Bounded by rules and regulations, or an opportunity to expand?
arrange a (green) business model to benefit from an innovative market given environmental rules and regulations

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*Arrange a (green) business model to benefit from an innovative market given environmental rules and regulations*

by

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Abstract
In this report the influence of environmental rules and regulations on the business model have been studied. Due to the increased interest in global warming and environment, environmental rules and regulations are introduced or become stricter than before. A transition towards a more sustainable method of operating has been created, meaning that the business model behind products and services also face necessary changes. A case study has been conducted in the field of public transportation, the transition from regular diesel busses towards electric busses in particular. The results show that the complete business model behind regular diesel model has been influenced with the exception of the business model elements ‘customer segments’ and ‘distribution channels’. The sales of electric busses require new insights, new (additional) activities, and the establishment of new relationships with new partners. Customer relationships are intensified and the value proposition has a new focus (zero emission).
Preface

This master thesis is the result of my graduation project for the degree of Master of Science in Innovation Management at the Eindhoven University of Technology (TU/e). The graduation project was carried out during an internship at RH Marine NL, a system integrator on the maritime market.

I would like to thank a few people, because the completion of this master thesis would not have been possible without the support of a number of people. First, my thanks go to my first supervisor at Eindhoven University of Technology, Sharon Dolmans. She provided me with valuable input and useful feedback, but also stimulated me to enhance a critical approach towards my own work. At the end of the master thesis project she was replaced by Bob Walrave, who I would like to thank as well for his flexibility and feedback. Second, I would like to thank Ksenia Podoynitsyna for her role as second supervisor. With her background and research field she provided me with supportive feedback on my literature framework as well as the master thesis itself. Third, I am grateful to my company supervisor Floor Meijs. She gave me the possibility to graduate at RH Marine NL and within the maritime market, and gave me the guidance on moments when I needed it the most. Fourth, I would like to thank Walter van der Pennen for his role as supervisor in the last phase of my master thesis. With excitement I look back on my experiences at RH Marine NL and I am also thankful to all colleagues at RH Marine NL for their cooperation and their support.

Last but definitely not least I would like to thank my family and friends for their support during my master thesis project and the Bachelor and Master in general.

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Management summary

Innovations are an important factor for business success, but their importance has not always been acknowledged in the past. Some literature argues that innovations are the most important revenue streams for organizations and that they should have the attention they deserve. In combination with the increased interest in global warming and environment, a transition towards the development of sustainable innovations can be identified. The development of sustainable innovations is also the result of the introduction of environmental rules and regulations, which set specific boundaries for organizations to operate within.

In this research the influence of environmental rules and regulations on the business model has been studied. Organizations can only benefit from the regulatory regime if they are able to integrate the regulatory regime into the business model, but most organizations have no idea how their business model is influenced by the environmental rules and regulations. This research will try to close this gap and provide new insights in the mechanism that is called rules and regulations. The research question that follows from above mentioned gap:

*How should an organization arrange its (green) business model to benefit from an innovative market given environmental rules and regulations?*

Literature framework

The business model used in this research is described by Osterwalder and Pigneur (2010), who state that the business model describes how an organization creates, delivers, and captures value. This description is complemented with the definition of the business model by Moris, Schindehutte and Allen (2005), who state that “A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets” (p.727). The business model consists of four main components, known as the value proposition, the customer interface, the supply chain, and the financial model (Morris, Schindehutte, & Allen, 2005; Boons & Lüdeke-Freund, 2013).

An increased interest in global warming has led to an increased interest in sustainable innovations. Successful commercialization of innovations depends on a good business model, however the commercialization of sustainable innovations is even more complex and therefore a regular business model does not suit anymore. The regular business model should be replaced by a green business model, which involves three types of relationships between the organization and its stakeholders: social relationships, environmental relationships, and economic relationships. These relationships are fully integrated through the whole model and influence all the different elements.

Several external factors influence the green business model and the commercialization of sustainable innovations. Although all these factors have to be taken into account when designing the business model, the existence of environmental rules and regulations has to be seriously considered as important theme within the business model. It has a serious effect on the organization’s innovation capacity and its green
business model. While rules and regulations might be positive to an organization, since it forces her to innovate, it can also be negative, because it limits the company and increases R&D expenditures.

As already stated, the importance of the business model cannot be underestimated. Rules and regulations influence the elements of the business model as well, the value proposition to start with. The strategy chosen by the organization to deal with rules and regulations is the main input for a change within the value proposition. How the value proposition is influenced depends on the type of strategy, for example the stretch-and-transform strategy. An example that has been given by Huijben, Verbong, and Podoynitsyna (2016) is the possibility for residents in Flanders to spread the invoice over two years, so this is an essential change within the value proposition to the customer. Another element that can be influenced by rules and regulations is part of the customer interface, known as channels or distribution channels. If the rules and regulation forces organization to become more sustainable, other channels might need to be used to deliver value to the customer. Old channels do not suit anymore, since these might be not sustainable enough.

Key partners and key activities can be influenced as well as a result of environmental rules and regulations. The strategy to intensify the communication with governments or agencies led to a situation that governments or agencies might become key partners within the chain. The communication and cooperation with them logically results in a key activity for the organization and her employees. The strategy of an organization how to deal with rules and regulation is also reflected within the financial model. Mainstream rules and regulations result in increased costs, definitely when the organization strives to fight against it instead of using a fit-and-form strategy. Acting within a niche is positive towards an organization’s revenue, since it shields the innovations against mainstream selection pressures. The possible existence of governmental grants is attractive to an organization as well, since it increases the revenue stream.

Methodology

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1. Introduction

The importance of innovation has been underestimated in the past, but the view on innovations is currently changing (Fagerberg, 2003). Some literature argues that innovations are the most important revenue streams for organizations and that they should have the attention they deserve (Di Benedetto, 1999). Innovations meet new or changed customer’s demands and are the key factor for business success (Hurley & Hult, 1998). Although most organizations are able to innovate, from incremental innovations to radical innovations, they might be threatened by rules and regulations. These rules and regulations create certain boundaries where organizations have to operate within.

Due to the increased interest in global warming and environment, environmental rules and regulations are introduced or become stricter than before (European Commission, 2010; Debnath, 2015). For organizations it means that a situation has been created that they can oppose the regulations, that they can comply with the regulations, or that can use it for their own benefit. Most organizations are not (yet) able to integrate those environmental rules and regulations into the business model and outpace competitors (Debnath, 2015). For business success the challenge is to integrate the environmental rules and regulations and maybe even benefit from it.

1.1 Empirical context

The context in which the research will be conducted is the maritime sector, at RH Marine NL to be specific. RH Marine NL is one of the key players on the maritime market, operating as a full-service provider and system integrator of tailor-made, innovative and sustainable technology solutions. RH Marine NL is specialized in automation (bridge and engine room), propulsion systems, power generation and distribution, and HVAC (heating, ventilation and air conditioning). Their headquarter is based in Rotterdam. They have acquired a good export position in the global market, especially for hybrid solutions, because Dutch knowledge is leading in the maritime market. (Imtech Marine, 2015). Innovation and R&D play an important role in the maritime sector, as we can conclude from the following quote (van der Aa, et al., 2014):

“The Dutch maritime sector has a strong position in the world as a result of the entrepreneurial and innovative capabilities of companies within this sector. The R&D investment of the sector is 3,9% additional value, which is much higher than the average 2,0% of the gross domestic product (GDP) (2012, numbers CBS). This means that the maritime sector is largely above the level that is targeted by the European Committee, namely 3,0% of GDP, and by the Dutch government, namely 2,5% of GDP.” (p.19)

RH Marine NL also focuses on continuously improving their products and developing innovations to meet (new) demand and to gain a good market position. In combination with the new and stricter emission rules and regulations from the European Committee, this has led to the new market opportunity of hybrid ferries (European Committee, 2010). These hybrid ferries are less noisy, more energy efficient and produce less emissions. Two hybrid ferries are already operating for Caledonian Maritime Assets Ltd in Scotland, a third ferry is under construction (Caledonian Maritime Assets Ltd, 2015). These three ferries
function as a pilot project, and the first results are positive with respect to emission reduction and fuel savings.

1.2 Research question
In this research the influence of environmental rules and regulations on the business model has been assessed. Environmental rules and regulations force organizations to adapt their business to comply with these regulations, while maximizing profit or customer satisfaction. Although environmental rules and regulations push organizations in a certain direction, most organizations have no idea how their business is directly influenced (Debnath, 2015). Therefore, it is unclear how organizations have to deal with rules and regulations which influence the market. As such the central research question of this research is as follows:

*How should an organization arrange its green business model to benefit from an innovative market given environmental rules and regulations?*

This research will try to close this gap and provide new insights in the mechanism that is called rules and regulations.
2. Literature review

2.1 Introduction

According to research conducted by the Product Design and Marketing Association (PDMA), the best performing companies on the market focus on innovation and the introduction of new products (Di Benedetto, 1999). Although most organizations spend serious resources to create an innovative culture and environment, the introduction of innovations to the market is not always successful (Rogers M., 2004). An increased interest in global warming has led to an increased interest in environmental economics, sustainable development, and corporate social responsibility. Innovations are more and more focused on sustainability, however sustainable development is more complicated than an innovation without a sustainable base. For the organization it is crucial to understand what society expects, and in return expressing what the organization stands for. The organization should also build the capacity to act sustainable and check the progress, by setting realistic targets and measure these during the whole process (Dearing, 2000).

Successful commercialization of inventions into innovations depends on many different elements (see Appendix A1), however a reliable business model for the invention is essential. Without a good business model the success of an innovation is seriously threatened (Osterwalder & Pigneur, 2010). As already stated, the trend to sustainable innovation becomes more and more important, but some literature argues that when the innovation is related to sustainability, a regular business model does not suit anymore. The drivers behind sustainable innovation are usually known, however less knowledge is available how sustainable innovations can be realized (Boons, Montalvo, Quist, & Wagner, 2013). The regular business model should be replaced by a green business model, which consists of the same elements as the regular business model, but it incorporates three types of relationships between the organization and its stakeholders: social relationships, environmental relationships, and economic relationships (Boons & Lüdeke-Freund, 2013; Matos & Silvestre, 2013). These relationships may help an organization to exploit new green opportunities (Nair & Paulose, 2014).

Research has shown that the development of a green business model is contingent on various factors, such as the economic environment, type of company and internal and external stakeholder relationships (Boons, Montalvo, Quist, & Wagner, 2013; Bohnsack, Pinkse, & Kolk, 2014; Abuzeinab & Arif, 2014). In addition to all these factors, some organizations act in a market that is controlled or dictated by rules and regulations. For the organizations in these markets the only option is to deal with the environmental rules and regulations and adapt their strategy to it. Although rules and regulations do not necessarily push organizations towards a specific technology, it can create landscape conditions that are necessary for successful sustainable innovation (Mazur, Contestabile, Offer, & Brandon, 2015).

There is no unanimous conclusion how rules and regulations influence an organization’s innovation capacity and the business model. Some literature argues that environmental rules and regulations influence an organization’s innovation capacity positively (Debnath, 2015; Porter & van der Linde, 1995), others suggests that there is no influence at all (Jaffe et al., 1995), while the third stream states that rules
and regulations are negatively related to the innovation capacity (Palmer, Oates, & Portney, 1995). Because of these three views, it is therefore unclear how environmental rules and regulations influence the organization and how organizations should organize their business model to commercialize a sustainable innovation given these rules and regulations.

2.1.1 Graphical overview framework
As a starting point for investigating the integration of environmental rules and regulations into the green business model, a framework has been developed. A total overview of the literature framework is given in figure 1, it shows the relationship between (sustainable) innovations and the business model, business model innovation from a regular business model to a green business model, and the external factors that influence the green business model. As mentioned above, existing literature has produced mixed results as to whether rules and regulations facilitate or hinder the commercialization of sustainable innovations. To further investigate how organizations should organize their business model to commercialize a sustainable innovation given these rules and regulations, the literature review is structured as follows. In paragraph 2.2 the importance of sustainability and sustainable innovations are discussed, while paragraph 2.3 explores business models in relation to sustainable innovations. A key factor for green business models is the role of the government by introducing rules and regulations, so paragraph 2.4 points out environmental rules and regulations and their influence on the organization’s innovation capacity and its business model. The literature review ends with paragraph 2.5, which is the conclusion on the relationships that have been found in the literature.

Figure 1: Graphical overview framework
2.2 Sustainable innovation

Global warming is a serious threat to the community, therefore topics as environmental economics, sustainable development, and corporate social responsibility are getting more and more attention (Souto & Rodríguez, 2015; Bocken & Short, 2015). As stated in Europe 2020 three goals with respect to sustainability are formulated: (1) Reduction of CO₂ emissions by 20%, (2) the raise of using sustainable resources by 20%, and (3) a raise of 20% in energy efficiency (European Commission, 2010). As a result of global warming and the objectives of Europe 2020 and the G8, there is an increased interest by organizations in sustainable innovations and sustainable energy. Hellström (2007) defines sustainable innovation as “the process of developing new ideas, behavior, products and processes that contribute to a reduction in environmental burdens or to ecologically specified sustainability targets” (p. 148). For example, the three major technological changes in sustainable energy development are energy savings on the demand side, efficiency improvements in the energy production, and the replacement of fossil fuels by various sources of renewable energy (Lund, 2007).

However, in practice sustainable innovation and sustainable development is more complicated than an innovation without a sustainable base. Dearing (2000) argues that leading companies in sustainable innovation have built their approach based on three principles. First, the organization’s attitude is important. It is crucial for the organization to understand what society expects, and in return expressing what the organization stands for. Second, the organization should build the capacity to act. It is necessary to develop tools and methods to improve performance in the social, environmental, and financial fields of sustainable innovation, and incorporate this into the already existing business processes. The last principle is to check the progress, by setting realistic targets and measure these during the whole process (Dearing, 2000).

Overall can be concluded that due to an increased interest in environmental economics and corporate social responsibility the development of sustainable innovations has become more and more important. However, sustainable innovation is more complicated than innovation without a sustainable base, so therefore organizations should definitely adapt to organizations to it. The adoption of sustainable innovations by users is also more complex than for innovations without a sustainable base. The structure of this paragraph is as follows. In subparagraph 2.2.1 the categorization of sustainable innovations will be discussed, while in subparagraph 2.2.2 the different types of adopters will be distinguished. Additional literature on innovation can be found in Appendix A. Appendix A1 contains the relationship between creativity, invention, and innovation. Appendix A2 discusses the different forms of innovation, while Appendix A3 distinguishes the different types of innovations for those forms of innovation. Appendix A4 contains predictors for innovation, and Appendix A5 discusses the barriers for innovation.

2.2.1 Categorization of sustainable innovations

Hellström (2007) analyzed 105 concept ideas related to sustainability, sampled from a national environmental innovation competition. He categorized these using the Schumpeterian innovation view, which categorizes innovations as follows: New products, new methods of production, new sources of supply, organizing new markets, new ways of organizing the business, new product & new source of
supply, or new production & new source of supply. Hellström (2007) assumed that most sustainable innovations aim to improve the production method, and based on the innovation sample, this assumption seems to be right. The category new methods of production is 54.3% of the sample. The second largest category is the category new products, which is equal to 30.5%. The third category, representing 9.5% of the total sample, is new production & new source of supply. The number of sustainable innovations in this category is seriously less than the number of sustainable innovations in the first two categories. The last three innovations are divided in the categories new source of supply and new product & new source of supply, with two and one innovations respectively. Overall, sustainable development is mostly related to new sustainable products or to new sustainable methods of production (equal to 84.8% of the innovation sample). The results are shown in table 1.

Table 1: Distribution of sustainable innovations by Schumpeterian view (Hellström, 2007)

<table>
<thead>
<tr>
<th>New products</th>
<th>New methods of production</th>
<th>New sources of supply</th>
<th>Organizing new markets</th>
<th>New ways of organizing the business</th>
<th>New product &amp; new source of supply</th>
<th>New production &amp; new source of supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 (30.5%)</td>
<td>57 (54.3%)</td>
<td>2 (1.9%)</td>
<td>n/a</td>
<td>n/a</td>
<td>4 (3.8%)</td>
<td>10 (9.5%)</td>
</tr>
</tbody>
</table>

2.2.2 Adoption of sustainable innovations

Based on the degree to which a consumer is relatively early in adopting new ideas in comparison to other consumers, Rogers (2003) categorized adopters of innovations into five different categories, known as innovators, early adopters, early majority, late majority, and laggards. Innovators are the first group that will adopt an innovation, and are usually characterized as consumers who are willing to take risks. They are well informed about product development and they represent about 2.5% of the group adopting the innovation. The second category is named as early adopters, a group that envisions the advantages of an innovation and adopts mainly to gain respect from others. The group size is around 13.5% of the adopting group. The third, early majority, and fourth category, late majority, are the two largest adopting groups, both are equal top 34%. The early majority has to be seriously convinced before they are willing to adopt the innovation, while the late majority is skeptical and cautious. They only adopt an innovation when it is on the market for a longer time and shows obvious advantages. The last category is named as laggards, also known as traditionalists, and they dislike change. They will only adopt if alternatives are no longer available. Their size is about 16% of the adopters (Noppers et al., 2015). Figure 2 shows all categories with corresponding percentages.

![Figure 2: Adopter categories (Rogers, 2003)](image)
For the adoption of sustainable innovation, three types of attributes are important (Noppers et al., 2015). These are known as instrumental, environmental, and symbolic attributes. Instrumental attributes are related to the perceived functional outcomes of using a sustainable innovation, for example limited driving range of an electric vehicle. Environmental attributes reflect the perceived outcomes for the environment of using a sustainable innovation, for example emission reduction when using an electric vehicle. Symbolic attributes are related to the perceived outcomes of using a sustainable technology for consumer’s identity and social status, for example driving an electric car like Tesla. A positive evaluation of the three attributes increases the possibility of adopting the sustainable innovation, although symbolic attributes are less recognized by consumers as motivation for innovation adoption. Research has also shown an interaction between instrumental and symbolic attributes which affects the adoption of sustainable innovations. When the instrumental attributes are negatively evaluated by instrumental drawbacks, for example higher costs, symbolic attributes will be more positively evaluated. Using a costly innovation reflects the intense desire of the consumer, since the consumer really wants to use the innovation even if it results in higher costs (Noppers, Keizer, Bockarjova, & Steg, 2015).

Noppers et al. (2015) investigated the differences in adoption motivations between earlier adopters and later adopters, for electric cars in specific. A questionnaire was conducted among 2794 Dutch respondents, randomly drawn and stratified according to gender, age, income and education. In this questionnaire the respondents were asked to scale statements, related to instrumental, environmental, and symbolic attributes. Noppers et al. (2015) concluded that there were no significant differences in the evaluation of environmental attributes and hardly any differences in the evaluation of instrumental attributes between early and later adopters. Although there were no differences for instrumental and environmental attributes, early adopters were more interested in electric cars because they seem to believe that it gives them status and show who they are. This is related to the positive evaluation of the symbolic attributes.

Another research with respect to sustainable innovation adoption was conducted by Ozaki (2011). He analyzed the adoption of green electricity and what encourages adopters to adopt. The sample group consisted of people with a green attitude towards sustainable innovations, however Ozaki (2011) concluded that there is a clear distinction between adoption intention and actual adoption behavior. The challenge for those who are offering the innovation, is to close the gap between intention and real adoption. To realize a shift from adoption intentions to actual adoption, the sustainable innovation has to offer personal benefits to the adopter, the innovation should be compatible with the adopter’s values and identity, the adopter is influenced by social norms, the adopter experiences a sort of control over the costs, there should be less risk and uncertainty, and good information is provided to the adopter (Ozaki, 2011).

It might be that the existence of environmental rules and regulations can also be a key factor that closes the gap between adoption intention and real adoption. Rules and regulations can push an organization towards a situation that the organization is no longer in the position to choose, because the organization is forced to use a certain sustainable product or sustainable production method. The adoption motivation
then lies within the existence of rules and regulations. The degree to which a consumer is relatively early in adopting is then also influenced by the existence of rules and regulations. Some governments finance sustainable (pilot) projects, which might be the trigger for the organization to switch to sustainable products or sustainable production methods relatively early. Other organizations switch later to sustainability, and stretching the change period as long as possible. Fixed dates might be formulated within rules and regulations, and these form the end of the adoption period.

2.3 Business models and sustainable innovation
To explore the relationship between sustainability, business models, and environmental rules and regulations, this paragraph addresses business models. The structure of chapter three is as follows. Subparagraph 2.3.1 discusses the regular business model and its main components. Subparagraph 2.3.2 is an extension of the regular business model, the green business model for sustainable innovations. It will discuss the role of the green business model and the challenges and influences that have to be taken into account when using the green business model.

2.3.1 Business model
According to Osterwalder and Pigneur (2010) the business model describes how an organization creates, delivers, and captures value. An extended definition of the business model is given by Moris, Schindehutte and Allen (2005), who stated that “A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets” (p.727). The business model consists of four main components, known as the value proposition, the customer interface, the supply chain, and the financial model (Morris, Schindehutte, & Allen, 2005; Boons & Lüdeke-Freund, 2013). Although the name of the main components may vary and depends on the choice of the author, the layout always remains the same. Figure 3 displays the business model canvas.

Figure 3: Business model canvas (Osterwalder & Pigneur, 2010)
Value proposition
The value proposition expresses the value created for a customer segment by meeting needs of those specific customers. Value to the customer can be qualitative, for example technical features, function, or customer experience, and/or quantitative, for example price or delivery time. Value creation can be achieved in several ways, for example newness of a product or service, meaning that a new set of demands which was not recognized by the customer before have been met. Other ways to create value are product improvements or product customization. Some customers appreciate a specific design or brand name, and therefore these are also recognized as a method of value creation. An attractive price or cost reduction for the customer while using the product is mentioned as methods as well (Osterwalder & Pigneur, 2010).

