data for the table. The average slope is 18%. The average price including battery for a mover is €1.951.

Table C.1 overview of movers

Brand	Slope [%]	Slope [DEG]	Max mass caravan [Kg]	Mass mover ex battery [kg]	Speed [cm/s]	Max power [W]	Max torque [Nm]	Price ex battery [€]	Price incl battery [€]
Enduro	18	10,4	1500	37	13	344	728		
Enduro	18	10,4	1800	74	10,2	324	874		
Truma XT	13	7,5	2300	28	13	381	807	1995	2595
Truma SE R	15	8,6	2250	33,9	16,9	560	910	1795	1995
Truma SR	15	8,6	2000	34	14	412	809	1295	1850
Truma GO2	15	8,6	1800	34	13	344	728	1095	1595
Power Classic	25	14,5	1600	37	13	510	1079	995	1795
Power EVO+	20	11,5	2000	38,8	14,4	565	1079	1395	1795
Reich	18	10,4	1800	34	12,5	397	874	1295	2295
Alko Mammut	13	7,5	2000	34,2	11,9	304	701	1995	2295
Kronings 1	16	9,2	1800	30	10,8	305	777		1495
Kronings 2	17	9,8	1800	32	13	390	825		1795
P1			3000	35,1	12,3	0	0	1595	
Average	17	10	1888	34	13	372	784	1483	1951
Max	25	14	2300	39	17	565	1079	1995	2595

Appendix D: Price of an Electrically Propelled Trailer

The power of the battery and the power of the motor are linear with the mass of the trailer (Figure D.1 and Figure D.2). Based on the calculations in chapter 4 the motor and battery powers are calculated for different masses. Table D.1 provides an overview of the motor and battery power for specific masses of the trailer. In table D.2 (costs of full size motor and battery) the prices of the motors and batteries are calculated based on the formulas in appendix E and F. In addition to the costs of the batteries and the motors 20% extra costs are added for cables and sensors etc. Than 50% is added to the costs for profit margin, distribution, marketing etc. Based on this the costs price of the Electrically Propelled Trailer for different masses is calculated.

As stated in chapter 4 is the cost price of a system that is fully powered, the price is too high compared with the willingness to pay. [REDACTED]

[REDACTED]

[REDACTED] Based on these assumptions the prices for the system can be calculated. These prices are shown in table D.3.

Figure D.1 Mass trailer vs motor power (W)

Figure D.2 Mass trailer vs power battery (kWh)

Table D.1 Overview of motor and battery power vs the trailer mass

Mass trailer (kg)	Motor power (kW)	Power battery (kWh)
1.000	24,6	78
2.000	29,1	92
3.000	33,7	106
3.500	36,0	114
10.000	55,0	206
20.000	110,0	349
30.000	156,0	492
40.000	211,4	634

Figure E.1 Price of battery vs power

Besides the regression line of battery price vs power from all different battery materials, a regression line with only lithium-ion batteries is made. The advantage of lithium-ion batteries is that these batteries have less mass for the same power. In addition it is possible for these batteries to take and deliver the same amount of power. For AGM batteries for example only 20% of the power that a battery can deliver can be taken. (Snoek, 2015) The amount of energy that should be taken is important whether the trailer brakes and the braking energy should be covered in the battery. As can be seen in figure E.2 the explained variance is very high. The price of a Li-Ion battery can be calculated with the formula: price = ([REDACTED]). The price for the batteries is based on the price for 1 battery. There will be scale advantage when more batteries are ordered at once.

Figure E.2 Price of Li-Ion battery vs power

Appendix F: Cost Price of the electrical motors

There are only a few companies that manufacture and distribute in-wheel motors. Quotations are requested by companies such as: Elaphe, ECOmove, Evans Electric, Onvolts, Kelly Controls and QS motors. The power of the motor is plotted against the price. The price of the motor can be defined with the formula: $P = \frac{C}{P}$ (Figure F.1). The torque of the motors is not taken into account; since the torque of the motors was big enough to full fill the criteria in chapter 4.4.7.

Figure F.1 Price motors vs power