Customer interface
A market segment is a group of customers in the market with similar needs and may include geographical location, purchasing power, and buying attitudes. The process of dividing the market into these segments is called market segmentation (Byers, Dorf, & Nelson, 2011). An organization may prefer to serve one market segment, however they also can choose to offer their products to multiple segments. Even serving the mass market could be an option (Osterwalder & Pigneur, 2010). Next to the market segment, customer relationships are an element of the customer interface as well. It is important for the organization to determine which relationship they would maintain with the specific market segment(s). This can vary from personal to fully automatic, but the motivation behind it is essential. Customer acquisition, customer retention, and boosting sales (upselling) are examples of such a motivation (Osterwalder & Pigneur, 2010). The last element of the customer interface is the method of delivering value to the customer, known as channels. An organization can choose to use their own channels, or to use the channels of a partner (Osterwalder & Pigneur, 2010).

Supply chain
The supply chain consists of the organization’s key activities, key resources, and key partners. The key activities are the most important activities the organization should execute to make the business model work. To execute the key activities, the organization should possess enough assets, called key resources. These resources can be categorized as physical, intellectual, human, and financial. In practice, the organization will combine key resources to have a successful market entrance. Which resources used mainly depends on the type of business model used. The last element of the supply chain, key partners, is the network of suppliers and partners involved in the business model. Motivations to establish partnerships can be found in benefits from economies of scale, reduction of uncertainty and risk, and acquisition of particular resources and activities (Osterwalder & Pigneur, 2010).

Financial model
The financial model consists of revenue streams and costs. Revenue streams can be generated through asset sale, ownership rights of physical products are sold to the customer. Other revenues can be generated as well, for example usage fees, subscription fees, lending, renting, leasing, or licensing. Total costs depend on the approach used within the business model, known as a cost-driven model or a value-
driven model. For the cost-driven model an organization strives to minimize costs when meeting customer needs, while the value-driven model has a clear focus on delivering maximum value to the customer with ‘less’ interests for the costs. Costs in the financial model can be divided into fixed costs and variable costs. Reducing the variable costs can be achieved by economies of scale and economies of scope. This means that variable costs per product reduce as the volume increases and the variable costs per product reduce due to a larger scope of operations respectively (Osterwalder & Pigneur, 2010).

2.3.2 Green business model
Several articles argue that when the innovation is related to sustainability, a regular business model does not suit anymore (Bohnsack, Pinkse, & Kolk, 2014; Matos & Silvestre, 2013; Nair & Paulose, 2014). The drivers behind sustainable innovation are usually known, however less knowledge is available how sustainable innovations can be realized (Boons, Montalvo, Quist, & Wagner, 2013). The regular business model should be replaced by a green business model, which consists of the same elements as the regular business model, but has a clear focus on three types of relationships between the organization and its stakeholders: social relationships, environmental relationships, and economic relationships (Boons & Lüdeke-Freund, 2013; Matos & Silvestre, 2013). It means that besides the financial view an organization always has, an organization should also focus on societal acceptance of sustainable innovations. The development of sustainable innovations is the creation of economic benefits as well as societal profits (Boons & Lüdeke-Freund, 2013). These relationships are not specific for one element of the business model, but are integrated through the whole model.

Role of the green business model
As already stated above, the green business model contains the same elements as a regular business model. The value proposition displays the balance in the needs within the economic, environmental, and social fields (Boons & Lüdeke-Freund, 2013; Matos & Silvestre, 2013). For existing products the organization has to seek for a balance in a relatively technological approach, while for new products this balance is more focused on the niches. The supply chain in the green business model contains suppliers who take their responsibility for their actions and engage in sustainable supply chain management. Not only suppliers should take their responsibility, but also customers should be motivated to take theirs. Customer relationships should focus on the awareness of sustainability and the challenges with this transition. The financial model is more or less the same as in a regular business model, however in some cases the focus of the organization is less related to profits but more related to sustainability itself (Boons & Lüdeke-Freund, 2013).

A solid business model is an important factor for market success, however when the innovation is related to sustainability it might be even more important because of the additional societal acceptance and environmental contribution. Sustainable innovations can be divided into technological, organizational, and social innovation. For each type of sustainable innovation the business model has its own role. When the sustainable innovation is technological, the fit between the business model and the technological change is crucial. A new business model can be created for an existing technology, an existing business model can take up new technologies, or a new business model is developed for a new technology (or vice
versa). Boons and Lüdeke-Freund (2013) conclude that the business model for a technological sustainable innovation is as follows: “Sustainable business models with a focus on technological innovation are market devices that overcome internal and external barriers of marketing clean technologies; of significance is the business model’s ability to create a fit between technology characteristics and (new) commercialization approaches that both can succeed on given and new markets” (p.16).

Next to the technological sustainable innovation, the innovation can also be related to organizational change. Stubbs and Cocklin (2008) stated that sustainability from the non-economic field is directly transferred to the organizational level. When the innovation is organizational, different factors have to be taken into account. They are known as structural and cultural attributes, organizational capabilities, and the socioeconomic environment. Their relationship is shown in figure 4. Based on the available information on organizational change and sustainability, Boons and Lüdeke-Freund (2013) state that: “Business model change on the organizational level is about the implementation of alternative paradigms other than the neoclassical economic worldview that shape the culture, structure, and routines of organizations and thus change the way of doing business towards sustainable development: a sustainable business model is the aggregate of these diverse organizational aspects” (p. 18)

![Figure 4: Factors of organizational change (Boons & Lüdeke-Freund, 2013)](image)

The last type of sustainable innovation is social innovation and is recognized as the key to realize a shift within the market to sustainability. The main focus is to create sustainable awareness, although profitability is not excluded from the business model. It usually is a combination of the two, since profitability is also necessary to remain operative in the sustainability field (Wells, 2013). Boons and Lüdeke-Freund (2013) have described the combination of social innovation and business models as: “Sustainable business models enable social entrepreneurs to create social value and maximize social profit; of significance is the business models’ ability to act as market device that helps in creating and further developing markets for innovations with a social purpose” (p.20).

**Challenges and influences**

As stated before, sustainable innovation and green business model development is related to environmental, economic, and social relationships and activities (Boons & Lüdeke-Freund, 2013; Matos & Silvestre, 2013). Each activity will differ in context as a result of spatial, temporal, and cultural factors.
Therefore Boons et al. (2013) mention the sustainable challenges in combination with the different types of economy, known as consumerist economies, emerging economies, and BOP economies (Base-Of-the-Pyramid). For example, organizations that operate in BOP economies face higher complexity and ambiguity, as a result of lower income of individuals. Additional challenges might develop because some stakeholders in the value may hold less power than other members (Matos & Silvestre, 2013).

Bohnsack et al. (2014) mentioned another element for the development of sustainable innovations and the corresponding business models. They did research in the field of electric vehicles and they found that the market position of an organization is important as well. There is a clear distinction between incumbents and new entrants and their capabilities to innovate sustainable. Both will face challenges to develop green business models, however there are crucial differences between the two. Incumbents and new entrants may have not the same access to different sources of value creation, which is constrained by the path-dependent behavior (Chesbrough, 2010). Path-dependent behavior is behavior that is constrained by past successes and therefore organizations stay consciously or unconsciously to old habits. Their findings suggest that incumbents are more cognitively constrained than new entrants by path dependencies, resulting in staying close to the existing business logic. The use of an existing business model is strengthened by incumbents’ complementary assets too, although it gives them the opportunity to respond faster to contingent events than entrepreneurial firms can. They conclude that the combination of dominant business model logic, complementary assets, and contingent events is a self-reinforcing mechanism, driving path-dependent behavior. New entrants however do not attempt to fit new technologies into old business models and are able to develop new (green) business models. Their problem is usually the lack of resources (Bohnsack, Pinkse, & Kolk, 2014).

A third challenge that may rise with the introduction of a new sustainable innovation is that user’s preferences are not clear to an organization. The transition to sustainability involves other preferences of consumers and barely knowing these results in difficulties with meeting customers’ demands. The introduction of new technologies may also involve new risks to customers who are therefore less willing to use it. For organizations who are introducing the sustainable innovation, the relationship between the value proposition and the consumer demand has been identified as challenging (Kemp, Schot, & Hoogma, 1998). The last challenge that may rise with the introduction of a new sustainable innovation is that the sustainable innovation has less technological functionality than expected by the users and is more expensive due to low-scale production. Optimization is required by consumers on a large scale, resulting in testing and redesigning. It also may be that complementary technologies are needed, but that they are perhaps not available (Kemp, Schot, & Hoogma, 1998).

The fourth factor, the key factor that can influence green business models, is the existence of environmental rules and regulations formulated by a local or the national government. It is an external factor which cannot be influenced by the organization, so they have to adapt their strategy to it. Boundaries have been shaped by an external actor, and the challenge for an organization is to perform optimally within those boundaries. A well-known example is the automotive industry, where the electric vehicle market is particularly shaped and controlled by rules and regulations, introduced by local, national,
and international governments. These rules and regulations are mainly focused on the reduction of carbon emissions and the improvement of the air quality (Ceschin & Vezzoli, 2010). The introduction of a new technology and the interference of governments require also a (parallel) innovation in the business organization, especially when the interference is related to governmental support. The first reason is to make sure that public funds are not wasted on a new technology that never gain market acceptance. A second reason for organizational innovation is that the costs are minimal in comparison with technology innovation and therefore attractive (Wells, 2013).

2.4 Environmental rules and regulations

Although several external factors are mentioned as influences to the green business model, the key factor is rules and regulations. Therefore, to investigate the relationship between sustainability, business models, and environmental rules and regulations, this chapter addresses environmental rules and regulations. The structure of this paragraph is as follows. Subparagraph 2.4.1 discusses the introduction of environmental rules and regulations, while subparagraph 2.4.2 discusses innovation as a result of rules and regulations. The third subparagraph distinguishes how an organization and its innovation capacity can be influenced by rules and regulations, while the last subparagraph review the need for environmental rules and regulations.

2.4.1 Introduction of environmental rules and regulations

There are many initiatives with respect to environmental rules and regulations. For example, extended producer responsibility (EPR) focuses on product systems, with the aim to encourage producers to prevent pollution and take responsibility for the product after the end of its useful life. Another policy instrument is environmentally responsible public procurement (ERPP), which is an instrument to promote greener products. A third policy is the integrated product policy, also known as IPP. It incorporate all tools that are product related and it takes an integrated, lifecycle approach towards improving the environmental performance of product systems (Li & Geiser, 2005). Each of the mentioned policies is shown in table 2 for various countries. ISO Type 1 refers to ‘seal-of-approval labels from independent third parties that award them to the best environmental performers in various product categories based on a set of performance criteria’ (p.706).

Table 2: Environmental product policy instruments in various countries (Li & Geiser, 2005)

<table>
<thead>
<tr>
<th>Country</th>
<th>Taxes and charges</th>
<th>Producer responsibilities</th>
<th>Ecolabeling (ISO Type I) programs</th>
<th>Environmentally responsible public procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X 1998</td>
</tr>
<tr>
<td>Belgium</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td></td>
<td>X</td>
<td>X 1995</td>
</tr>
<tr>
<td>Denmark</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X 1999</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td>X</td>
<td>X 1999</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X 1999</td>
</tr>
<tr>
<td>Norway</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Switzerland</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X 1996</td>
</tr>
<tr>
<td>UK</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>US</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
2.4.2 Innovation as a result of environmental rules and regulations

Innovation is typically the result of technology push and market pull factors. Technology push means that the development of a new technology will be the input for an innovation, and market pull means that the innovation is created as a result to input of customer needs (Luyten, 2003). The introduction of environmental rules and regulations by governments is considered a push factor, since it forces organizations to meet the set standard. However, rules and regulations are also capable of directly affecting the market structure and mechanism because innovative organizations are capable to create a shift to from a regulatory push to a market pull situation (see figure 6). Therefore environmental rules and regulations may increase demand, it may create new demand and it may increase the competitiveness for several organizations operating in the market (Debnath, 2015).

![Figure 5: Technology push vs. market pull (Debnath, 2015)](image)

Porter and van der Linde (1995) distinguish two different categories for sustainable innovations in response to environmental rules and regulations. The first category describes the innovation as a new technology or approach that minimizes costs of dealing with pollution. Cost minimization is the conversion of pollution factors into something of value, for example recycling of waste materials. The second category focuses on the improvement of resource productivity. These innovations offer solutions to the cause of pollution by substituting polluting factors or utilize resources better than they have been before (Porter & van der Linde, 1995).

2.4.3 Effects of rules and regulations on the organization’s innovation capacity

Literature suggests that the relationship between rules and regulations and the organization’s innovation capacity and competitiveness can be influenced in three ways: positive, negative, or no effect at all. In the following paragraphs each of these types of influence will be discussed.
Positive influence

Some literature argues that rules and regulations have a positive effect on the organization and its innovation capacity. Debnath (2015) investigated the relationship between environmental rules and regulations and innovations on the electrical vehicle market. The base for his research was the SWOT analysis, which is an internal and external analysis to determine strengths, weaknesses, opportunities and threats of an organization (Byers, Dorf, & Nelson, 2011). Debnath (2015) categorized environmental rules and regulations, usually introduced by a local or national government, as a threat to the organization. Although environmental rules and regulations may increase investment costs, it will force the organization to behave innovative. Finally, this will result in improved products or production processes to neutralize these costs. This relationship used in Debnath’s (2015) research is shown in table 3.

Table 3: Regulation in a SWOT analysis (Debnath, 2015)

<table>
<thead>
<tr>
<th>Inside Of Company</th>
<th>Outside Of Company</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths (Increase)</strong></td>
<td><strong>Opportunities (Increase)</strong></td>
</tr>
<tr>
<td>Technology</td>
<td>New product</td>
</tr>
<tr>
<td>Human Resources</td>
<td>eco product etc.</td>
</tr>
<tr>
<td>Brand</td>
<td></td>
</tr>
<tr>
<td>Competitiveness</td>
<td></td>
</tr>
<tr>
<td><strong>Weaknesses (Decrease)</strong></td>
<td><strong>Threats (Increase)</strong></td>
</tr>
<tr>
<td>Low technology</td>
<td>Environmental Regulations</td>
</tr>
<tr>
<td>Low Brand</td>
<td></td>
</tr>
<tr>
<td>Low Innovation</td>
<td></td>
</tr>
<tr>
<td>Low skilled H.R</td>
<td></td>
</tr>
<tr>
<td><strong>Positive Factor</strong></td>
<td><strong>Negative Factor</strong></td>
</tr>
</tbody>
</table>

As mentioned before, Debnath investigated the relationship between environmental rules and regulations and the electric vehicle market. As a result of new regulations in Japan to decrease the emission of CO₂, Toyota and Nissan both introduced a new vehicle to the market, the Prius and the Leaf respectively. The Toyota Prius reduced its emission by 75 percent from the level of 2005 emission standard, while the Nissan Leaf even exceeded this and became the first hundred percent electric car. Both car manufacturers used R&D as a response to the rules and regulations and created innovation, which not only led to a new car but also created a new whole market for them. Nissan as well as Toyota cleared the standard of the rules and regulations by their efforts in R&D and the introduction of the Nissan Leaf and Toyota Prius.

The sales of the new cars allowed the manufacturers to increase their sales and increase the investment in R&D. The technology capability and human resources improved as well, and made it possible to improve the older electric vehicles and to develop newer ones. Is seems to work as an expanding spiral and encourage the company to innovate continuously. Continuous innovation helped Nissan and Toyota to expand the product life cycle and to respond quickly to environmental rules and regulations (Debnath, 2015). The concept of expanding spirals and continuous innovation is displayed in table 4, which is an extension of table 3.
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

Table 4: Continuous innovation through rules and regulations (Debnath, 2015)

<table>
<thead>
<tr>
<th>Positive Factor</th>
<th>Negative Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inside Of Company</strong></td>
<td><strong>Outside Of Company</strong></td>
</tr>
</tbody>
</table>
| Strengths  
• Human Resources  
• Brand | Weaknesses  
• Low technology  
• Low Brand  
• Low innovation  
• Low skilled H.R. |
| Improve Cost ↓ | ① Regulation |
| Gain Profits || ② Increase Investment |
| ③ Innovation |
| ④ Further Innovation |
| Be an expanding spiral |

Next to Debnath (2015), also Porter and van der Linde (1995) stated that environmental rules and regulations can have a positive influence on an organization’s innovation capacity, because they believe that pollution is a form of economic waste. To strengthen this claim they used the Dutch flower industry as an example. Previously, the cultivation of flowers led to serious environmental problems such as contamination of soil and groundwater with pesticides. The introduction of new rules and regulations to prevent the contamination, led to a situation where the organizations had to innovate to overcome the problem. They developed a closed-loop system, with the re-use of water and less need for pesticides. As a result of these closed-loop systems, the soil and groundwater were no longer contaminated and the quality of the flowers even improved, because the variation in growing conditions was also reduced. The costs of cultivation flowers decreased as well. Using this example, Porter and van der Linde (1995) concluded that the aim of policy makers, business leaders, and environmentalists have been wrong, since they were focused too much on the static cost impacts and ignored the productivity benefits that raised from the environmental innovation.

No effects

Jaffe et al. (1995) argue that there is relatively little evidence to state that environmental rules and regulations influence the organization and its competitiveness. Although the introduction of rules and regulations may involve social costs, elements as net exports, overall trade flows, and plant-location decisions are not significantly influenced. There are a number of reasons to believe why the relationship between rules and regulations and the organization’s competitiveness is small (nor significant) and difficult to detect.

First, the data used to examine the relationship is limited in their ability to detect a significant influence of rules and regulations on economic performance. Second, in large industries compliance costs are just a small portion of the costs of production, which means that other costs as labor costs or raw material costs are relatively higher and therefore overwhelm the environmental effect. Third, the existence of differences in rules and regulations between countries makes it harder to investigate the relationship. Fourth, multinationals always aim to build state-of-the-art plants in foreign countries resulting in the fact
that differences in rules and regulations not always may be exploited. The last reason is that even in developing countries plants are built by local or national organizations with relatively high pollution control, sometimes more than is required (Jaffe, Peterson, Portney, & Stavins, 1995).

Negative influence
Palmer, Oates, and Portney (1995) states that environmental rules and regulations can negatively influence an organization, however they acknowledge that their view has several similarities with the view of Porter and van der Linde (1995). First, they agree that incentive-based regulation should be preferred above command-and-control. Second, early estimates of compliance costs seemed to be biased (too high) because of technological changes that not have been foreseen. Third, the availability on environmental information may help to develop and disseminate new technologies. And the last similarity, environmental rules and regulations may lead to the cost-saving or quality-improving.

Palmer, Oates, and Portney (1995) argue that environmental rules and regulations could have a negative influence on the organization. To show and explain their statement, they used an example of an organization operating on a market which is controlled by incentive-based environmental rules and regulations. They assumed that this organization maximizes profits within a perfectly competitive market, that the organization takes note of competitors’ outputs and R&D expenditures, and that the organization does operate under the introduced environmental rules and regulations. Figure 7 shows the organization’s options with the abatement level on the horizontal axis, meaning the reduction in pollution moving from left to right. The vertical axis displays the costs of pollution reduction measured in dollars.

Figure 6: Innovation incentives under rules and regulations (Palmer, Oates, & Portney, 1995)

The MAC curve is the Marginal Abatement Cost function, which is the marginal cost for the organization to reduce its pollution by an additional unit. The positive slope of the curve means that the marginal cost increases to reduce pollution. Using R&D expenditures, assumed that there is no risk or uncertainty in these expenditures, it might be possible for the organization to realize a shift from MAC to MAC*. MAC* is then the new Marginal Abatement Cost function, meaning the cost for the organization to reduce its
pollution by an additional unit after they invested in R&D. The organization will only decide to invest if the benefits that have been achieved are greater than the total investment costs in R&D.

If the introduction of environmental rules and regulations forces the organizations to decrease its pollution, total costs will rise (shown as a movement from $P$ to $P'$ in figure 7). Even when the organization decided earlier to invest in R&D, total costs will increase as a result of the new environmental rules and regulations. Although the abatement level is higher than before and it is positive for society, total costs have been increased. Palmer, Oates and Portney (1995) argue therefore that an organization and its innovation capacity are negatively influenced.

2.4.4 Effects of rules and regulations on the organization’s business model

It might be difficult for radical sustainable technologies to be competitive, because they are too demanding in the socio-technical field. To shield these innovations against mainstream selection pressures, such as mainstream rules and regulations, end-user practices and existing infrastructure, protective spaces within the market can be created. Within these protective spaces, also known as niches, the radical technology can develop and scale-up (Schot & Geels, 2008; Smith & Raven, 2012; Huijben, Verbong, & Podoyntsyna, 2016). Niches can be developed by shielding processes which are described by Smith and Raven as ‘processes that hold at bay certain selection pressures from mainstream selection environments’ (p.1027). Huijben, Verbong, and Podoyntsyna (2016) studied business models and their interaction with the regulatory regime. Their results showed that the level of niche shielding is positively influencing the financial component of the business model, leading to interesting opportunities for organizations operating in the market. A high level of niche shielding is also positive for the implementation of third party business models, since it is more attractive for external investors. Niche shielding, basically a form of financial support, is usually followed by certain niche shielding rules and regulations, to determine what comes at the costs for the organization as well. Organizations also have to integrate mainstream regulations into their business models, which may lead to additional costs. Economies of scale may be a solution to encounter such costs (Huijben, Verbong, & Podoyntsyna, 2016).

Their findings also showed that organizations choose differently to deal with particular rules and regulations. For example, some organizations choose to adapt a fit-and-form strategy. An extended version is the future fit, which means that organizations adapt their business models in such a way that they can anticipate on changes in rules and regulations. Other organizations might choose for the stretch-and-transform strategy. An example that has been given by Huijben, Verbong, and Podoyntsyna (2016) is the possibility for residents in Flanders to spread the invoice over two years, so they could avoid the maximum cap set for tax deduction. This is identified as an stretch strategy with incremental business model innovation, which requires changes in the internal organization and the value proposition to the customer. By increasing the depth or width of the available niche shielding instruments, opportunities can be exploited through minor business model adaption. A more radical strategy is the stretch strategy with radical business model innovation, when new technologies enable the implementation of new business models. The organization strives to exploit new opportunities in new ways. A third stretch strategy that can be adopted is to openly cross the borders of the rules and regulations in order to start a discussion
and expand the existing rules and regulations. This strategy is officially illegal and long term financial benefits are not always guaranteed. The relationships between the business model and rules and regulations are shown in figure 8.

![Figure 7: Influence of rules and regulations on the business model (Huijben, Verbong, & Podoynitsyna, 2016)](image)

Huijben, Verbong, and Podoynitsyna (2016) concluded that rules and regulations do not affect all the elements of the business model, usually one or two elements are affected. Figure 8 shows that the level of niche shielding has a positive impact on the financial model, while mainstream rules and regulations are negatively related to that business model element. The value proposition can be affected as well, which is linked to the chosen strategy to deal with rules and regulations. Business model innovation requires a certain adaption within the value proposition to the customer.

In addition to Huijben, Verbong, and Podoynitsyna (2016), Hopkins (2016) stated that business models can be blocked or even be stopped by regulatory roadblocks. The possibility of blockage is a serious threat to business model innovation and to underline this statement she provided three examples of strategies that have been followed by startups. The startup 23andme launched self-testing test kits as a way for customers to learn about genetics, but unfortunately these kits were not FDA-approved. As a result of regulatory regime 23andme was forced to shut down, but instead of completely leaving the market they adapted their business model with the integration of rules and regulation. After two years of intensive communication and cooperation with the FDA, they relaunched a test kit which met the set standards. Another example of strategies can be found within the business model of Uber and Airbnb. The strategy of Uber and Airbnb are more or less similar to each other, however the strategy of Uber is more aggressive. They fight each regulative challenge, one by one. Sort of like pulling one card at a time from a house of cards, looking forward to the day it will collapse. The third strategy is chosen by Aereo, who rented each of its customers a micro-antenna to stream over-the-air TV stations. Aereo aimed at a potential loophole in the Copyright Act of 1976, but failed to exploit that loophole and lost all legal cases. Based on the strategies of these startups, Hopkins concluded that two aspects are crucial for the business model. First, anticipate regulatory issues while still designing and testing the business model and second, understand
how to work with government. These aspects result that, based on the strategy chosen by the organization, rules and regulations might influence the value proposition, the delivery method (channels), and key activities. When communication and cooperation with governments and agencies is part of an organization’s strategy, the key partner element of the business model is influenced as well (Hopkins, 2016). An overview of the organization’s strategy to deal with the regulatory regime and the influenced business model components are shown in table 5.

Table 5: Strategies and business model components

<table>
<thead>
<tr>
<th>Author</th>
<th>Strategy</th>
<th>Business model components influenced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future fit</td>
<td>Customer interface, Financial model</td>
<td></td>
</tr>
<tr>
<td>Stretch – Incremental business model innovation</td>
<td>Value proposition, Internal organization, Financial model</td>
<td></td>
</tr>
<tr>
<td>Stretch – Radical business model innovation</td>
<td>Customer interface, Internal organization, External value chain, Financial model</td>
<td></td>
</tr>
<tr>
<td>Stretch – Openly illegal operation of business model</td>
<td>Internal organization, External value chain, Financial model</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fight the law</td>
<td>Customer interface, Supply chain, Financial model</td>
</tr>
</tbody>
</table>

*Note that Huijben, Verbong & Podoynitsyna (2016) have divided the business model into five parts: Value proposition, customer interface, internal organization, external value chain, and financial model. The internal organization and external value chain form the supply chain together, which is the terminology used in this research. No distinction has been made between the types of business model, only between the different types of strategies to deal with the regulatory regimes.

2.4.5 Need for rules and regulations

Porter and van der Linde (1995) argue that environmental regulation can be profitable to an organization through an increase in resource productivity, and that it will transcend the costs of compliance. The question that automatically rises is the real need for rules and regulations, because companies can strive to improve their resource productivity without any form of rules and regulations. Although the situation without rules and regulations and still improved resource productivity is labeled as ideal, this is not realizable. This might not be realized since not all the opportunities have been discovered without the
existence of rules and regulations, managers not always have perfect information available, and the organizational incentives are not always aligned with innovating. Six different reasons are distinguished to emphasize the need for rules and regulations.

The first reason is to create pressure that motivates organizations to innovate. Pressure from outside an organization increases creative thinking and the innovation capacity, which will lead to overcoming barriers. Secondly, it also makes organizations aware of resource inefficiencies and the possibility of technological change and improvement. The third reason is to improve environmental quality, even in cases when the costs of compliance are high in comparison with the improvement in resource productivity. Fourth, the need for environmental rules and regulations can also be found in the need to make sure that product and process innovations will become more environmentally friendly. The fifth reason is to create demand for environmental improvement, while the last reason is to make sure that all organizations face the same barriers during the transition period of environmental innovations (Porter & van der Linde, 1995).

Formulation of rules and regulations

Although rules and regulations can promote innovation, resource productivity, and competitiveness, it should have a clear purpose and it should be formulated well. For example, rules and regulations should be focused on outcomes and not on technologies. Best Available Technology (BAT) and Best Available Control Technology (BACT) imply that there is one outstanding technology, but this approach does not necessarily lead to the best outcome. Therefore it should aim for the best outcome. The formulation of rules and regulations should be strict instead of lax, because strict formulation promote innovation more than lax does (Porter & van der Linde, 1995).

Incremental introduction of rules and regulations is more effective than a complete introduction at once, since it gives organizations more flexibility and it forces them less to innovate hastily. During the introduction, market incentives should also be incorporated. These are very effective and encourage the use of technologies that exceed current standards. However, the use of these market incentives and the introduction of rules and regulations can be best done in cooperation with other countries, because it is important to minimize competitive disadvantages that occur due to the introduction of the new rules and regulations. Foreign organizations might be not familiar with the same standards and therefore might face competitive disadvantages (Porter & van der Linde, 1995).

Another important facet of the introduction of rules and regulations is to stabilize the regulatory process and make it predictable. Porter and van der Linde (1995) argue that the regulatory process might be as important as the regulations itself. The participation of the industry can be useful for the process, because regulators and the industry should cooperate. Therefore among regulators strong technical capabilities should be developed, so regulators understand what drives organizations and what creates competitiveness. During the regulatory process it is crucial to minimize time and resources consumes, because this can be very costly for an organization (Porter & van der Linde, 1995).
2.5 Conclusion

An increased interest in global warming has led to an increased interest in environmental economics, sustainable development, and corporate social responsibility. The development of sustainable innovations is becoming more and more important, and besides economic profit it also brings societal profits. For innovations without a sustainable base, the business model is an important factor for market success. For sustainable innovations the development of a solid green business model is even more important due to the addition of societal and environmental aspects. The integration of environmental, societal, and economic relationships between the organization and its stakeholders is crucial and these are integrated through the whole business model. It needs to be implemented within all the business model elements.

Several external factors influence the green business model and the commercialization of sustainable innovations. Factors like type of economy, market position, and customer preferences have to be taken into account when designing the business model, but the existence of environmental rules and regulations has to be seriously considered as an important theme within the business model. It is an factor that has been introduced by an external actor, which has shaped certain boundaries for the organization. It has a serious effect on the organization’s innovation capacity and its green business model. While rules and regulations might be positive to an organization, since it forces her to innovate, it can also be negative, because it limits the company and increases R&D expenditures.

As already stated, the importance of the business model cannot be underestimated. Rules and regulations influence the elements of the business model, the value proposition to start with. The strategy chosen by the organization to deal with rules and regulations is the main input for a change within the value proposition. How the value proposition is influenced depends on the type of strategy, for example the stretch-and-transform strategy. An example that has been given by Huijben, Verbong, and Podoynitsyna (2016) is the possibility for residents in Flanders to spread the invoice over two years, so this is an essential change within the value proposition to the customer. Another element that can be influenced by rules and regulations is part of the customer interface, known as channels or distribution channels. If the rules and regulation forces organization to become more sustainable, other channels might need to be used to deliver value to the customer. Old channels do not suit anymore, since these might be not sustainable enough.

Key partners and key activities can be influenced as well as a result of environmental rules and regulations. The strategy to intensify the communication with governments or agencies led to a situation that governments or agencies might become key partners within the chain. The communication and cooperation with them logically results in a key activity for the organization and her employees. The strategy of an organization how to deal with rules and regulation is also reflected within the financial model. Mainstream rules and regulations result in increased costs, definitely when the organization strives to fight against it instead of using a fit-and-form strategy. Acting within a niche is positive towards an organization’s revenue, since it shields the innovations against mainstream selection pressures. The
possible existence of governmental grants is attractive to an organization as well, since it increases the revenue stream.

While the organization aims to design the green business model in the best possible way, it is important for them to understand what consumers drive to adopt a sustainable innovation. For the adoption of sustainable innovation, three types of attributes are important (Nopppers et al., 2015). These are known as instrumental, environmental, and symbolic attributes. Instrumental attributes are related to the perceived functional outcomes of using a sustainable innovation, environmental attributes reflect the perceived outcomes for the environment of using a sustainable innovation, and symbolic attributes are related to the perceived outcomes of using a sustainable technology for consumer’s identity and social status. Based on the degree to which a consumer is relatively early in adopting new ideas in comparison to other consumers, Rogers (2003) categorized adopters of innovations into five different categories, known as innovators, early adopters, early majority, late majority, and laggards. It might be that the existence of environmental rules and regulations can also be a factor that forces consumers to adopt the innovation, whether the instrumental, environmental, and symbolic attributes are positively evaluated or not. It also might force consumers to adopt earlier than they would have done without the existence of environmental rules and regulations. The introduction of rules and regulations is therefore influencing the adoption process of consumers, and must be taken into account by organizations when designing the business model.
3. Methodology

Van Aken (2004) made a distinction between explanatory sciences and design sciences. Explanatory sciences aim at developing valid knowledge to describe and explain certain empirical phenomena, and usually follow the empirical cycle. The phases of the empirical cycle are as follows: The researcher chooses a phenomenon, makes a research design, makes empirical observations, develops a theory by induction, deduces from that theory empirically observations, and then test these hypotheses. On the other hand, design sciences are the development of valid knowledge to design solutions to field problems. Researchers with an aim to design, usually follow the reflective cycle. Researchers following the reflective cycle choose a business problem, solve that problem using the regulative cycle, reflect on the results, determine design knowledge, and then start a new project with the same type of problem. As stated, the reflective cycle contains another cycle, which is known as the regulative cycle. The regulative cycle is a problem-solving cycle, and contains the problem choice, diagnosis, plan of action, implementation, and evaluation (van Aken, Berends, & van der Bij, 2007). The reflective and regulative cycle are shown in figure 9.

![Reflective and regulative cycle](image)

Figure 8: Reflective and regulative cycle (van Aken, Berends, & van der Bij, 2007)

The aim within this research is to analyze the influence of environmental rules and regulations on the business model and to design a green business model that can be used to commercialize hybrid ferries. For this purpose the best cycles to follow are the reflective and regulative cycle. The problem for RH Marine NL is to commercialize their hybrid propulsion systems for ferries, and based on a case study of electric busses a green business model can be designed suited for the hybrid propulsion systems.
3.1 Data collection

Within literature, there has been made a clear distinction between qualitative collection methods and quantitative collection methods. Qualitative collection methods focus on the discovery of certain phenomena, while quantitative methods describe the number or amount of these phenomena (van Aken, 2004). The type of research determines which type of data is required, and therefore which collection method should be used. For example, qualitative collection methods are very useful when studying people, groups, organizations or societies. Although qualitative collection methods are very important for qualitative data gathering, standardization of the measurement instrument cannot be recommended (van Aken, Berends, & van der Bij, 2007).

For this research the qualitative data collection method interviewing has been chosen, because it provides the most useful data to investigate the relationship between the green business model and the introduction of environmental rules and regulations. This research does not focus on the numbers of the phenomena, but is more interested in the discovery of rules and regulations and their impact on the business model. A case study will be conducted to gather data from the public transportation sector, where the introduction of environmental rules and regulations have created boundaries for the organizations operating on that market. The interviewees are semi-structured, meaning that a question framework has been developed but it also gives the possibility to ask additional questions if necessary. In addition to the case study, an internal analysis with respect to the hybrid ferry business model will be conducted. For the internal analysis the same data collection method will be used, interviewing. The results of the case study and the internal analysis can be compared, and based on this comparison the solution design can be developed.

3.1.1 External data collection

External data collection is related to the case study, the public transportation sector. Within this sector a replacement of regular diesel busses by electric can be distinguished, as a result of the introduction of environmental rules and regulations. The public transportation sector has been chosen because it shows most similarities with the hybrid ferry market, since it is also transportation and a business-to-business market. The case study about the introduction of environmental rules and regulations and the use of electric busses provides useful insights in the relationship between sustainability, business models, and environmental rules and regulations, which function as an input for the development of a green business model in combination with the regulatory regime. The organizations that have been chosen for the case study all face environmental rules and regulations and are important actors in the public transportation sector. Their operations are direct or indirect influenced by the regulatory regime, and it forced them to adapt to the new situation. For the case study a distinction has been made between producers and consumers. Producers are responsible for the production of electric busses and the commercialization of the product. An overview of the organizations and their role is shown in table 6.
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

Table 6: Organizations and their role

<table>
<thead>
<tr>
<th>Organization</th>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebusco</td>
<td>Producer</td>
<td>Ebusco is a Dutch company, focused on the development, marketing and sales of full electric buses for the European market. In addition, existing designs are adapted to the European regulations and the buses are equipped with the monitoring systems that the European concessionaires require serving a safe and economically optimal public transport (Ebusco, 2016).</td>
</tr>
<tr>
<td>VDL ETS</td>
<td>Producer (R&amp;D)</td>
<td>VDL ETS focuses on research, development, and testing of new opportunities for transport related activities for VDL-companies. The objective is to develop environmental friendly, innovative hard-en software solutions in the area of e-mobility and battery technology (Communication Department VDL, 2016).</td>
</tr>
<tr>
<td>VDL Bus&amp;Coach</td>
<td>Producer</td>
<td>The core activities of VDL Bus &amp; Coach consist of the development, manufacturing, sales and after-sales of a wide range of buses, coaches and chassis modules, the conversion or extension of mini &amp; midi buses and the purchase and sales of second-hand buses (VDL Bus&amp;Coach, 2016).</td>
</tr>
<tr>
<td>Bluekens Bus</td>
<td>Producer (Maintenance)</td>
<td>Bluekens Bus is a global partner in passenger traffic. Volvo Bus is one of the largest bus manufacturers in the world and Bluekens is the Level One service dealer in the Benelux region. Bluekens Bus is also involved in the development of electric vehicles (Bluekens, 2016).</td>
</tr>
<tr>
<td>Arriva Nederland</td>
<td>Consumer</td>
<td>Arriva Nederland is a public transport operator and provides public transportation in the provinces Drenthe, Flevoland, Friesland, Gelderland, Groningen, Noord-Brabant, Overijssel and Zuid-Holland. In those regions they offer a smart public transportation network where bus and train complement each other (Arriva, 2016).</td>
</tr>
<tr>
<td>GVB Amsterdam</td>
<td>Consumer</td>
<td>GVB connects Amsterdam and its region. They focus on the passenger in everything they do and they want to contribute to an improved livability of Amsterdam (GVB Amsterdam, 2016).</td>
</tr>
</tbody>
</table>

For each of the above mentioned organizations one interviewee has been interviewed to discuss the relationship between sustainability, business models, and environmental rules and regulations. Only one interviewee has been interviewed, because the organizations have not allocated (yet) major resources to the electric bus sales. All interviewees are directly related to the concept ‘zero emission’ and have knowledge about environmental rules and regulations and their influence on the organization and current operations. The interviewees and their function within the organization are displayed in table 7.

Table 7: Interviewees and their function (external)

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Function</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walter Luijten</td>
<td>Ebusco</td>
<td>Managing Director</td>
<td>Helmond, The Netherlands</td>
</tr>
</tbody>
</table>
The questionnaire for producers (Appendix B1) only contains open questions and is built on the different components of the business model that have been found in literature, already mentioned as the value proposition, customer interface, supply chain, and financial model. The questions related to the value proposition tries to point out the value that electric busses offer to the consumer and to explain the development of electric busses within the industry. Other questions are related to the existence of environmental rules and regulations and the integration of these rules and regulations into the value proposition. Question with respect to the customer interface are mainly focused on the type of customers, the differences between customers, and the main activities of the customers. Other questions with respect to the customer interface are related to influence of environmental rules and regulations on the purchasing behavior of customers. Questions related to the supply chain are focused on logistic and financial partners within the supply chain, and try to point out the key activities required to deliver value to the customer. It also examines the degree to which the supply chain is green, which is indirectly connected with the integration of environmental rules and regulations. The last element, the financial model, has questions regarding the revenue model and pricing mechanism, the cost structure, and the return on investment. It also discusses the involvement of subsidiaries for within certain green projects.

The questionnaire for users (Appendix B2) has three core elements, named as the purchasing process, performance, and environmental rules and regulations. Questions related to the purchasing process aim to discover the important aspects of the purchasing process, the stakeholders during the purchasing process, the number of parties offering, and the availability of substitute products. It is likely that environmental rules and regulations influence that process. Questions related to the performance of electric busses point out the benefits and disadvantages of electric busses in comparison with regular busses, the need to adapt the organization, and the degree to which the electric busses meet the expectations. The third and last element consists of questions allied to the existence of environmental rules and regulations and the influence on the current operations of the consumer. Next to rules and regulations, the existence and use of subsidiaries is pointed out as well. Users are interviewed to determine which drives them to implement the electric busses into their current operations and to determine the process from decision till actual implementation.

3.1.2 Internal data collection

Interviews with employees of RH Marine NL are used to gather data to determine the current business model of (hybrid) ferries, which function as an input for the comparison with the case study. Two interviewees have been chosen, because these two are responsible for the hybrid propulsion systems for
ferries. The interviewees are directly involved in all the activities related to the sales of products and services with respect to (hybrid) ferries. They have knowledge of products and services, and of the customers and their demands and needs. The interviewees and their function within RH Marine NL are shown in table 8.

Table 8: Interviewees and their function (internal)

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walter van der Penen</td>
<td>Consultant (Concept design &amp; consultancy)</td>
<td>Rotterdam, The Netherlands</td>
</tr>
<tr>
<td>Douwe van der Meer</td>
<td>Sales Director Ferries</td>
<td>Rotterdam, The Netherlands</td>
</tr>
</tbody>
</table>

The questionnaire (Appendix B3) for internal data collection is almost similar to the questionnaire for producers of electric busses. It only contains open questions and these are related to the current value proposition, customer interface, supply chain, and financial model of hybrid propulsion systems for ferries. The questionnaire strives to point out the products and services RH Marine NL offers to their customers in the ferry market, the added value RH Marine NL provides with their products and services, and the existence of after-sales. It also distinguishes the different types of customers and their needs, and the relationship and contact points with the customers. Third, the questionnaire has questions related to the role of suppliers and investors, and fourth, questions related to the revenue model of (hybrid) ferries. It highlights the costs and revenue streams within the different projects RH Marine NL has done in the past.

3.2 Data analysis

The second part of the diagnosis is the process of data analysis. The objective of the data analysis is to analyze the data retrieved from the case study and the internal interviewees, with the aim to draw valid conclusions.

3.2.1 Case study analysis

As stated before, the questionnaire for producers is built on the different components of the business model that have been found in literature, known as the value proposition, customer interface, supply chain, and financial model. After each interview a complete report will be written, and subsequently all data will be coded based on the nine elements of the business model for each of the respondent. After coding the interviews, it will be possible to determine how each business model element has been influenced by the introduction of rules and regulations. It also shows how the producers have adapted those business model elements to the new created boundaries by the introduction of the regulatory regime. This analysis is based on all data of producers and no distinction is made between the respondents. A sub-analysis investigates the similarities and differences between the producers for each of the elements of the business model.

The questionnaire for users has three core elements, namely the purchasing process, performance, and environmental rules and regulations. Just like the interviews with producers, a complete report will be written. Data will be coded based on the different factors that can be distinguished within the purchasing process and for the performance. After coding the interviews, the most important factors of the
purchasing process and performance of electric busses can be determined. The influence of environmental rules and regulations on the purchasing process can be distinguished, which can be used to optimize the business model of producers. The analysis is based on all data of the users and no distinction has been made between the respondents. A sub-analysis investigates the similarities and differences between the users for the purchasing process and the performance of electric busses.

### 3.2.2 Internal analysis

The questionnaire for internal data collection is almost similar to the questionnaire for producers of electric busses. It makes it easier to compare the results of the case study results and the results from the internal analysis. Reports of the interviews have been written, and coded using the same method as the one for electric bus producers. This makes it be possible to determine all important factors with respect to that specific element of the business model and how environmental rules and regulations might have created a change within the ferry market. The analysis is based on both interviews and no distinction is made between the respondents, because both respondents are employed at RH Marine NL.

### 3.2.3 Case study versus internal analysis

The data gathered from the case study and the data gathered from the internal analysis can be compared based on the nine different business model elements. Similarities and differences can determined, and use as the input for the solution design. The solution design compares the public transportation market with the hybrid ferry market, and copies solutions from the public transportation market to the business model design of the hybrid ferry market.
4. Results
This chapter shows the results of the case study as well as the results from the internal analysis.

4.1 Case study results
The case study results can be divided into four parts, known as a general description of the market mechanism, the existence of environmental rules and regulations, the influence of environmental rules and regulations on the business model, and the influence of environmental rules and regulations on the user. A graphical overview will be given to show the different relationships between the actors on the market. The interviews with producers can be found in Appendix C1 till Appendix C4, and the interviews with end users are shown in Appendix D1 and Appendix D2. A complete overview analysis of the interviews is displayed in table 10 and table 11 in Appendix F1 and Appendix F2 respectively.

4.1.1 General description of the market mechanism
Key players on the public transportation market are public transport authorities (PTA’s) and public transport operators (PTO’s). These two are not similar to each other, except for the city of Amsterdam (W. Luijten, personal communication, April 21, 2016; A. de Jong, personal communication, May 2, 2016; G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). Each PTA is responsible for a certain region or city and outsources the transportation of passengers to PTO’s. Each PTO can offer their services via a tender and if they win this tender, that operator takes care of the public transportation for a time frame (concession) of seven to ten years (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016; G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). At the end of the concession, a new tender will be carried out and all PTO’s are free to offer their services (again).

4.1.2 Environmental rules and regulations
The introduction of environmental rules and regulations has created a shift within the industry and has forced PTA’s and PTO’s to adapt their activities. Recently a political agreement has been signed that states that from 2025 all public transportation must be zero emission. The main objective of this agreement is to reduce (local) air pollution and to improve the air quality (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016; G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). Direct consequences for the industry are that the regular diesel busses are no longer allowed and that these have to be replaced. PTO’s are free to choose any substitute for the diesel busses as long as it complies with the standards in the agreement.

4.1.3 Influence of environmental rules and regulations on the business model
The existence of environmental rules and regulations has created a new way of thinking within the (public) transportation industry. Results of the case study show that some elements of the business model certainly have been influenced.
Value proposition

The introduction of environmental rules and regulations directly influences the needs and demands of the operators. Before the existence of the regulations the operators chose for regular diesel busses, because these operate with the lowest total cost of ownership (TCO) (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). The environmental rules and regulations now force operators to seek for zero emission alternatives, and therefore their demands have been changed. Producers have to adapt their offerings to it and adapt their value proposition. The initial investment of zero emission busses is significantly higher than for the diesel busses, therefore producers must highlight the benefits of zero emission busses.

The introduction of environmental rules and regulations comes with the introduction of new technology, which is relatively unknown to the user, the PTO’s in this case. The integration of after-sales in the sales contract is extremely important and most users expect those after-sales (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016). Producers can distinguish themselves from competitors by the length of the respond time and those after-sales are normally captured in a service-contract (A. de Jong, personal communication, May 2, 2016). Decent after-sales become a crucial element of the value proposition.

Customer interface

The customer segments are not directly influenced by the introduction of stricter environmental rules and regulations. In the past situation diesel busses were offered to PTO’s and to tour operators (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). In the new situation both have to comply with environmental rules and regulations, so for public transport operators it will be in the form of the purchase of electric busses, while tour operators will probably going to use plug-in hybrid busses, which is a combination of diesel and electricity. The introduction of rules and regulations has not created a new market segment for the sales of electric or plug-in hybrid busses.

Each producer has its own interpretation how to achieve zero emission. It could be that the first producer just offers overnight charging (W. Luijten, personal communication, April 21, 2016), while the second analysis the complete operation of her customer and adapts her offering to it (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). Due to some disadvantages of the electric bus, it is not possible to implement electric busses one-on-one into the current operations (G. Naber, personal communication, May 24, 2016). The tailor-made approach requires therefore a more intense and direct communication with the customer than the sales of just diesel busses (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). The customer relationships are influenced by the introduction of stricter environmental rules and regulations.

The electric busses are sold via the same channels as the diesel busses were before, but as a producer it is important to create awareness of the new product (W. Luijten, personal communication, April 21, 2016).
As already stated, the electric busses have some benefits and disadvantages in comparison with the diesel busses and cannot be copied one-on-one into the current operations. Potential customers have to be informed of these benefits (and disadvantages), which is done by customer visits or by visiting fairs related to (public) transportation (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016).

Supply chain
The key partners in the business model of electric busses are government, (external) investors, knowledge institutes, and suppliers. First, governments are essential within the business model since they are responsible for the introduction of the environmental rules and regulations. They do not only introduce the regulations, but take their responsibility as well by subsidizing pilot projects. These pilot projects function as testing periods of the new technology and form the input for upscaling (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). Second, if the sustainable technology has proven to be functional, investors have to be found for the next step in the project. The development from a pre-series bus into a series-bus requires serious investments and the offering of electric busses to a user is no longer financed by governmental subsidiaries. Some organizations use external investors (W. Luijten, personal communication, April 21, 2016), while other like VDL have enough assets to finance this themselves. VDL has VDL Financing who is also involved in lease models for operators (M. Kleingeld, personal communication, April 25, 2016). Third, cooperation with knowledge institutes is essential in the development of the technology and knowledge. Although most components are not innovative, the linkage between all is relatively new to the market. Research is done in cooperation with these knowledge institutes and universities (M. Kleingeld, personal communication, April 25, 2016). Fourth, without the suppliers it won’t be possible for producers to deliver the electric busses to the users. The role of supplier is to provide the producers with the components or parts, which allow the producer to assemble/produce the electric bus (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016). Overall it can be concluded that the existence of environmental rules and regulations influences the key partner element of the business model. Key partners as suppliers and (external) investors are not new to the organization although a shift might have been realized, but governments and knowledge institutes are new partners for the producers.

The drive line and the battery pack are the most valuable components of the electric bus (W. Luijten, personal communication, April 21, 2016; A. de Jong, personal communication, May 2, 2016). All activities related to these components are seen as key activities to deliver value to the customer. Another example of a key activity is the demonstration of electric busses to the user, since it has different features than the regular diesel busses. Testing of the busses by bus drivers is an element of such demonstrations, because they are the final user and a critical factor in the road to success (W. Luijten, personal communication, April 21, 2016). If they do not encourage the introduction of the electric bus and even resist, the possibility of total failure increases (M. Kleingeld, personal communication, April 25, 2016). Demonstrating the busses to governments is recommended as well success (W. Luijten, personal communication, April 21,
As already stated, producers differ in their approach to e-mobility. The tailor-made approach some producers enhance requires a series of activities that can be categorized as key activities within the business model (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016).

The implementation of new technology requires skills and knowledge. Knowledge on the new technology is seen a key resource within the business model, just like skilled personnel. It is extremely important to train personnel to produce/assemble zero emission busses, but also for maintenance and service repair (M. Kleingeld, personal communication, April 25, 2016; F. Kustermans, personal communication, May 26, 2016). Other resources are production facilities and governmental subsidiaries. These subsidiaries can be used to develop the technology and to test it within pilot projects (W. Luijten, personal communication, April 21, 2016).

Financial model
The most general revenue stream is the sales of electric busses to the end user. In that case, the operator finances the zero emission busses themselves or seeks for an external investor (W. Luijten, personal communication, April 21, 2016). Another possibility is a lease model, where the operator leases the busses from a lease company. VDL Bus&Coach cooperates with VDL Financing to offer the lease model themselves, without the involvement of an external lease company (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). Additional revenue streams can be generated with the maintenance and repair services, which are usually integrated into a service contract with the user (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016). A third revenue stream is the use of subsidiaries, which are used to finance the development of technology, to finance pilot projects, or to finance demonstration projects (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). Some producers also generate revenues with consultancy, like supportive activities for operators with respect to the emission paragraph in a tender (M. Kleingeld, personal communication, April 25, 2016). Because governmental subsidiaries and consultancy activities with respect to emission are involved, the revenue stream is influenced as well by environmental rules and regulations.

As already stated the battery pack and driving line are the most valuable components of the bus and also the most expensive components (W. Luijten, personal communication, April 21, 2016; A. de Jong, personal communication, May 2, 2016). Especially the battery pack is costly, and the costs with respect to the charging infrastructure cannot be underestimated as well (M. Kleingeld, personal communication, April 25, 2016). Other costs that are faced by the producers are the costs of maintenance personnel and possible costs (fines) if certain standards in the service contract are not met (A. de Jong, personal communication, May 2, 2016). Like already stated above, some producers offer consultancy work to operators to meet the emission paragraph in the tender. This also involves additional costs (M. Kleingeld, personal communication, April 25, 2016).
Similarities and differences between producers

The interviewees all have their own view on the introduction of environmental rules and regulations and how they can benefit from it. The change in demand has seriously created opportunities to gain business. Table 9 shows the similarities and differences between the interviewees with respect to the view on environmental rules and regulations and the business models behind electric busses.

Table 9: Similarities and differences between producers

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental rules and regulations</strong></td>
<td></td>
</tr>
<tr>
<td>– Recently an agreement has been signed that all public transportation must be zero emission from 2025.</td>
<td>– No differences.</td>
</tr>
<tr>
<td>– The introduction of rules and regulations has created a shift within the market. Regular diesel busses of public transport operators (PTO’s) needs to be replaced by electric busses or plug-in hybrid busses.</td>
<td></td>
</tr>
<tr>
<td><strong>Value proposition</strong></td>
<td></td>
</tr>
<tr>
<td>– Important benefits of the electric bus are the zero emission aspect and noise reduction.</td>
<td></td>
</tr>
<tr>
<td>– After sales are extremely important, because the operator is not familiar with the new technology.</td>
<td></td>
</tr>
<tr>
<td>– Standardization of drive line is preferred above customization, because it enhances series production. Customization only appears when it comes to adjustments of seats, doors, etc.</td>
<td></td>
</tr>
<tr>
<td>– The development of the electric busses is a combination between sustainable technology development and the increasing demand from the market, which has been created by environmental rules and regulations.</td>
<td></td>
</tr>
<tr>
<td><strong>Customer interface</strong></td>
<td></td>
</tr>
<tr>
<td>– A distinction has to be made between PTO’s and PTA’s. Both have different needs and demands.</td>
<td></td>
</tr>
<tr>
<td>– PTO’s are the first customer segment.</td>
<td></td>
</tr>
<tr>
<td>– PTA’s are able to influence PTO’s, because they outsource the public transportation to PTO’s.</td>
<td></td>
</tr>
<tr>
<td>– Second market segment is tour operators, although their needs are slightly different than the operators’ needs. Plug-in hybrid will be the best solution for them.</td>
<td></td>
</tr>
<tr>
<td>– Bus drivers are crucial for the success of the electric bus implementation.</td>
<td></td>
</tr>
<tr>
<td>– No other distribution channels than the channels that have been used for regular diesel busses.</td>
<td></td>
</tr>
<tr>
<td>– Some interviewees offer an electric bus, just a product that could be implemented within the current operations of the operator. Other interviewees offer their customers e-mobility solutions, which optimizes the operations with the implementation of electric busses.</td>
<td></td>
</tr>
<tr>
<td>– Customer contact is more intense when the current operations have to be analyzed for optimal e-mobility solutions.</td>
<td></td>
</tr>
</tbody>
</table>
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

Supply chain
- Most important key partners are governments, external investors, and suppliers.
- Key activities are demonstrating electric busses to operator and government, but also to give bus drivers the opportunity to test.
- Key resources are knowledge on the technology, production facilities, workshops for repair and maintenance, skilled personnel, and subsidiaries.
- R&D with respect to sustainable technology is often done in cooperation with knowledge institutes and universities.
- The e-mobility approach (‘it is more than just an electric bus’) is crucial to deliver the best solution to the customer.

Financial model
- Most costs are related to the battery pack and drive line.
- PTO’s usually prefer lease models.
- Revenues with respect to maintenance and repair services (after-sales).
- Subsidiaries to finance technology development and pilot projects.
- Costs (fines) for not meeting the agreed up-time percentage.
- Some interviewees offer lease models themselves.
- The e-mobility approach also involves consultancy activities to support operators with the emission paragraph in tenders.

All producers agree that the introduction of stricter environmental rules and regulations has changed the market and the demands and needs of customers. Recently an agreement has been signed that all public transportation must be zero emission from 2025, meaning that the regular diesel busses are not allowed from them and that these have to be replaced by zero emission busses, for example electric busses. They also agree that, because the replacement is associated with new technology, the electric bus has to be offered in combination with decent after-sales. Maintenance and repair services are essential to keep the busses operational and therefore gaining revenues for the operator (W. Luijtens, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016).

The first difference between producers is the approach of electric mobility, also known as e-mobility. While one of the operators offers just electric busses with after-sales (W. Luijtens, personal communication, April 21, 2016), others state that e-mobility is more than just an electric bus. It is a complete system and the optimal solution for the customer is to analyze the current operations of the operator and to adapt the offering to it (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). They both use another value proposition towards the customer. Although both have different views on the offering, they all agree that customization of electric busses is not achievable. Standardization leads to series production, which is required to achieve a sustainable shift within the public transportation sector. The path to standardization differs, for example the modular approach used by VDL, but all have the same vision on standardization.

The producers all have identified the same customer segments with corresponding needs and demands. PTO’s and tour operators are the two types of customers that will be served with the production of electric busses, although tour operators will use a plug-in hybrid version (W. Luijtens, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016). The electric busses will be sold via the same channels as regular busses, but there is a difference in the intensity of customer contact between the producers. This is a logical result from the e-mobility approach, since analysis of the
current operations require closer communication with the operator than regular sales (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016).

The key partners in all business models are governments, suppliers, and (external) investors (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016). Governments are the actors on the market who introduced environmental rules and regulations, but also provide subsidiaries in the early phase to make the shift towards sustainability realizable. The suppliers have to deliver the necessary components for the production of the electric busses, while (external) investors are required to finance the phase from pilot project busses to series production. If the producer is wealthy enough then they will finance this themselves, otherwise an external investor has to be found. Knowledge institutes are the fourth key partner, but they are only involved during the technology development phase (M. Kleingeld, personal communication, April 25, 2016).

As stated before, the approach towards e-mobility differs between producers. Therefore the key activities to deliver value to the customer also differ, meaning that some producers have to perform analysis and diagnosis activities at the customer (M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). Besides those activities, all producers agree that bus drivers are a crucial element for successful implementation of the electric busses, so testing and demonstrating are key activities for all producers. They all use the same key resources as well, known as knowledge on the technology, production facilities, workshops, skilled personnel, and subsidiaries (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016).

The financial model in the business model does not really differ between the producers. Most costs are related to the development of the drive line and the battery pack, and with the e-mobility approach also consultancy costs occur (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016). Revenue streams are gained by sales of the electric busses, the after-sales, and consultancy activities. The last financial input comes from the subsidiaries that are provided by governments to finance technology development or pilot projects (W. Luijten, personal communication, April 21, 2016; M. Kleingeld, personal communication, April 25, 2016; A. de Jong, personal communication, May 2, 2016; F. Kustermans, personal communication, May 26, 2016).

Overall the conclusion can be drawn that the producers agree that the introduction of the regulatory regime has changed the market and the demand and needs of customers. However, their approach towards electric transportation differs. One offers just electric busses with overnight charging, others offer a complete e-mobility solution with the analysis of current operations and on-route charging. The second category strives to offer their customers optimal e-mobility transportation. Although the approach differs, both agree that after-sales are extremely important and therefore provide these to their customers. The case study shows that the introduction of environmental rules and regulations still allows
the producers use different approaches towards customers within the boundaries created by the regulatory regime.

4.1.4 Influence of environmental rules and regulations on the end user
The users are directly influenced by the introduction of environmental rules and regulations and are forced to adapt their organization. It has resulted in the implementation of new technology and knowledge into their current operations.

Purchasing process
Zero emission busses are not purchased for their profitability, since they cannot compete with diesel busses regarding TCO (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). The drivers to purchase zero emission busses are on the one hand the sustainability goals formulated by the organization herself, while on the other hand the introduction of environmental rules and regulations (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). Most PTA’s demand from PTO’s that they operate without any emission to reduce the air pollution and to improve the air quality. The PTO’s have no other option than to meet this demand, otherwise they won’t win the tender.

During the purchasing process several stakeholders are involved. Because a situation has been created that new technology has to be implemented within the current operations, the technical department is closely involved (G. Naber, personal communication, May 24, 2016). The zero emission busses have other specifications than the regular diesel busses, so the technical department is responsible for that part of the process (G. Naber, personal communication, May 24, 2016). The purchasing department is leading in the purchasing process, but close communication with the management team is required. The initial investments for zero emission are significantly higher than for diesel busses, so approval from the top management is needed (G. Naber, personal communication, May 24, 2016). Bus drivers are also involved within the purchasing process, because the e-mobility approach is completely different than the current operations. Bus drivers will lose their flexibility, so early involvement and expectation management for them is crucial (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). Other stakeholders are the steering team and project committee.

The choice for a specific supplier depends on the offered charging technique and on the financial aspect. No supplier offers all the charging techniques, so the choice for a specific charging technique eliminates some suppliers in advance. The remaining suppliers are categorized based on prices and usually the most financial attractive supplier will be chosen. So the choice for a specific supplier is a two phased process (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016).

Performance
Most important benefit of zero emission busses is the zero emission aspect. The electric busses have zero emission and therefore comply with the strict environmental rules and regulations (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). Another benefit
is the reduction in internal and external noise, which is a benefit for the bus driver, the passenger, and the citizens living around end points of routes. One operator finds it a bonus benefit (G. Naber, personal communication, May 24, 2016), while the other states that noise reduction is a serious benefit of zero emission busses (E. Brakenhoff, personal communication, May 27, 2016).

Several disadvantages of the electric busses have been identified. First, the electric bus has a limited driving range in comparison with the driving range of the diesel busses. Second, the charging time is relatively long. It requires some time to charge the battery pack, which means that the bus cannot be in operation at that moment. Third, large investments in the charging infrastructure are required. The total investment fluctuates and depends on the charging technique, but the introduction of electric busses definitely comes with additional costs for the charging infrastructure (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016).

The influence of environmental rules and regulations can also be found within the organization itself. The organization structures have changed and the importance of zero emission has been acknowledged. Employees are assigned to the zero emission projects (G. Naber, personal communication, May 24, 2016) and managing bus drivers is intensified (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). The success of zero emission depends partially on the attitude of the bus drivers, since they will seriously lose flexibility.

Similarities and differences between users
The interviewees all have their own view on the introduction of environmental rules and regulations and how their business is influenced. The new environmental rules and regulations require several adaptations within their operations. Table 10 shows the similarities and differences between the interviewees with respect to the view on environmental rules and regulations and how their organization is influenced.

Table 10: Similarities and differences between producers

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Differences</th>
</tr>
</thead>
</table>
| Environmental rules and regulations | A political agreement has been signed that from 2025 all public transportation must be zero emission.  
– Pilot projects have been subsidized by governments. Additional costs can be covered by the subsidiaries.  
– European funds are also available to finance sustainability projects. | The market mechanism gives PTO’s little security, so do they not know if they are still in business in 2025. One exception is the city of Amsterdam, where the PTA is equal to the PTO (GVB Amsterdam). |
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

**Purchase**
- Electric busses cannot compete with regular diesel busses based on total cost of ownership (TCO).
- Two drivers for the implementation of electric busses, known as the internal sustainability goals and the introduction of rules and regulations.
- Stakeholders in the purchasing process are the technical department, the purchasing department, the implementation team, the project team, and the management team.
- The choice for an offeror is based on the charging technique and the financial aspect (lowest TCO).
- No real substitutes available, because hydrogen busses are too expensive.

**Performance**
- Most important benefit of electric busses is the zero emission aspect. Another benefit is the reduction in internal and external noise.
- Disadvantages are the limited driving range, the long charging time, and the investment in the charging infrastructure.
- Bus drivers are crucial for the success of the implementation into the current operations. Their attitude towards e-mobility can make or break the project, so decent guidance from management is required.
- Positive results so far with electric busses, even with the busses within pilot projects. Managing expectations is required.

- One important stakeholder for GVB Amsterdam is the city of Amsterdam, because in that case the PTA is equal to the PTO.

GVB Amsterdam is bounded to one region, while other PTO’s can lose a region after the concession. GVB Amsterdam will use the electric infrastructure of tram and subway.

One PTO outsources all maintenance and repair services, while others will use their own maintenance and repair personnel.

All users agree that the implementation of electric busses within the current operations has been caused by internal sustainability goals as well as the introduction of rules and regulations (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016). The internal sustainability goals are a sort of responsibility feeling towards society, although it is the opposite of profit goals formulated by the organization. The introduction of environmental rules and regulations, a political agreement which states that all public transportation must be zero emission from 2025, has pushed the operators in a situation that they actually have no other choice than the replacement of their current diesel busses fleet. A combination of both drivers has resulted in the purchase of electric busses (G. Naber, personal communication, May 24, 2016; E. Brakenhoff, personal communication, May 27, 2016).

All users also agree that the purchasing process is more complex than the purchasing process of diesel busses. Several stakeholders are involved, like the technical department, the purchasing department, the implementation team, the project team, and the management team (G. Naber, personal communication, May 24, 2016). One different stakeholder can be identified for GVB Amsterdam, because they are directly linked to the city of Amsterdam. In Amsterdam the PTA is equal to the PTO, but this situation is not very common (E. Brakenhoff, personal communication, May 27, 2016). Another important stakeholder all users
安排一个绿色商业模式，以从创新型市场中受益，考虑到环境规则和规定。

同意的是公交车司机，他们是对电车成功的至关重要的因素。他们的态度对电车的成败至关重要（G. Naber，个人交流，2016年5月24日；E. Brakenhoff，个人交流，2016年5月27日）。

选择特定的生产商对所有用户来说都是一样的。它始于对特定充电技术的选择，这已经淘汰了一些市场上的生产商。最终的选择基于最低的总拥有成本。金融因素真的很重要，所以氢蛋车作为零排放车的替代品不是个好选择。

所有用户也识别了同样的好处和劣势与电动车的使用。好处是零排放和外部和内部噪音的降低，而有限的驾驶范围，长时间的充电时间和昂贵的充电基础设施被认为是劣势（G. Naber，个人交流，2016年5月24日；E. Brakenhoff，个人交流，2016年5月27日）。用户的差异可以在现有的电车和地铁的基础设施中发现，可以用于电车。对于常规运营商来说，当让结束时，他们可能在十年后在不同的地区操作，而GVB阿姆斯特丹知道他们仍然在十年后在相同的地区营运（E. Brakenhoff，个人交流，2016年5月27日）。这使事情更容易了。他们已经拥有的关于电车的知识也可以用于电车，而其他用户则将维护和修理外包。他们知识较少，因此外包是最好的解决方案（E. Brakenhoff，个人交流，2016年5月27日）。

总的来说，可以得出结论，从常规的柴油电车到电动车的过渡是由内部可持续性目标和环境规则和规定的规定触发的。然而，这是一个复杂的过程，对于终端用户来说。电动车的购买过程比柴油电车的购买过程更困难，而且由于充电基础设施的加强和公交车司机的参与而延长。尽管零排放和噪音降低是电车的主要优点，但也有许多劣势被识别。终端用户一直在强调，好处无法与劣势竞争，所以过渡只在环境规则和规定存在的情况下实现。

4.1.5 图形概述

在图10中，可以找到案例研究结果的图形概述。它展示了政府、用户、生产商和外部利益相关者的作用。
Figure 9: Graphical overview results electric busses industry

4.2 Internal analysis

The results from the internal analysis can be divided into three parts, known as a general description of the market mechanism, the existence of environmental rules and regulations, and the current business model of (hybrid) ferries. The interviews for the internal analysis can be found in Appendix E1 and Appendix E2. A complete overview analysis of the interviews is displayed in table 12 in Appendix F3.

4.2.1 General description of market mechanism

Key players on the ferry market are the ferry owners, the yards, and the suppliers. If an owner decides to build a new ferry, the first step in the whole process is to find an external financer for the new vessel. When financing is arranged, a naval architect designs the ferry based on the list of requirements that has been formulated by the owner in advance. If the design has been approved by the owner, several yards are asked to come up with a budgetary quotation for the ferry. If one of the budgetary quotations more or less levels with the price the owner has in mind, that yard will be responsible for the construction of the vessel. Because the yard is not capable to install all systems, several suppliers are asked for a quotation for a certain system or service. (W. van der Pennen, personal communication, June 29, 2016; D. van der Meer, personal communication, June 30, 2016)

For traditional ferries there is no need for communication between the ferry owner and a supplier like RH Marine NL, because it only involves investment costs. When it comes to more complex systems like hybrid propulsion, direct communication between the ferry owner and RH Marine NL is required. In that case the suppliers can offer supportive activities to ensure that the operational goals of the owner can be optimized. The objectives of ferry owner and yards differ, operational expenditures (OPEX) versus capital
Expenditures (CAPEX) (D. van der Meer, personal communication, June 30, 2016). The triangle relationship of the market is shown in figure 11.

**Figure 10: Triangle relationship on ferry market**

### 4.2.2 Environmental rules and regulations

International Maritime Organization (IMO) is an agency of the United Nations which has been formed to promote maritime safety. IMO ship pollution rules are contained in the “International Convention on the Prevention of Pollution from Ships”, known as MARPOL 73/78. NOx emission limits are set for diesel engines depending on the engine maximum operating speed (n, rpm). Tier I and Tier II limits are global, while the Tier III standards apply only in NOx Emission Control Areas. Tier II standards are expected to be met by combustion process optimization. The parameters examined by engine manufacturers include fuel injection timing, pressure, and rate (rate shaping), fuel nozzle flow area, exhaust valve timing, and cylinder compression volume. Tier III standards are expected to require dedicated NOx emission control technologies such as various forms of water induction into the combustion process (with fuel, scavenging air, or in-cylinder), exhaust gas recirculation, or selective catalytic reduction (Dieselnet, 2016).

### 4.2.3 Current business model ferries

Based on the interviews with employees from RH Marine NL it is possible to determine the current business model for hybrid ferries. The business model has been divided into the four components that already have been found in literature. Three types of ferries can be distinguished, known as diesel-direct ferries, diesel-electric ferries, and hybrid ferries. The third category is the diesel-electric version combined with a battery pack. For each type RH Marine NL has done projects in the past, but they generate the most revenues with the hybrid version (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016). Hybrid ferries are not always equipped with a battery pack in advance, it is also possible to install a LNG (Liquefied Natural Gas) tank and engine. The most common problem however is the space required to install the tank and engine, because it requires serious space. Therefore the battery pack is the best option for the hybrid version (D. van der Meer, personal communication, June 30, 2016).
Value proposition
RH Marine NL offers electric systems and their knowledge of propulsion and system integration, and provides all types of activities related to it. Their experience and knowledge makes them a reliable partner for their customers. They differ from their competitors by developing a ‘smart’ algorithm, which determines the best input option for the end user based on several external factors. Operational goals like emission reduction and fuel savings can therefore being optimized, resulting in complying with environmental rules and regulations as well as operating with the lowest cost of ownership (TCO) (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016).

Because the hybrid propulsion deals with new technologies, after-sales are also offered to the end user. Sometimes the yard takes full responsibility of the vessel and acts like a mediator between RH Marine NL and the end user, and sometimes RH Marine NL communicates directly with the end user. It really depends on the project. In the hybrid ferry market most projects are customized projects, standardization is not common. It might be that operators choose for a specific system for their new build vessels, so the crew does not have to be re-trained, but most projects are one-of-a-kind. Each project is a new challenge (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016).

Customer interface
Two important customers can be distinguished for RH Marine NL. Yards are always seeking for the lowest investment costs, while operators are seeking to maximize their operational goals like emission reduction or fuel savings. Yards purchase the electric systems and other system integration activities directly from RH Marine NL, so they are the first customer segment that can be identified (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016). System integration for traditional ferries only involves investment costs, so direct contact between the end user and RH Marine NL is not required. When it comes to more complex (hybrid) systems, direct communication with the end user is recommended and RH Marine NL might participate in the design phase. The operators are also able to place suppliers like RH Marine NL on the preferred supplier list, and therefore partially influence the yards. So, the second customer segment that can be identified are the end users (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016). After-sales without the involvement of yards are a revenue stream directly from the operators.

It is important to communicate with the right people. It could be that the fleet owner has specific and more costly demands, but at the end someone from the purchasing department overrules and chooses for the cheapest option (W. van der Pennen, personal communication, June 29, 2016). Therefore it is important to know who makes the final decision. Meetings with people from the operator’s technical department are useful, and they maybe even recommend RH Marine NL as a supplier, but finally a completely different design is chosen. Before the project starts communication between the yard and RH Marine NL takes place about technical aspects of the vessel, the amount of space available at the yard,
the other systems that needs to be installed, etc. All these things needs to be known before we start with the planning, and is also needed to determine who is responsible for which phase (D. van der Meer, personal communication, June 30, 2016). Most projects are a chain of activities, so delays are not unusual at all. The approved planning is our guide during the project. We have contact with the yard on regular base during the projects to discuss the progress (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016).

Supply chain
The supply chain of RH Marine NL for the hybrid ferries is reasonably standardized, but which suppliers are used depends on the project. They have specific suppliers for certain main components of the system, for example the switchboard. However, if the end user requests other suppliers it is possible for them to make a switch between suppliers (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016). What they produce internally is standardized, and they have agreements with sub-suppliers for those components. RH Marine NL has a certain degree of freedom where we purchase our components (supplier independent).

Key activities are planning and communication. Planning to make sure that the projects are on schedule and communication to evaluate the project are crucial (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016).

Revenue model
The end user and the yards have different views on the purchasing price. The main goal of the end user is to optimize its total cost of ownership (TCO), while yards have the objective to purchase products and services for the lowest price. Overall, yards are really price sensitive. RH Marine NL uses fixed prices, so they do not work with performance based contracts (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016). Although the use of performance based contracts could be interesting for them in the future, for example guaranteed uptime or guaranteed fuel reduction, the use of performance based contracts is not realistic at the moment. The technology is relatively new and RH Marine is not sure yet what the real savings will be in practice. The real savings are unknown (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016).

Most costs are related to man hours and the purchase of components. RH Marine NL also has costs related to overhead, distribution, and travelling (W. van der Pennen, personal communication, June 29, 2016: D. van der Meer, personal communication, June 30, 2016). Some staff has to work on location, so therefore they have relatively large travel costs (W. van der Pennen, personal communication, June 29, 2016). Of course the costs depend on the project. RH Marine NL appreciate projects the most when the balance between labor costs and material costs are 50/50. Just material costs or just engineering costs are not interesting, so make sure that you have projects with the right balance between these two (D. van der Meer, personal communication, June 30, 2016).
5. Solution design

RH Marine has several innovative products and services that comply with the new or stricter environmental rules and regulations and also meet the needs and demands of customers on the maritime market. However, due to economic crisis and the corresponding effect on the maritime market it has been difficult to commercialize the products and services towards a valuable and commercial revenue stream. The business model design can provide guidance and support for an organization during the process of designing the business model with the influence of environmental rules and regulations.

5.1 Case study versus internal analysis

5.1.1 Environmental rules and regulations

The environmental rules and regulations in the public transportation sector state that from 2025 all public transportation must be zero emission. It strives to reduce (local) air pollution and to improve air quality. The regulatory regime in the maritime market however aims at emission reduction, since completely zero emission is most often not achievable. Vessels are usually operating outside city boundaries, their propulsion needs more power which can not only be generated from battery packs, and they usually sail from point A to point B with relatively long distances instead of following a complete route schedule. There are examples of zero emission within the maritime market, but these projects are within in city boundaries and where the distance between point A and point B is relatively short. For these short distances it seems to be possible to operate with just battery packs and without the involvement of diesel engines.

5.1.2 Value proposition

The most important benefits that can be identified for the implementation of electric busses are the zero emission aspect and (internal and external) noise reduction. These two benefits can also be identified for the use of hybrid ferries, but with the addition of one large benefit for ferry operators: fuel savings. In the public transportation sector zero emission is the main driver for the implementation of electric busses, while emission reduction but also fuel savings are the main drivers for ferry operators to use hybrid ferries.

The transition towards sustainability has come with the introduction of new technologies. These technologies are unknown to the end user, so in case of failure most users won’t be able to repair it. The producers of electric busses always include after-sales in their offering, because it increases customer satisfaction and it generates additional profit. Most customers expect after-sales, so producers can distinguish themselves from competition by the length of the respond time. The integration of after-sales for hybrid ferries is essential as well, since those hybrid ferries also have new technology included. The construction might be slightly different in comparison with the public transportation sector, because sometimes after-sales are directly offered to the end user of the vessel while it is also possible that the yard take full responsibility of the vessel. Then they purchase after-sales from the system integrator as RH Marine NL, and function as a mediator between end user and RH Marine NL.

A big difference can be found in the production line. While producers of electric busses prefer standardization because it enhances series-production, most projects in the maritime market are one-of-
a-kind. This results in customization, which has been created by all the different needs of all users and the different approaches of the projects by each yard. Although series production is rarely in the ferry market, operators often choose for the same systems on board in the upcoming projects. The main reason to do so is that the crew onboard is already familiar with these systems, so they do not have to be retrained.

The approach of e-mobility differs within the public transportation. Some producers offer just electric busses which can be charged overnight. Others analyze the current operations of operators and adapt their offerings to it. It determines the best routes and the optimal charging infrastructure. This approach is hard to apply to the ferry market, because most ferries sail from point A to point B instead of following an extensive route. The approach of offering just the product or service in combination with after-sales could be easier implemented in the hybrid ferry market.

5.1.3 Customer interface
The customers that have been identified in the public transportation sector are public transport operators (PTO’s) and tour operators. The transition from regular diesel busses to electric busses did not create new customer segments but also did not eliminate already identified customer segments. It means that there has been no change in the customer segments for the implementation of electric busses. In case of the hybrid ferries it is slightly different. For traditional ferries the customer segment that can be identified is the yard, because they purchase the systems and services directly from RH Marine NL. The objective of yards is to fulfil the demands of their client, who has initiated the construction of the ferry. With the introduction of hybrid propulsion system it becomes a bit more complicated, because now the end user has to be convinced as well to order the system. The objective of the end user is to operate with the lowest costs (TCO), which is different in comparison with the objective of the yard. End users have the power to place a specific supplier on the ‘preferred supplier list’, meaning that they recommend that supplier to the yard. In the end, the yards remain the customer but end users are able to influence the purchasing process.

The relationships with customers for the sales of electric busses are intensified in comparison with the sales of the regular diesel busses. Especially when the current routes of operators are analyzed the relationships are intense. In the hybrid ferry market the relationships with the yards as well as the end user are intensified in comparison with the construction of diesel-direct ferries. The integration of a hybrid propulsion system is more complex and more expensive than regular propulsion systems, so planning and communication with the yard is essential. As already stated before, direct communication with the end user for diesel-direct ferries is not necessary while it is a crucial element in the business approach for hybrid ferries.

The channels that can be used for electric busses do not differ from the channels that have been used for regular diesel busses. Communication lines between producers and operators have been established in the past and the same lines are now used to promote the electric busses. In addition to these lines, producers of electric busses visit fairs to demonstrate their offerings. The same approach is used in the ferry market, where communication lines with yards and naval architects have been established in the
past. In addition, close communication with the end user has become a crucial part of the business approach.

5.1.4 Supply chain
Most important key partners for the development and implementation of the electric busses are governments, external investors, and suppliers. Some producers do not use external investors and finance the phase from prototype to series production themselves. The same key partners are important for the hybrid ferry market,

Key activities for electric busses are demonstrating busses to operators and governments, but also give bus drivers the opportunity to test. These are different in comparison with the key activities that have been identified for the hybrid ferry market. Planning and communication are the key activities, planning to make sure that the project is on schedule because delay leads to fines, and communication to evaluate the project with the yard and the end user. Demonstration and testing are not characterized as key activities.

Key resources within the public transportation sector are knowledge on the technology, production facilities, workshops for repair and maintenance, skilled personnel, and subsidiaries. This is also slightly different for the hybrid ferry market, since yards have their own production facilities. Suppliers like RH Marine NL have their own facility for assembling components, but most work is done onsite. Maintenance and repair is usually done at the end users’ location. Most important key resource that could be identified for the hybrid ferry market is knowledge on the technology. The technology is relatively new, so therefore developing a knowledge database is crucial for business success.

5.1.5 Financial model
Due to the different market mechanisms, the financial model of the case study is different than the financial model of hybrid ferries. For electric busses the most operators prefer a lease model with a service contract (after-sales), so the revenue streams generated by producers are sales, after-sales, consultancy, and subsidiaries. For hybrid ferries, the two most important actors have different views on the purchasing price. The main goal of the end user is to optimize its total cost of ownership (TCO), while yards have the objective to purchase products and services for the lowest price. Therefore for RH Marine NL it is important to find the balance between the right price for the yard and maximization of the operator’s operational goal. RH Marine NL also offers after-sales and consultancy activities to the operators. Most costs of electric busses are related to the battery pack and driving line of the bus, and the construction of the charging infrastructure. Other costs that are faced by the producers are the costs of maintenance personnel and possible costs (fines) if certain standards in the service contract are not met. Like already stated above, some producers offer consultancy work to operators to meet the emission paragraph in the tender. This also involves additional costs. Most costs within the projects of RH Marine are related to man hours and the purchase of components. RH Marine NL also has costs related to overhead, distribution, and travelling. Some staff has to work on location, so therefore they have relatively large travel costs. Of course the costs depend on the type of project and fluctuate if the projects are more complex or it involves more vessels.
5.2 Business model design
The business model design provides guidance and support for the commercialization of the hybrid propulsion systems. It uses the knowledge gathered from the public transportation sector and translates it for designing the green business model of hybrid propulsion systems. A direct transfer of the data can be found in table 15 in Appendix G.

5.2.1 Value proposition design
The results of the case study have shown that internal sustainability goals and the introduction of environmental rules and regulations are the drivers for operators to realize the transition from regular diesel busses to electric busses. However internal sustainability goals are the complete opposite of profit goals, and are usually inferior to these profit goals. The benefits of using zero emission busses cannot compete with the disadvantages of using them, therefore the main driver for realizing the transition can be found in the existence of the regulatory regime. So the base of the value proposition is that the sustainable products and services realize for the user that they comply with the environmental rules and regulations on the market.

In addition to the message that hybrid propulsion systems comply with the latest environmental rules and regulations, it is also important to highlight another important benefit of the sustainable product. The case study and internal analysis have shown that operators always seek to operate with the lowest cost of ownership, so the fuel savings that can be realized with the use of the hybrid propulsion systems should also be communicated to the user. The results of the pilot project (three hybrid ferries for CMAL) with respect to fuel savings and emission reduction can be used in the value proposition as well to show potential customers the results that can be achieved with the hybrid propulsion system.

In the public transportation sector the operators found it very common that the producers offer after-sales to them. The producers emphasize the importance of after-sales as well due to the introduction of new technology and new knowledge. Producers can distinguish themselves by the responding time for maintenance and repair. The hybrid propulsion systems involve also new technology and new knowledge, so after-sales should be offered to the ferry operators as well. Due to the market mechanism of the ferry market the after-sales contract can be signed with the end-user directly or with the yard if they act as a mediator between a supplier like RH Marine NL and the operator. For RH Marine NL it is important to show the operator that they are able to respond quick to problems or system failures and that they are able to fix those for the customer within a reasonable time frame. It distinguish them from the other competitors in the market.

Producers of electric busses strives to standardize as many as possible, since it enhances series production. This is a major difference with the ferry market, since the internal analysis has shown that the projects in the maritime market are one-of-a-kind. Customization is preferred above standardization, but the e-mobility approach of one of the electric bus producers shows the modular approach. It uses blocks for each of the system’s main components and it is possible to vary within those blocks to offer the best possible solution to the customer. It aims at a good balance between standardization and customization, which is a good approach for the hybrid propulsion as well.
The conclusion for the design of the value proposition is that it should focus on two types of value creation for the end user. On the one hand the operators comply with the environmental regulatory regime when using hybrid propulsion systems, while on the other hand fuel savings can be achieved. This is for the operator very attractive since they are always seeking for the lowest total cost of ownership (TCO). RH Marine NL should also offer after-sales to the operators, and they can distinguish themselves from the competition by the responding time for maintenance and repair. Since RH Marine NL strives to offer the best possible solution to their customers, the modular approach is a valuable tool to standardize despite the one-of-a-kind character of most projects. Building blocks of the systems are standardized, but it is possible to vary within those blocks.

5.2.2 Customer interface design

The case study has shown that the transition from regular diesel busses to electric busses has not identified new customer segments. The internal analysis however already marked the role of the end user in the construction of new vessels. Although the yard is responsible for the purchase of systems and services for the vessel, the end user is able to influence that process by placing suppliers on the preferred supplier list. There is still one customer segment, but is important to have close contact with the end user as well. The objectives of both also differ, since the yard is always seeking for the lowest investment costs while the operators is more interested in the lowest operational costs. That difference is important in the approach towards these two actors.

The customer relationships for electric busses have been intensified in comparison with the sales of regular diesel busses. The same can be implemented in the business model for hybrid propulsion systems, because the hybrid propulsion systems are more complicated than the electric systems used for diesel-direct ferries. It requires close contact with the end user to express the added value for them, while end users are not contacted for simple systems for diesel-direct ferries. It also requires close contact with the yards when integrating the systems onboard. More activities need to be executed, what makes the planning more complex. During the project frequent evaluation between the yard and the supplier like RH Marine NL is required.

The electric busses are sold via established sales channels, because most operators are already known by the operators. Next to the established channels, the electric bus producers visit fairs related to (public) transportation. This design can be copied to the hybrid ferry market, because RH Marine already have close contact with some yards and naval architects. The experience and knowledge of RH Marine NL is known in the market, but cold acquisition to extend their reach is recommended. Visiting fairs with respect to maritime or sustainability should also be part of the sales channels.

Overall can be concluded that there is one customer segment that needs to be served, namely the yards, but that these can be influenced by another important actor on the market, known as the end user. By placing a specific supplier on the preferred supplier list an end user can influence the purchasing process. Therefore it is important for RH Marine NL to have close relationships with the yards, who are seeking for the lowest costs, but also with the end users, who are seeking for the lowest total cost of ownership (TCO). The sales can be done via already established sales channels, but cold acquisition is required to extend
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their reach. Visiting fairs with respect to maritime or sustainability is also required to create awareness for the new sustainable technology.

5.2.3 Supply chain design

The key partners the public transportation sector are governments, suppliers, (external) investors, and knowledge institutes. Those key partners cannot be copied into the business model of hybrid ferries, only governments and suppliers are from importance. As stated, governments introduce environmental rules and regulations but are also often shareholders of the ferry operators. Governments also finance green projects, which can be financially attractive but also function as a knowledge development project. With respect to suppliers, the supply chain is standardized for electric busses. RH Marine NL however chooses, due to the one-of-a-kind characteristic of most projects, to reasonably standardize the supply chain. They are supplier independent, so the choice for a supplier can be changed if requested by the end user or yard. External investors are not needed to scale up production for suppliers like RH Marine NL, they are only needed for the end users to finance the construction of the vessel. Knowledge institutes are not included in the current business model, but can be a valuable addition. In cooperation with knowledge institutes the current knowledge database can be extended, which may lead to an improved added value for the customer.

The key activities in the business model for electric busses depends on the approach towards e-mobility. While one producer offers just electric busses with after-sales, other producers offer a complete e-mobility solution. This requires analysis of the current operations, and so this analysis is seen as a key activity in the business model. This approach however cannot be copied to the hybrid ferry market since the ferry require more powerful propulsions and they usually just sail from point A to point B instead of following a route schedule. It shows more similarities with the approach of just sales with service and maintenance contracts. Independent of the approach that has been chosen, all producers and end users highlight the importance of bus driver involvement. This key activity can be integrated into the business model of hybrid ferries, by giving ferry captains the opportunity to test a hybrid ferry. Their involvement has been seen as crucial for implementation success.

All producers in the public transportation sector use the same key resources for the electric bus, known as knowledge on the technology, production facilities, workshops, skilled personnel, and subsidiaries. All these key resources can also be used as key resources for hybrid ferries. The only main differences between the public transportation sector and the ferry market is the production facility which is directly related to the yard. The yard has his own production facility and propulsion systems are installed at the yard’s side. Knowledge on the technology is already developed by RH Marine NL, and they have skilled personnel available in the organization. RH Marine NL does currently not participate in green projects, but the case study has shown that these green projects could be interesting to an organization. On the one side it is financially attractive in the form of subsidiaries, while on the other hand it enhances knowledge development.

The conclusion with respect to the supply chain design is that key partners for RH Marine NL are governments, suppliers, and knowledge institutes. Governments are usually shareholders of ferry
operators, introduce environmental rules and regulations, but also support green projects. Suppliers provide subcomponents, but the supply chain of RH Marine NL should not be standardized. They are supplier independent, which might be useful for the one-of-a-kind characteristic of ferry projects. Knowledge institutes can be added to the list of key partners, since a cooperation with them leads to knowledge development. It increases the added value to the end user. One of the key activities is the involvement of ferry captains, by giving them the opportunity to test the hybrid propulsion systems. Key resources are technology, production facilities, workshops, skilled personnel, and subsidiaries.

5.2.4 Financial model design

In the public transportation sector there are two types of sales models, one is the direct sales of busses to the operator while the second is a lease model, meaning that the operators lease the busses from a lease company. Because RH Marine NL is just a supplier of hybrid propulsion systems and electronic systems, they do not work with lease models. They are not responsible for the construction of the whole vessel, so direct sales to the customer can only be applied for them. Additional revenues can be generated, just like for electric busses, by offering after-sales services like maintenance. One of the producers also offers consultancy work with respect to sustainability, and for RH Marine NL these revenues can be generated by offering consultancy activities during the design phase of the vessel. With their knowledge and experience they can provide valuable input for the propulsion system design for the vessel. Subsidiaries should also be generated by participating in green projects. An example of such a project is the Green Shipping Project in Norway.

Costs are directly related to the purchase of components for the hybrid propulsion system, which shows similarities with the public transportation market. The charging infrastructure will be less costly since less charging points have to be realized. Other expenses, also already determined for the electric busses’ producers, are costs for personnel and fines if the planning is delayed due to own mistakes. RH Marine NL also faces large travel costs, because there personnel works on side.

Overall can be concluded that revenues can be generated by sales, after-sales, consultancy activities and subsidiaries. Costs are related to the purchase of components, personnel, fines, and travel expenses.
6. Discussion

This paper explores the relationship between sustainability, business models, and environmental rules and regulations. The influence of environmental rules and regulations on the organization’s innovation capacity and business models have only been recently the topic of interest and this paper addresses the importance to integrate the regulatory regime into the business model. The research question that follows from this view:

*How should an organization arrange its (green) business model to benefit from an innovative market given environmental rules and regulations?*

The methods used in this research are a literature study, a case study and an internal analysis. The literature study provided a theoretical base and showed the current views on environmental rules and regulations and their influence on the organization’s innovation capacity and business models. The findings in literature have been used as input for the interviews for the case study. The case study focused on the public transportation sector, specifically the transition from regular diesel busses to electric busses. The public transportation sector has been chosen because it has the most similarities with the hybrid ferry market. The interviews have been conducted with producers of electric as well as user of electric busses to find out the business model behind the electric busses, but also the purchasing process itself. The internal analysis has been carried out to determine the business model behind hybrid ferries.

The findings of the case study has shown that most elements of the business model has been influenced by the introduction of environmental rules and regulations, except for the elements ‘customer segment’ and ‘channels’. Literature states that one or two elements usually have been influenced, depending on the type of business model and the strategy chosen how to deal with the regulatory regime. The case study has shown that seven elements have been influenced, although all players on the market use the same strategy to deal with the regulatory regime. The same findings can be found for the hybrid ferry business model.

6.1 Theoretical contribution

The introduction of environmental rules and regulations within the public transportation sector has led to a transition towards sustainable solutions. The aim of the regulatory regime is to reduce local air pollution, which should result in improved air quality. Hellström (2007) has analyzed a sample of sustainable innovations and concluded that most sustainable innovations can be categorized as new methods of production or new sustainable products. Sustainability in the public transportation sector has been achieved by the development of zero emission busses, which is in line with the findings of Hellström (2007). Operating with new methods of production does not comply with the new environmental rules and regulations, therefore the most practical and financial attractive solution within the boundaries of the regulatory regime was the development of zero emission busses.

The adoption of these electric busses can be done by five different types of adopters according to Rogers (2003). These are known as innovators, early adopters, early majority, late majority, and laggards. Innovators are usually characterized as consumers who are willing to take risks, while early adopters
envision the advantages of an innovation and adopt mainly to gain respect from others. Early majority has to be seriously convinced before they are willing to adopt the innovation, while the late majority is skeptical, cautious, and they only adopt an innovation when it is on the market for a longer time. Laggards, also known as traditionalists, dislike change and they will only adopt if alternatives are no longer available. The introduction of rules and regulations resulted in certain boundaries which created guidance for operators in the public transportation sector. Whether operators embrace the transition towards sustainability or not, they have no other option than to comply with the regulatory regime. Due to the time frame of the environmental rules and regulations (no emission from 2025) operators are forced to implement the electric busses earlier than they might have done without the existence of the regulatory regime or they wouldn’t have it done because of the higher total cost of ownership. The adoption motivation is directly linked to the existence of the regulatory regime and operators are categorized based on the rules and regulations instead of the internal motivation.

For the adoption of sustainable innovations, Noppers et al. (2015) identified three types of attributes. These are known as instrumental, environmental, and symbolic attributes. Instrumental attributes are related to the perceived functional outcomes of using a sustainable innovation. Environmental attributes reflect the perceived outcomes for the environment of using a sustainable innovation. Symbolic attributes are related to the perceived outcomes of using a sustainable technology for consumer’s identity and social status. A positive evaluation of the three attributes increases the possibility of adopting the sustainable innovation, although symbolic attributes are less recognized by consumers as motivation for innovation adoption. For electric busses the instrumental attributes have been negatively evaluated, since operators identify more disadvantages than benefits for the implementation of these busses. The environmental attributes are positively evaluated, while the symbolic attributes are less important than the financial aspect. It means that these have been negatively influenced based on the higher total cost of ownership in comparison with the regular diesel busses. The case study has shown that the existence of environmental rules and regulations force operators to adopt, even when the three attributes have negatively been evaluated. The regulatory regime have created the situation where operators can adopt the sustainable innovation or to refuse to adopt, but with the consequences that business will be lost.

As already stated before, the development of electric busses is a direct result of the introduction of environmental rules and regulations. In literature different views can be distinguished with respect to the influence of environmental rules and regulations on the organization’s innovation capacity. Debnath (2015) categorized environmental rules and regulations initially as a threat to the organization, because it may increase investment costs. However, eventually it will force the organization to behave innovative which results in improved products or production processes to neutralize these costs. In addition to Debnath (2015), Porter and van der Linde (1995) stated that environmental rules and regulations can have a positive influence on an organization’s innovation capacity, because they believe that pollution is a form of economic waste. An opposite view is provided by Palmer, Oates, and Portney (1995), who argue that environmental rules and regulations could have a negative influence on the organization. In addition to these two views, Jaffe et al. (1995) argue that there is relatively little evidence to state that environmental rules and regulations influence the organization and its competitiveness. The case study has shown that
in the public transportation sector the introduction of environmental rules and regulations has positively influenced the organization’s innovation capacity, since the electric bus is a sustainable solution which complies with the regulatory regime. It contributes to society by reducing air pollution and by improving the air quality.

In addition to the influences of environmental rules and regulations on the organization’s innovation capacity, the regulatory regime also influences the business model. Huijben, Verbong, and Podoynitsyna (2016) concluded that rules and regulations do not affect all the elements of the business model, but that usually one or two elements are affected. Hopkins (2016) stated that business models can be blocked or even be stopped by regulatory roadblocks. The possibility of blockage is a serious threat to business model innovation and Hopkins (2016) concluded that two aspects are crucial for the business model. First, anticipate on regulatory issues while still designing and testing the business model and second, understand how to work with government. These aspects result that, based on the strategy chosen by the organization, rules and regulations might influence the value proposition, the delivery method (channels), and key activities. When communication and cooperation with governments and agencies is part of an organization’s strategy, the key partner element of the business model is influenced as well (Hopkins, 2016). The business models in the case study have been influenced more than literature suggested, since all business model components have faced serious changes towards sustainable solutions. Only the elements ‘customer segments’ and ‘channels’ of the customer interface have not been significantly influenced. The case study has shown that the organization needs to adapt to implement these changes and that without business model innovation sustainability is hard to achieve.

6.2 Practical contribution
At the start of this master thesis the problem of the organization was the step between an invention and an innovation. The introduction of environmental rules and regulations within the maritime market has created opportunities, but so far they were not able to exploit these opportunities. The case study and internal analysis has shown that their business model for hybrid ferries has several similarities with the business model used for electric busses, but they differ in the supply chain and financial model. The report has suggested some improvements for the business model to realize a successful commercialization of the products and services RH Marine NL offers with respect to hybrid ferries. These improvements in combination with the existing business model should eventually lead to more business and their contribution to society.

6.3 Limitations and future research
As stated before, the case study has been conducted in the field of electric busses, because it shows the most similarities with the hybrid ferry market. Two questionnaires have been developed, one for the producers of electric busses and one for the users of electric busses. Using these two questionnaires most aspects with respect to the replacement of regular diesel busses by electric busses have been covered. However, the case study has some limitations that could be investigated in future research.
First, the market mechanism of public transportation is slightly different than the market of regular consumer goods. In the public transportation sector two key actors play an important role. On the one hand these are the public transport authorities (PTA’s), and on the other hand, these are the public transport operators (PTO’s). PTA’s are able to create a specific demand by setting standards in the tenders, for example lowest costs or zero emission. Lowest costs will lead to the use of regular diesel busses, since these operate with the lowest total cost of ownership, while zero emission will lead to the use of electric busses. Therefore PTA’s are in a position to push the market in a specific direction, which is usually not the case for regular consumer goods. PTO’s are not able to make their own decision, because offering zero emission when lowest costs is asked will definitely result in not winning the tender and therefore in losing business.

Second, there are fewer players active on the public transportation market than for regular consumer goods. The Netherlands have been divided into several regions with their own PTA’s and concessions. Each PTO is allowed to offer their services via a tender at the end of a concession, but it seems that some PTO’s only operate in specific region like the north or the west of the Netherlands. Only three PTO’s take care of most of the public transportation in the Netherlands, and therefore the market might be less competitive than the markets for regular consumer goods. Because the market structure also influences the business model, this could be the topic of interest for future research.

Third, the PTO’s only use one strategy to deal with environmental rules and regulations. PTO’s are not in the position to adopt another strategy than the conform-and-fit strategy, because they won’t win the tender otherwise. Therefore the conform-and-fit strategy is the only strategy used on the market, while some literature has shown that organizations can also adopt different types of strategy to deal with environmental rules and regulations. Future research could be investigating the role of the chosen strategy by organizations to deal with environmental rules and regulations and the influence on the business model.
7. Conclusion

Literature has shown that an increased interest in global warming has led to an increased interest in sustainable innovations. The introduction of environmental rules and regulations might threaten successful commercialization of the innovations, since literature suggests that the regulatory regime influences the organization’s innovation capacity negatively. Other literature states that environmental rules and regulations influence the innovation capacity positively or not at all. The case study has shown that it for the public transportation sector the producers have been influences positively, since they developed an electric bus in response to the introduction of environmental rules and regulations.

Another statement that has been made in literature is that the regulatory regime usually influences one or two components of the business model, in some cases it might be three components. The business model for electric busses is completely influenced by environmental rules and regulations, all components have faced direct or indirect changes. Only the elements ‘customer segments’ and ‘channels’ have not been changed in the transition towards sustainability. The case study has proven that the influence of the regulatory regime on the business model is larger than could have been expected by literature.

The transition towards sustainability is a complex and expensive process. It requires financial effort from several actors on the market and it requires a change in attitude from those actors. The development of sustainable technologies and testing of those technologies in pilot projects is often the start of a transition, and is usually (partly) financed by governments. The role of governments in sustainable entrepreneurship is definitely enlarged in comparison with the situation without the existence of environmental rules and regulations.
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Bibliography


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Appendix

Appendix A: Additional literature on innovation

Appendix A1: Idea, invention, and innovation
An innovation should not be confused with the term invention, although these two can be almost the same in practice. However, the base of the innovation process is creativity. It all starts with creative ideas that are the result from extensive research with respect to customer problems or technology driven shifts. These creative ideas are the input for an invention, which is a basic concept, but has not yet real financial value. Then the organization has to combine several types of knowledge, skills, and resources to turn an invention into an innovation by commercialize it successfully (Toner & Tompkins, 2008; Sarooghi, Libaers, & Burkemper, 2015; Fagerberg, 2003; El Bassiti & Ajhoun, 2013). The relationship between idea, invention, and innovation is shown in figure 1.

![Figure 11: Idea, invention and innovation (Stein, 2012)](image)

Appendix A2: Forms of innovation
We can distinguish three principals for the different forms of innovation: products, processes, and services. The most common form of innovation is product innovation, which is the development of a new or improved product. It also contains the innovation in all of the functional processes of a product. The second form of innovation is process innovation, innovation directly related to the development of new production processes or logistic processes (Crawford & Di Benedetto, 2008) (Greenhalgh & Rogers, 2010). Service innovations are normally less visible for consumers, however they can be very important to an organization. A service innovation is the improvement in technology, business model, and social-organizational aspects with the aim to deliver an improved service to the customer (Chen, Wang, Huang, & Shen, 2016).

Appendix A3: Types of innovation
Within each form of innovation, innovations can also be categorized by type. The first manner to do so, is by having a look at the relationship between the basic design concepts and the linkages between the components (Byers, Dorf, & Nelson, 2011; Magnusson, Lindström, & Berggren, 2003). The first type can be distinguished when the basic design concepts are improved but the linkages between components remain unchanged. Then the innovation is categorized as incremental, which is an innovation to improve
a product, process, or service, without making any changes to the way components are structured. It is an innovation to doing things better than an organization already does (Norman & Verganti, 2014).

Second, when the basic design concepts are improved and the linkages between components are changed, the innovation is named as an architectural innovation. Architectural innovation does not introduce new component technologies, it only changes the product configuration and combines the components in a new way. The third type is determined when the basic design concepts are overturned but the linkages between the components are unchanged. The innovation is then categorized as a modular innovation. Modular innovation introduces new technologies, but the ways the components are structured remain unchanged (Magnusson, Lindström, & Berggren, 2003).

Fourth and last, an innovation is called radical, or disruptive, when the basic design concepts are overturned and the linkages between components are changed. Usually new and highly complex technologies are used, and shifts in market structures are acquired (Lettl, 2007). Acceptance of radical innovations takes longer than the three other types of innovation (Norman & Verganti, 2014). A complete overview of the four types of innovation is displayed in table 1.

Table 11: Types of innovation (Byers, Dorf, & Nelson, 2011)

<table>
<thead>
<tr>
<th>Linkages between components</th>
<th>Basic design concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unchanged</td>
<td>Improved</td>
</tr>
<tr>
<td></td>
<td>Incremental innovation</td>
</tr>
<tr>
<td></td>
<td>Modular innovation</td>
</tr>
<tr>
<td>Changed</td>
<td>Architectural innovation</td>
</tr>
<tr>
<td></td>
<td>Radical innovation</td>
</tr>
</tbody>
</table>

An additional method to categorize an innovation by its type is proposed by Booz, Allen, and Hamilton (1982). They suggest that the newness of the innovation to the organization as well as to the market has to be determined. This method distinguish six different types of innovation, known as new-to-the-world products, improvements and revisions of existing products, new product lines, additions to existing product lines, repositioning, and cost reduction. New-to-the-world products are innovations that create a new market, while improvements and revisions of existing products innovations only replace a product or improve it. These innovations make small adjustments to existing products by improved performance or greater perceived value. The third category, new product lines, may contribute to the opportunity for an organization to enter an established market for the first time. Additions to existing product lines are the extensions of established product lines by adding new products. The last two types are repositioning and cost reduction, which is the process of targeting the product to new markets or market segment, and producing products or deliver services at lower costs respectively (Booz, Allen, & Hamilton, 1982).
Appendix A4: Predictors for innovation

The probability of successful commercialization is not the same for every organization, neither is the access to innovation resources. Detienne, Koberg & Heppard (2001) did an extensive research with respect to predictors for incremental and radical innovation. They examined 900 organizations, operating in the aerospace industry, the telecommunications industry and the electronics industry. Their research contained predictors of four different categories, named as environment, organization, process, and managerial.

Their findings showed that an increase in environmental dynamism, reflecting the extent to which strategists perceive unpredictable change in the external environment, results in an increase in incremental innovation. Next to environmental dynamism, the age and the size of the organization are predictors for incremental innovation as well. When the age of the organization increases, the probability of successful commercialization of incremental innovations increases as well. This trend is the same for the size of the organization. The fourth predictor of incremental innovation is intrafirm structural linkages, which are cross-functional and coordination mechanisms designed with the aim of increasing integration. When the number of intrafirm structural linkages increases, the number of incremental innovations increases as well. The last predictor, the age of the CEO, is negatively related to incremental innovation (Detienne, Koberg, & Heppard, 2001).

There are less predictors for radical innovation, however there is some overlap with incremental innovation predictors. Similar to incremental innovation, an increase in environmental dynamism results in an increase in radical innovations. The second predictor is also mentioned before, intrafirm structural linkages, meaning that a rise in the number of intrafirm structural linkages leads to an increased number of radical innovations. The last two predictors for radical innovations differ from those for incremental innovations and are known as experimentation and transitioning. Experimentation and transitioning, sequencing from one project to another, are both positively related to the commercialization of radical innovations (Detienne, Koberg, & Heppard, 2001).

In the article of Tavassoli (2004) other predictors of innovation have been discussed. He mentioned three important factors: availability of human capital, firm size, and engagement in export and import. He did not distinguish different types of innovation, but used the term innovation in general. The base for his research is the industry life cycle, which describes how an industry evolves over time, measured in total amount of sales. It has four different stages, known as emergence, growth, maturation, and decline (Byers, Dorf, & Nelson, 2011). Human capital is more important for the innovative performance of an organization in growing industries than for the firms in other stages of the industry life cycle. On the other hand, firm size is more important for innovation propensity of the firms in mature industries than the firms in other stages of the industry life cycle. Engagement in export and import is more important for innovation propensity of the firms in declining industries than the firms in other stages of the industry life cycle.
Appendix A5: Barriers for innovation
As mentioned before, invention and innovation are key success factors for an organization’s performance. However, it seems really difficult for an organization to develop an idea into an invention, and even more difficult to commercialize an invention into an innovation. Organizations face several barriers during this process, which can be divided in three different categories: cost barriers, knowledge barriers, and market barriers (Segarra-Blasco, Garcia-Quevedo, & Teruel-Carrizosa, 2008). Each category has its own impact on the commercialization process and it is essential for an organization to identify barriers in an early stage. If needed and if possible, the organization can attempt to overcome the barriers and increase the possibility of a successful commercialization.

Cost barriers are concerned with the lack of financial resources, internal and external, and the high costs of innovation. Innovations are often related to the adoption or introduction of a new technology, which seems to be very complicated for an organization resulting in raised costs (Long, Blok, & Coninx, 2016). Knowledge barriers are related to the limited access to information on technology and the availability on skilled personnel. Market barriers are the lack of understanding of customer needs, the uncertainty in demand, and the lack of demand. An innovation can be useless if it does not match with customers’ needs (Segarra-Blasco, Garcia-Quevedo, & Teruel-Carrizosa, 2008).
Appendix B: Interview protocol

Appendix B1: Interview protocol electric busses (producer)

Name respondent: 
Organization: 
Function: 
Date: 
Location: 

General

1. What is the core business of your organization? 
2. What is the strategy of your organization? 

Value proposition

1. Which products and services does your organization offer to her customers? 
2. What is the added value that the products and/or services deliver for the customer? 
   a. Distinctive profile in comparison with competitors? 
3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc)? 
4. Are the products or services standardized or customized for each customer? 
5. Are the products or services technology or demand driven? 
6. Is the value proposition influenced by environmental rules and regulations? 
   a. Which specific environmental rules and regulations do exist? 
   b. How is the value proposition influenced? 
   c. Are environmental rules and regulations used to create ‘new’ demand? 

Customer interface

1. What type of customers does your organization serve? 
   a. Which customer segments can be identified? 
   b. What differences can be identified between these segments? 
   c. Do environmental rules and regulations identify a new segment of customers? 
2. What are the core activities of the customers? 
3. What are the customer’s demands and needs? 
4. Is the customers’ purchasing behavior influenced by environmental rules and regulations? 
   a. How does it influence the purchasing behavior? 
5. Can you describe the relationship with your customers? 
   a. Which stakeholders are involved in the purchasing process? 
   b. Are all stakeholders involved during the development process? 
6. What contact points occur during the relationship with the customer?
Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?
   a. Which logistic partners and what is their specific role?
   b. Which financial partners and what is their specific role?
   c. Which suppliers and what is their specific role?
2. Which key activities are essential to deliver value to the customer?
3. To which degree is the supply chain ‘green’?

Financial model

1. What is the revenue model of electric busses?
   a. What pricing mechanism does the customer prefer?
   b. How price sensitive is the customer?
   c. Is the price fixed or is it performance-based pricing (low fixed price plus performance-based bonus)?
   d. Are there any governmental grants involved?
2. Can you describe the cost structure?
3. What is the return on investment (ROI)?
4. Does the organization participate in ‘green projects’ (initiated by local or national government)?
   a. What is the main reason (for the government) to launch these ‘green projects’?
   b. What is the main reason for the organization to participate?
      i. Is it financially attractive to participate?

Ending

1. Do you have any additions to the discussed topics?
2. Do you have any further remarks regarding this interview?

Appendix B2: Interview protocol electric busses (user)

Name respondent:
Organization:
Function:
Date:
Location:

General

1. What is the core business of your organization?
2. What is the strategy of your organization?
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

Purchase

1. What is the main reason to purchase electric busses instead of regular (diesel) busses?
2. What are important aspects when purchasing electric busses?
3. Who are the stakeholders in the purchasing process?
4. How many parties are offering the electric busses?
   a. What are the main differences between them?
   b. What are the main reasons to choose for the final supplier to deliver the electric busses?
5. Are there any substitutes regarding sustainable transportation?

Performance

1. What are the benefits of electric busses in comparison with regular busses?
2. What are the disadvantages of electric busses in comparison with regular busses?
3. Does the use of electric busses require any adaptations within the organization?
4. Do the electric busses meet the expectations?
   a. If yes, is there still improvement possible?
   b. If no, what should be improved and how can these improvements be achieved?

Rules and regulations

1. Does the organization have to deal with environmental rules and regulations?
   a. If yes, which environmental rules and regulations?
   b. If yes, does it influence the current operations of the organization?
   c. If no, do you expect that environmental rules and regulations will become important within the area you are operating in?
2. Are there any subsidiaries involved for the use of electric busses?

Ending

1. Do you have any additions to the discussed topics?
2. Do you have any further remarks regarding this interview

Appendix B3: Interview protocol RH Marine NL

Name respondent:
Organization:
Function:
Date:
Location:
Value proposition

1. Which products and services does the organization offer to her customers?
2. What is the added value that the products and/or services deliver for the customer?
   a. Distinctive profile in comparison with competitors?
3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc)?
4. Are the products or services standardized or customized for each customer?

Customer interface

1. What type of customers does the organization serve?
   a. Which customer segments can be identified?
   b. What differences can be identified between these segments?
2. What are the core activities of the customers?
3. What are the customer’s demands and needs?
4. Can you describe the relationship with the customers?
   a. Which stakeholders are involved in the purchasing process?
   b. Are all stakeholders involved during the development process?
5. What contact points occur during the relationship with the customer?

Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?
   a. Which logistic partners and what is their specific role?
   b. Which financial partners and what is their specific role?
   c. Which suppliers and what is their specific role?
2. Which key activities are essential to deliver value to the customer?

Financial model

1. What is the revenue model of ferries?
   a. What pricing mechanism does the customer prefer?
   b. How price sensitive is the customer?
   c. Is the price fixed or is it performance-based pricing (low fixed price plus performance-based bonus)?
2. Can you describe the cost structure?

Ending

1. Do you have any additions to the discussed topics?
2. Do you have any further remarks regarding this interview?
Appendix C: Interviews with producers

Appendix C1: Interview Walter Luijten

Name respondent: Walter Luijten
Organization: Ebusco
Function: Managing Director
Date: 21-04-2016
Location: Helmond, The Netherlands

General

1. What is the core business of your organization?

The core business of our organization is electric transportation in the form of electric busses and electric bus components.

2. What is the strategy of your organization?

Our strategy is to provide our customers electric transportation solutions where only night charging is required (no difficult charging infrastructure across the city).

Value proposition

1. Which products and services does your organization offer to her customers?

We offer electric busses to our customers, which we develop, produce, and bring to the market. Next to electric busses, we offer sustainable drives for vessels in cooperation with our partner Nonox gas engines. Due to the extreme carbon emissions of inland (and offshore) vessels, a serious reduction in emission needs to be realized. Fully electric drives for inland won’t be achievable, therefore these need to be equipped with a hybrid drive.

2. What is the added value that the products and/or services deliver for the customer?

The current large engines installed on the inland vessels are outdated and do not fit anymore with the required performances. The adaption of the current drive line to an electric drive line in a hybrid system offers economic benefits to the customer in particular. In contrast, the electric busses are fully electric but are financially attractive as well. Additional benefits the electric busses provide to our customer are emission reduction (no emission at all) and noise reduction. At Ebusco, we strive to serve our customer with an electric bus that has the capacity to be operational for one full day. In-between charging is therefore not needed, so this situation shows the most similarities with the current operations (busses with diesel engines). In-between charging requires serious investments in a charging infrastructure across the city while night charging only requires a charging infrastructure at the depot. Some cities already have
the charging infrastructure across the town, and for these cities one single load is not actually required. For others, for example Paris, overnight charging is the only option.

3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc.)?

After-sales services are extremely important, because the technology is relatively new. Customers have less knowledge available of the technology itself, resulting in service agreements for maintenance and repair. Usually these services are paid for a price per kilometer. When operators lease or buy the electric busses, their first concern is after-sales services.

4. Are the products or services standardized or customized for each customer?

The drive line within the bus is standardized, since it is universally applicable for all busses. The battery pack for the electric busses can be used for a 300 kilometer drive, which is enough for most public transportation. So overall, the drive line and battery pack is standardized. Other elements on the bus like chairs, doors, and the driver’s cabin can be customized, but these elements can also be customized for busses with diesel engines. So this does not differ in comparison with the diesel engine busses.

5. Are the products or services technology or demand driven?

The development of the electric bus at Ebusco is the result of the knowledge available on foreign markets. China and India face serious problems with respect to environment and carbon emission, and solving these problems is priority number one. The knowledge they have been developed during the years and the concept of the electric bus that has been developed for their own needs, is adapted to the needs of European customers. Although there is an increased awareness for sustainability and economics in Europe, serious actions have not been taken so far. The electric bus shows European governments that sustainable technology is available, and by giving demonstrations in European cities the awareness for the existence of the electric bus increases. Three bus types has been developed so far, and we now have a final configuration which has entered the market. So overall, you could say that the electric bus is the result of customer needs combined with available existing technology.

6. Is the value proposition influenced by environmental rules and regulations?

Last week an important agreement has been signed between several cities in The Netherlands and the state secretary stating that all public transportation in 2025 must be ‘zero emission’. This means that all busses for public transportation will use electricity or hydrogen as fuel. Electric busses have zero emission and hydrogen busses only produce water as emission, so both options could be interesting for operators. It is important know how the energy is generated, since a coal power plant is far from sustainable. Gas is much better, but solar or wind energy are the most sustainable solutions for generating energy. Hydrogen busses are sustainable, but are not competing enough with respect to costs. The costs are too high for operators, so electric busses will be the best option for operators.
Customer interface

1. What type of customers does your organization serve?

First, electric busses are sold to public transport operators (PTO’s). Public transport authorities (PTA’s) issue concessions to public transport operators, which allow the operators to offer their services to the customer for a certain period. Normally this period is eight to ten years, equal to the average durability of a bus. Public transport authorities may demand from the operators that the busses are zero emission, which is the latest trend. In return, the operators demand from the authorities a financial contribution in the form of grants in the beginning of the transitional phase from diesel busses to electric busses. For example, the province Noord-Brabant in The Netherlands takes care of the additional costs for the buy of electric busses. Second, a customer segment ‘private bus companies’ can be identified. However, this is not a large segment within in the Netherlands and private bus companies are more price sensitive than public transport operators. Therefore is it relatively hard to let the electric busses compete with the regular diesel busses.

2. What are the core activities of the customers?

The core activity of the customers is the safe transportation of customers from point A to point B.

3. What are the customer’s demands and needs?

The customers demand a reliable bus, which means that it has a high percentage of uptime and few disruptions. Next to that, they expect zero emission in accordance with the new environmental rules and regulations. As a result of new technology, they demand maintenance and service repair as well.

4. Is the customers’ purchasing behavior influenced by environmental rules and regulations?

As already mentioned, an important agreement has been signed between several cities in The Netherlands and the state secretary stating that all public transportation in 2025 must be ‘zero emission’ customers’. Based on this agreement and the new environmental rules and regulations, the operators are forced to purchase electric busses. So overall, purchasing behavior of customers is definitely influenced by environmental rules and regulations.

5. Can you describe the relationship with your customers?

Bus drivers are not directly involved during the purchasing process, but drivers are extremely important for the success of electric busses. Therefore we demonstrate our electric busses and let bus drivers test the vehicle. Public transport operators strive to familiarize their drivers with the new techniques and the principle of electric transportation. The testing period varies, from two days to two months.
6. What contact points occur during the relationship with the customer?

Because after-sales are so important for new technology, we have contact with the customer on a regular base. We also demonstrate our busses to potential customers and let bus drivers have the opportunity to test our busses. It contributes to a better relationship between us and our customers.

Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?

The bus consists of several crucial components, like the drive motor, the motor controller, the battery pack, and the battery management system. For each of the components we have one or more suppliers that cooperate with us to deliver value to the customer.

2. Which key activities are essential to deliver value to the customer?

The key activities that are essential can be found within the electric driving line and the battery pack. A combination of these two components of the bus makes the electric bus unique. The construction of the bus is done in Asia.

3. To which degree is the supply chain ‘green’?

We have not analyzed the production process of all the different elements within electric busses. The battery pack is an essential component of the bus, but it is unknown if the production process of these batteries is a sustainable production process. The key driver for electric transportation is the elimination of local emission, but there is still emission during the production process. The emission can be found within the supply chain, known as emission from well to wheel. To achieve real sustainability, the supply chain should be sustainable as well. An important factor that should be taken into account as well, is the type of energy used for the electric bus, since solar and wind energy are definitely more sustainable than energy from a coal power plant. Full sustainability is very hard to achieve.

Financial model

1. What is the revenue model of electric busses?

Nowadays operators prefer to lease the busses, because they do not want the busses as an asset on the balance sheet. Lease also means that the total cost of ownership (TCO) is known in advance and therefore the business is less risky. Operators lease the electric busses from lease companies, who charge the operators a lease fee. In the transitional phase from diesel busses to electric busses, the operator can gain governmental grants. When the number of electric busses increases, grants will be withdrawn.

2. Can you describe the cost structure?

The price of the electric bus is more or less determined by the battery pack, since it is fifty percent of the costs. So the price of the bus is influenced by the size of the battery pack, which is determined by the
required range of the operator. Customer specific demands are also an important cost factor, but the costs for the battery pack stands above all costs.

3. What is the return on investment (ROI)?

Due to the fact that customers prefer a lease construction, total cost of ownership is known in advance. Therefore there is no real return on investment, except for the lease companies.

4. Does the organization participate in ‘green projects’ (initiated by local or national government)?

Governments subsidize the transitional phase from the moment that producers show that the technology is available but it is still expensive to implement it until the moment that the numbers sold are large enough. Their goal is the introduction of electric busses within the public transportation sector and subsidizing contributes to it. Governments also subsidize the development of the technology via innovation funds, so they really stimulate the industry to develop sustainable technologies. A good technology finally attracts external investors in the business, which is financially attractive.

Ending

1. Do you have any additions to the discussed topics?

The shift within the bus industry needs to be realized within the maritime market as well. The engines are outdated, so new electric drive lines are essential.

2. Do you have any further remarks regarding this interview?

No, I do not.

Appendix C2: Interview Menno Kleingeld

Name respondent: Menno Kleingeld
Organization: VDL Enabling Transport Solutions (VDL ETS)
Function: Managing Director
Date: 25-04-2016
Location: Valkenswaard, The Netherlands

General

1. What is the core business of your organization?

VDL (Van Der Leegte) consists of 88 companies, organized within 4 divisions. The first division is ‘subcontracting’, the second division is ‘finished products’, the third division is ‘Bus&coach’, and the fourth and last division is ‘car assembly’. Within the division Bus&coach, VDL ETS is recently established as a result of the growing interest in e-mobility, so we focus on the development of e-mobility. It is pretty hard to fund new developments while still selling your cash cow, so the core business of VDL ETS is to develop
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

the business for e-mobility. Activities of VDL ETS are energy (supply), energy storage, charging infrastructure, monitoring and maintenance charging infrastructure, building blocks for electric vehicles, battery-assembly / re-conditioning, hydrogen technology, simulation software, autonomous driving, and new business models. We are not responsible for sales of the electric busses and other electric vehicles.

2. What is the strategy of your organization?

Of course our strategy is to sell as many busses as we can. However, due to the introduction of environmental rules and regulations and the shift in e-mobility that has been creates, our first concern is to provide our customers with the best possible electric solutions for their specific needs.

Value proposition

1. Which products and services does your organization offer to her customers?

E-mobility is more than just a vehicle, it is a chain of activities that needs to be executed. Within the division Bus&Coach we offer transportation solutions to our customers, which also include repair and maintenance, and monitoring services. The basic product is the vehicle and around the product we offer several services.

Initial investment costs are no longer the issue, operators are focused on total cost of ownership (TCO). If you divide the costs of electric busses in pieces, the initial investment is only 10% of the costs. Energy is 30% and maintenance is 10%. The largest costs are known as the costs made by drivers, which is equal to the remaining 50%. It does not matter how many busses you buy, but how you can deploy your drivers as optimal as possible. We call this e-logistics, because we analyze the longest and most difficult route. The results of this analysis determine the charging infrastructure and the charging duration to fully operate.

2. What is the added value that the products and/or services deliver for the customer?

E-mobility has several disadvantages. First, it is more expensive, the initial purchase price of an electric bus is twice as much as a regular diesel bus. Second, the range of the electric bus is limited. With batteries the bus is able to drive around 200 to 250 kilometers, while diesel busses have a range of 400 kilometers. Besides that, the impact of heating and cooling on the range is significant. Third, the high vehicle weight is a result of the weight of the battery pack. Fourth, new technology is never as reliable as technology that has been developed for one hundred years (diesel engines). However, e-mobility knows several benefits as well. First, an electric bus has less interior and exterior noise than a diesel bus. Second, the electric bus is zero emission and therefore has no local air pollution. Third, the electric bus is more efficient and has lower energy consumption. On top of that, it is possible to use more alternative energy resources. Fourth, political involvement to reduce emission results in pressure to operate with zero emission busses.

We distinguish ourselves from the competitors by offering tailor made solutions to our customers instead of the ‘one-size-fits-all’ principle. Based on the routes of the busses we determine the best battery pack, the best infrastructure, and monitoring and repair services.
3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc)?

As already stated, the bus is the product however e-mobility is more than just a product. Activities that need to be taken care of are generating energy, transport of energy, and energy storage. Usually generating energy and consumption of energy are not in synchronism with each other. The charging infrastructure is also completely new to customers, so after-sales services are extremely important for the electric bus. New technology requires definitely after-sales.

4. Are the products or services standardized or customized for each customer?

We use modules for components of the bus, like the battery pack or the driving line. We strive to apply these standardized modules as often as possible, so that is a form of standardization. We also customize certain elements of the busses, which gives the customer the feeling that he has a unique product.

Pilot busses are often equipped with special features and the latest developments in technology. However, our advice to governments is to come up with designs suitable for series-production and not one-of-a-kind busses which are often funded. The community can only benefit from a design that is suitable for series-production.

5. Are the products or services technology or demand driven?

I think it a combination of both. On the one hand the product can be realized by what is possible with the current developments in technology, while on the other hand demand increases due to the introduction of environmental rules and regulations.

6. Is the value proposition influenced by environmental rules and regulations?

Two weeks ago, in Amsterdam, a zero emission agreement has been signed meaning that from 2025 the bus transportation must be electric. It is a cooperation between the Dutch government, provinces and public transport operators. The new fleet is not allowed to have any emission. Nine years ahead looks a long time, but is ‘tomorrow’ in our business. Shipping and aviation face the same influences of emission reduction.

The paragraph of environment and emission within a tender becomes more and more important when operators offer their services to an authority. We help the operators to meet those standards and support them via consultancy. Consultancy is an element of the way we sell our products.

Customer interface

1. What type of customers does your organization serve?

We offer our products and services directly to the end user, which are the public transport operators. They are responsible for the public transportation within a certain area, commissioned by the province. Operators buy or leases the busses, Arriva and Connexxion have electric busses produced by VDL in
operation for example. Other customers are private bus companies, although this market is relatively small. Busses of private bus companies usually cover long distances and an electric bus has a driving range that is too limited. All busses within the city must be zero emission from 2025, so a hybrid solution (diesel-electric) will be the best option for these customers.

2. What are the core activities of the customers?

The core activity of our customer is the safe transportation of passengers from point A to point B.

3. What are the customer’s demands and needs?

Our customer wants to make a profit with the transport of passengers, but their final demand is a reliable bus that is fully operational. Customers do react different to e-mobility, because one hesitate due to the high investment costs while others look at the costs per kilometer and think that it is not that bad. The only remark they have is to be profitable during the concession.

4. Is the customers’ purchasing behavior influenced by environmental rules and regulations?

All customers are aware of the environmental rules and regulations, because the authorities are the initiators of public transportation. When agreements with respect to environment and emission are signed, the operators participate in those meetings. They have an active role.

5. Can you describe the relationship with your customers?

All types of stakeholders are involved during the purchasing process, like finance but also the bus drivers. They are of course less involved during the development process, although we invite sometimes stakeholders to have a look at our production process. We also give some drivers the opportunity to test the electric bus and evaluate the performances.

6. What contact points occur during the relationship with the customer?

We do not have specific contact points, but it is really important to keep a good relationship with your customer. We do invite stakeholders to our factory to show them the production of the electric busses, and as the result of our tailor made approach we stay in direct contact with our customer. The after-sales services also contribute to a close relationship with our customers.

Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?

Important stakeholders are for example the battery suppliers. For financing stakeholders within the supply chain we have VDL Financing, who cooperates with other parties for financing activities.
2. Which key activities are essential to deliver value to the customer?

We do not have specific activities that are essential, because our whole supply chain needs to be excellent. At our product planning department we determine the dot on the horizon, where do we want to be at a certain moment in time. Then we search for reliable partners to complete our activities, next we develop a software infrastructure to connect all the parts, and after that we build a prototype bus which we test and adapt according to the feedback. We map the customer needs and the developments of environmental rules and regulations, based on that you plan all the years. Important is to plan backwards instead of plan onwards.

3. To which degree is the supply chain ‘green’?

The degree to which the supply chain is green is partly analyzed. We try to purchase locally (Europe) to avoid unnecessary shipment. Our first priority is to deliver a sustainable and reliable vehicle, a green supply chain is therefore only the second priority. In the future we will strive to make our supply chain more sustainable, and we always advise our customers to use green energy. It is a bit more expensive, but it shows that you are willing to contribute to a better and greener environment.

Financial model

1. What is the revenue model of electric busses?

With the traditional diesel busses we use lease models, and we are going to use the same models for the electric busses. Some suggested to lease just the battery pack, but at the end a battery pack without vehicle is useless. Leasing allows monitoring of battery use, which is a great benefit for the durability of the batteries. The purchase of electric busses by the customer also includes additional services like monitoring, maintenance, and repair (total package).

2. Can you describe the cost structure?

With VDL ETS we strive to achieve break-even, since we are a development organization and our main objective is not to gain profits. The profit can be generated at the end of the chain, the sales department. We invoice the hours of work to the other department of VDL. Generating profit at each department leads to a situation that the products will become too expensive.

3. What is the return on investment (ROI)?

Some technology needs to be developed, otherwise you will give the business away. The Asians will then take over the market leading to your own ‘death’. Therefore it is not an option to not invest, and the return on investment is less important.
4. Does the organization participate in ‘green projects’ (initiated by local or national government)?

We participate in green projects as long as it contributes to the path we already have determined. We do not participate in projects, just for grants. The projects contribute to knowledge development and it could be financially attractive due to governmental subsidiaries.

Brussel should consider what to fund, because there is a lot of money available. Companies who innovate should be rewarded instead of penalized, since innovation is costly. It is important to create employment in Europe, brains and hand. There is serious fear that knowledge of electric transportation is transferred to Asia, and there they have no legacy about engines. There they have a lot of knowledge about batteries.

Ending

1. Do you have any additions to the discussed topics?

No, I do not.

2. Do you have any further remarks regarding this interview?

No, I do not.

Appendix C3: Interview Alex de Jong

Name respondent: Alex de Jong
Organization: VDL Bus&Coach
Function: Business Manager Public Transport
Date: 02-05-2016
Location: Eindhoven, The Netherlands

General

1. What is the core business of your organization?

At VDL Bus&Coach we are responsible for the business with respect to public transport. With my department I arrange all tenders and all the project management.

2. What is the strategy of your organization?

We strive to provide our customers with the best possible electric solutions for their specific needs.
Value proposition

1. Which products and services does your organization offer to her customers?

We offer busses to our customers, like diesel busses, hybrid busses, and electric busses. Traditionally we provided our customers with diesel busses and corresponding services, but nowadays we offer hybrid and electric busses as well. Large numbers can be still found for the diesel busses, but the number of electric busses is increasing. Due to the new environmental rules and regulations the need for electric transportation is increasing. Hybrid busses, hydrogen busses, and electric busses all have an electric drive line, but the electric bus is the only zero emission bus.

VDL is not the largest, but still a big player on the market. Actually, it is possible to distinguish three types of actors on the market. First, the large truck brands like Volvo. Normally truck brands focus on diesel engines and not so much on e-mobility. The second category consists of European companies with a lot of activities related to electric transportation, and third, Chinese and Turkish firms. They have no history in Europe and a lot of battery manufacturers over there developed electric busses. The performance of these busses cannot be compared with the performance of electric busses manufactured in Europe. As VDL, we distinguish ourselves from the competition by the modular approach we use. We do not offer one solution to the customer in contrast to Chinese manufacturers. We analyze the operations of our customer, and adapt our offering to their specific needs. We advise our customers and offer more than just an electric bus, think of the charging infrastructure and maintenance contracts. Overall, we offer an e-mobility system and not just a bus.

2. What is the added value that the products and/or services deliver for the customer?

The main advantage of the electric bus is zero emission, so it fits within the strict environmental rules and regulations. Environmental rules and regulations become stricter and with the electric busses operators can still operate under these new rules and regulations. Our modular approach allows us to offer the best solution to our customer, so they experience the most value from our products and services.

3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc.)?

After-sales are extremely important. The process of e-mobility consists basically of three steps. The first step is the transition from a diesel bus to an electric bus. Then, the second step, is the development of a pre-series bus towards a series bus. The last step, is the approach that e-mobility is not just an electric bus but a system. Service has been integrated through that whole process. In principle, service is really easy simple, since every customer expects it. However, differences can be made between you and your competitor by the length of the respond time, so good communication and quick action is required. With new technologies problems do always exist, therefore it is crucial to react quickly and solve the problem within a reasonable timeframe. It determines your image as an organization.
4. Are the products or services standardized or customized for each customer?

As mentioned before, we have a modular approach. De drive line is a module, the management system (software) is a module, the battery pack is module, and design is a module. Within each module it is possible to vary, and by linking the best variations within each module customers will receive the best option for their operations. So the products and services are a combination of standardization and customization.

5. Are the products or services technology or demand driven?

The electric bus is basically a combination of the two. The development of the technology is a result of the introduction of environmental rules and regulations, and the demand of customers has been created as well by environmental rules and regulations. Local governments strive to become green and set an example for other industries to become green too. Authorities have direct influence on public transportation, therefore the zero emission bus is a logical result. Environmental rules and regulations are the initiator of the demand.

All the components used for the technology are not new, but the combination of all these elements makes the product unique. For example, batteries and a drive line are not unique components, however the combination of the two results in a new technology on the market.

6. Is the value proposition influenced by environmental rules and regulations?

Recently an agreement has been signed that from 2025 all public transportation has to be zero emission within city boundaries. Total zero emission in 2025 means that an operator has to replace its fleet with electric busses, and the estimated replacement time is around ten to twelve means. This means that more and more cities have started pilot projects and test projects. They also start with official tendering, but one city reacts quicker to the introduction of environmental rules and regulations than the other.

Customer interface

1. What type of customers does your organization serve?

We have to make a distinction between public transport operators (PTO’s) and public transport authorities (PTA’s). The cities or province normally outsource public transportation to public transport operators, in that case the operator is not the same as the authority. In some cases, for example Amsterdam, the city takes care of the public transportation herself. This means that the operator is the same as the authority. Public transport authorities may force, as a result of stricter environmental rules and regulations, operators to use zero emission busses. Operators have no choice to accept it and adapt their fleet, otherwise they have no chance of winning the concession. So, we sell our busses directly to public transport operators, but it is important for us to keep in touch with the authorities. Their demands towards the operators must be in line with what we offer, otherwise we won’t have any business.
Next to public transportation there is ‘closed’ transportation (tour operators), who can be hired for example to transport school kids during an excursion. These busses need to be electric as well in the city, but outside the city they can still use diesel. Therefore the best solution for them is the diesel-electric bus (hybrid). This solution can also be used for busses that are operational within regional transportation.

2. What are the core activities of the customers?

The core activity of the customer is to transport passengers from point A to point B. The challenge for us is to find the balance between technology, think of batteries, and the transportation of passengers.

3. What are the customer’s demands and needs?

Customers have the option to purchase the electric busses themselves, or to use a lease model. In most cases operators choose to lease the busses, often financed by VDL. VDL offers service contracts and maintenance and repair will be executed at VDL’s own workshops. The operator just wants to focus on the transportation of passengers and activities like maintenance are outsourced. Purchasing is more risky for the operator, because they don’t know all costs in advance. Margins are not known in advance.

4. Is the customers’ purchasing behavior influenced by environmental rules and regulations?

It is really simple. If the authorities demand emission reduction or a certain level of emission, the operator is free to choose the type of bus as long as she meets the criteria. It is also possible that authorities choose to demand from the operators to produce zero emission with their busses. In that case the operator has no other option than the use of electric busses. The purchasing behavior is therefore definitely influenced by rules and regulations.

5. Can you describe the relationship with your customers?

A good relationship with our customers is crucial within our business, especially with these new technologies. We are a full partner to our customers, more than our competitors can be.

6. What contact points occur during the relationship with the customer?

We have contact with our customers on a regular base, since we analyze their operations and adapt our offering to it.

Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?

The most important component within the supply chain is the battery pack, next to the electrical engine. The electrical engine exists for years now and is adapted to the application. Within the battery market there are more developments and aspects like capacity and charging duration are really important. The numbers of offerors is large, but the number of offerors with quality products is limited. Some battery manufacturers link an energy management system with the battery pack, resulting in more efficiency. The
quality of these systems varies, so we are continuously searching for the best partner. We switch regularly between battery manufacturers, as a result of many developments on the market.

We do not have external investors. As VDL we are wealthy enough to finance to the projects ourselves. We help start-up companies as well if they are interesting for us in the future within the transportation sector.

2. Which key activities are essential to deliver value to the customer?

As already stated, the first step within the whole process is the transition from a diesel bus to an electric bus. Then, the second step is the development of a pre-series bus towards a series bus. The last step, is the approach that e-mobility is not just an electric bus but a system. Our approach of a complete e-mobility system requires a thorough analysis of the customer’s current operations. All activities related to these three phases are essential to deliver maximal value to our customers.

3. To which degree is the supply chain ‘green’?

A green supply chain starts with all the packing, so we attempt to minimize packing and if it is there, we strive to recycle it. We also attempt to produce locally as many as possible, which is an element of green entrepreneurship in our opinion. The transportation of batteries is a challenge, because we purchase our batteries in Europa and the Middle-East. Transportation is equal to emission, so we are in doubt to what extent it is possible to produce these locally as well. Important is to keep in mind that a good balance is required between green entrepreneurship and complementary costs.

Energy consciousness has increased the last years, people wants to know where energy comes from. An electric bus with energy from a coal power plant is not sustainable, solar or wind energy are sustainable resources. As VDL we do not purchase electricity for the electric busses, it is the responsibility of the operators. We do advice our customers to purchase green energy, and authorities may demand green electricity within the concession.

Financial model

1. What is the revenue model of electric busses?

As mentioned before, customers have the option to purchase the electric busses themselves, or to use a lease model. Operators request an up-time of 95% for diesel busses, however for e-mobility this cannot be achieved so far. Probably in four years it is possible to meet this standard. Within the contract it is therefore essential to formulate achievable goals, because new technologies involve new types of services and changes within the organization. Operators formulate in consultation with the producer fines within the contract, so it important to estimate what is achievable and what is not.
2. Can you describe the cost structure?

The driving line and battery pack are the most costly components of the bus, but of course costs for the charging infrastructure cannot be ignored. We also have costs related to consultancy work.

3. What is the return on investment (ROI)?

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4. Does the organization participate in ‘green projects’ (initiated by local or national government)?

As VDL we participate in green projects as long as it does not push us away from the path we follow. In these projects we develop new knowledge in cooperation with knowledge institutes and universities, and it is financial attractive as well. The government offers a couple of grants. The first grants are development grants, which can be used during the development of new technologies. Second, demonstration grants which can be used for the demonstration of the new technology (within Europe). Third, local governments subsidize pilot-projects. We do not participate in projects just for grants.

The main reason for governments to offer grants can be found in the development of knowledge and technologies, because it can be very attractive for a country.

Ending

1. Do you have any additions to the discussed topics?

No, I do not.

2. Do you have any further remarks regarding this interview?

Good preparation of the interview.

Appendix C4: Interview Frans Kustermans

Name respondent: Frans Kustermans
Organization: Bluekens Bus
Function: Manager Bus
Date: 26-05-2016
Location: Breda, The Netherlands

General

1. What is the core business of your organization?

Our core business is maintenance and repair of electric busses.
2. What is the strategy of your organization?

Bluekens Bus distinguishes herself by optimal service and high customer satisfaction. By innovation and development of new services her goal is to become the number one partner for her customers. The values of Bluekens are safety, quality, attractiveness in design, and respect for human and environment.

Value proposition

1. Which products and services does your organization offer to her customers?

We are responsible for maintenance and repair services, so with our services the electric busses remain operational. We are not an active player in sales, meaning that we are an independent maintenance organization and that we are able to repair all bus brands. We have a service contract with producers like Volvo and VDL, and take care of maintenance and repair for our customers.

2. What is the added value that the products and/or services deliver for the customer?

We take care of the maintenance and repair services for electric busses, resulting in a situation that the electric busses of the user are in optimal condition. The end user therefore has no active role in maintenance, and is able to focus on their core business. We distinguish ourselves from our competitors with our history in electric transportation, the conversion of diesel busses into electric busses. When your name is established in this business, customers will find you. Our knowledge and experience has resulted in an excellent position for maintenance and service repair.

3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc)?

After-sales are definitely integrated into sales, and our maintenance and repair services are an example of those services. New technology requires extensive knowledge and some experience, and therefore after-sales are usually integrated into the sales contract.

4. Are the products or services standardized or customized for each customer?

At the moment, a couple of large players on the market has signed a covenant to seek for a standardized charging infrastructure. All electric busses of different brands are able then to use the same charging infrastructure, which is a form of standardization.

5. Are the products or services technology or demand driven?

It is a combination of both. On the one hand, we have shown that it is possible to convert a diesel bus into an electric bus, while on the other hand environmental rules and regulations and internal sustainability goals has led to a situation where demand has been created. To fulfil the need of an electric bus, the technology has to fit as well.
6. Is the value proposition influenced by environmental rules and regulations?

Recently new environmental rules and regulations have been introduced which states that from 2025 all public transportation should be zero emission. I doubt the feasibility of it, because electric transportation for the whole country cannot be achieved. Within city boundaries it is feasible, but for regional transportation it will be too complex. For regional transportation, a combination of diesel and electricity could be an option. The reason that it is not feasible to introduce e-mobility across the country before 2025 is on the one hand the financial aspect and on the other hand the charging infrastructure aspect.

Customer interface

1. What type of customers does your organization serve?

We serve the producers of electric busses, who outsource maintenance and repair services. They integrate maintenance into the service contract, and we are the external organization responsible for it. The customers of the producers are mainly public transport operators, so we are indirect connected with them.

2. What are the core activities of the customers?

The core activities of our customer are manufacturing and sales of electric busses. They produce or assemble the electric busses and sell them to public transport operators. Their core activity is transport from point A to point B.

3. What are the customer’s demands and needs?

The customer desires from us that we take care of all maintenance and service repair, and that we guarantee the operator an uptime percentage of X.

4. Is the customers’ purchasing behavior influenced by environmental rules and regulations?

Before the introduction of electric vehicles we took care of the maintenance of diesel busses, and now we take care of the maintenance of electric busses. In principle, we offer the same services to our customer. The type of maintenance and service repair has changed, since the driving line of the busses has changed. This change is more or less the result of sustainability goals of operators and the introduction of environmental rules and regulations, which directly influences the operations and purchasing behavior of our customer.

5. Can you describe the relationship with your customers?

We have direct contact with the producer, since they outsource maintenance and repair to us. However, we also communicate with the operators to evaluate the maintenance activities from the last period. This meeting is attended by the producer, like Volvo and VDL, by the operator, like Arriva, and by us.
6. What contact points occur during the relationship with the customer?

As stated, we have evaluation meetings on a regular base with the operators and the producers. Bottlenecks and possible improvements are discussed during these meetings.

Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?

We have started the ‘electric bus’ project a while ago and we were cooperating with a party who went bankrupted. A restart was realized, but then they went bankrupted again. And it happened even a third time. Because of this we faced some problems within the project and therefore we do not have one hundred percent unity in what we offer with respect to batteries, battery management systems, etc. We now have the challenge to create a range of components as small as possible, so that we will be able to have components in stock. In the most ideal situation we have two or three suppliers that deliver us all necessary components.

2. Which key activities are essential to deliver value to the customer?

Key activities are the investment in activities in knowledge and technology. Without those investments it is difficult to remain competitive and to be a number one partner to our customers.

3. To which degree is the supply chain ‘green’?

We have several battery suppliers and their attitude towards sustainability is unknown to us, so we have no idea to which degree the supply chain is green. On the other hand, we also have a couple of suppliers that have a sustainability label. To determine if a supplier is into sustainability and how she acts is for us relatively difficult. The suppliers we now have are the suppliers we will use for the upcoming period.

Financial model

1. What is the revenue model of electric busses?

We have a service contract with the producer of electric busses and the price paid by the customer depends on the total number of kilometers driven. It is also possible to have a fixed price, but that depends on the preferences of the customer.

2. Can you describe the cost structure?

We have costs related to our maintenance personnel, possible costs related to fines (up-time), and we have costs related to the purchase of components. Fines are related to the up-time of the electric busses, since the operators demand a certain up-time percentage. If we do not meet the agreed level there could be consequences in the form of fines.
3. What is the return on investment (ROI)?

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4. Does the organization participate in ‘green projects’ (initiated by local or national government)?

We have participated in a project which focused on electric driving in Helmond. Due to bankruptcy of one of the project members, the project has ended differently than it should have ended. In such projects there are always subsidiaries involved, otherwise e-mobility is not feasible at all. Bluekens is an organization that has its business interests; we are willing to invest in new technology and in new developments, but at the end we still have to make a profit. At the moment that is quite difficult, because when the subsidiaries are withdrawn, projects are outbalanced with respect to the financial aspects.

In principle I think subsidiaries are wrong. Sustainable development should be encouraged, but some receive subsidiaries without being really sustainable. Driving a hybrid car and just using the diesel engine is not sustainable, despite the fact that you are driving a hybrid car.

Ending

1. Do you have any additions to the discussed topics?

No, I don’t.

2. Do you have any further remarks regarding this interview?

No further remarks.
Appendix D: Interviews with users

Appendix D1: Interview Gert Naber

Name respondent: Gert Naber
Organization: Arriva Nederland
Function: Program Manager Zero Emission
Date: 24-05-2016
Location: Meppel, The Netherlands

General

1. What is the core business of your organization?

We provide public transportation services to our customers, which include busses, trains, and water busses. Transportation via water is a joint venture with rederij Doeksen, and as Arriva we only take care of scheduling activities. Personnel and ferries are managed by Doeksen, so we are slightly involved in that operation. Next to transportation via water, we are a key player for public transportation by train. We are the second largest organization providing these services (Dutch Railways is the biggest actor on the market). As third, we also have 1200 busses in our fleet.

2. What is the strategy of your organization?

Safety is our first priority, because if you cannot guarantee safety you won’t be able to survive in this business. On the other hand, we have a certain profit strategy. We are part of DB and they would like to see positive results. We only participate in tenders if we are certain that there is a good return on investment for us.

Purchase

1. What is the main reason to purchase electric busses instead of regular (diesel) busses?

We don’t purchase electric busses for profitability, because I don’t think they can compete with the regular diesel busses regarding total cost of ownership (TCO). It could be that they are for some specific regions, but it is not realistic for most city lines. The main reason to purchase electric busses is on the one hand the sustainability goals formulated by Arriva herself, which are more or less the complete opposite of the profitability goals, and on the other hand the request from our clients. A list of requirements is included within a tender, and it might be that zero emission is included in those requirements. If it is not requested, then we are not forced to offer zero emission although bonus points can be earned for zero emission. So we have to make choices, sometimes we offer zero emission and sometimes we don’t.
2. What are important aspects when purchasing electric busses?

At the moment, we have seven electric busses in operation in Den Bosch. One bus driver has been trained by VDL, and he has become our ambassador. He now trains other bus drivers within Arriva and so far the reactions on electric busses are positive. For them the reduction in noise is a real benefit, but losing flexibility has been highlighted as critical. Guidance from management will be crucial to emphasize the need to follow the routes strictly.

3. Who are the stakeholders in the purchasing process?

The technical department is responsible for the specifications and the purchasing process itself is guided by the purchasing department. In case of implementation, we also have an implementation team, a steering committee, and a project committee. We have to keep them posted all the time. Close communication with the top management team is also required, because we have to deal with significant amounts.

4. How many parties are offering the electric busses?

We are pretty close with VDL for several years. We are both Frisian organizations from origin, but at the end that won’t be the reason to choose for VDL. Actually we always make our decision based on TCO calculations. We determine the initial investment, maintenance costs, and fuel or energy consumption, and spread all costs over the length of the concession. Purchasing zero emission busses is slightly different, because the market is less mature. New players enter the market and there are differences in techniques, like overnight charging, hydrogen, opportunity charging, and on route charging. Not every producer can offer all techniques, so choosing for a specific technique exclude some producers. At the end, it all comes to the balance between charging and using the bus. Finally, we choose for a specific technique and make a financial driven decision between the producers offering these techniques. We always purchase our busses and do not lease.

5. Are there any substitutes regarding sustainable transportation?

We don’t have any experience with hydrogen busses, since these are not competitive with electric busses based on TCO. Hydrogen busses meet the standards within the emission regulations and they are also labeled as completely safe, but they are just too expensive to implement in the current operations. Benefits of hydrogen are the driving range, which is significantly larger than the driving range of electric busses, and filling with hydrogen is quicker than charging a battery pack.

Performance

1. What are the benefits of electric busses in comparison with regular busses?

The most important benefit of an electric bus in comparison with a regular diesel bus is zero emission. Zero emission is the driver for implementation of the electric bus, reduction in CO₂ as well as other
gasses. Another benefit is reduction in noise, which is a benefit for the bus driver but the passenger as well. Noise reduction is an added bonus, because in principle electric busses are all about zero emission.

2. What are the disadvantages of electric busses in comparison with regular busses?

A large disadvantage of electric busses is the limited driving range, which is significantly smaller than the driving range of a diesel bus. Another disadvantage is the charging time, because it requires a relatively long time to charge an electric bus. Large investments in charging infrastructure are also required, so overall it is less efficient and less comfortable.

3. Does the use of electric busses require any adaptions within the organization?

The importance of electric busses and zero emission have resulted in the situation that I have been assigned as program manager zero emission. I take care of all activities related to the concept of electric busses and the implementation of the busses into our current operations. The guidance of bus drivers driving electric busses is completely different, since bus drivers are less flexible to skip a part of the route. It is crucial to always follow the route to charge the bus on designated points, driving to the depot for a cup of coffee is not an option anymore. The operation with electric busses is a completely different approach, and if employees are not aware of this, it is doomed to fail. We are not able to test yet, but it definitely will be a challenge for us.

Arriva usually outsource all maintenance, and these external partners train their own maintenance personnel. Due to the new technology, maintenance personnel have to be trained with the knowledge of the new technology.

The electricity used for the busses is wind generated electricity. We have signed an agreement with a wind mill farm and usually the client requires green electricity within the tender. However, some electric busses use a heating installation that runs on diesel, so these cannot be categorized as completely zero emission.

4. Do the electric busses meet the expectations?

The first electric busses in the pilot projects are converted from diesel busses, and can be categorized as prototypes. We faced several problems with these prototypes, but you expect these problems in advance. The second phase was the implementation of electric busses on Schiermonnikoog, produced by a Chinese manufacturer. These comply with respect to the driving line, even above expectation. The VDL busses in Den Bosch are now in operation for six weeks, and these comply as well. They meet the expectations we have for electric busses. We have faced some difficulties, but these cannot be related to the electric element of the bus. With the implementation of electric busses managing the expectations is crucial.

As stated before, the busses on Schiermonnikoog do meet the expectations, but it is essential to keep in mind that it cannot be copied one-on-one to a city like Venlo. The passenger flow is completely different and cannot be compared. The most difficult element for the implementation of electric busses is that your actions are based on assumptions. We purchase diesel busses for 30 years now, so that is more or less
standardized. Purchasing and implementing electric busses is completely new and therefore more complex.

Rules and regulations

1. Does the organization have to deal with environmental rules and regulations?

A political agreement has been signed that from 2025 all public transportation should be zero emission. Amsterdam stepped in by taking over that ambition, but for them it is easier since they know that they will still be operative in 2025. For us that is more insecure, because it is possible that we don’t exist anymore in 2025. That is a worst case scenario and of course we don’t expect that to happen, but it is possible that we will operate in completely different regions in 2025. We are now driving with electric busses in Den Bosch, but we cannot indicate if we will be operative in 2025 in Den Bosch with zero emission busses. It all depends on the clients.

The introduction of zero emission busses is a phased process, because a replacement of all diesel busses in once is not realistic. We still offer diesel busses to our client, because if the client request minimal costs diesel busses are the most suitable option. Electric busses are not competitive enough then.

2. Are there any subsidiaries involved for the use of electric busses?

Past projects have been subsidized by governments, especially in the province Noord-Brabant. They are actively involved in such projects, and they take care of most additional costs made by the introduction of electric busses. When an operator offers the electric busses to a client herself, no subsidiaries will be provided. There are also European funds which can be used for pilot projects and the introduction of electric busses.

Ending

1. Do you have any additions to the discussed topics?

No, I don’t have any additions.

2. Do you have any further remarks regarding this interview?

No, I don’t.

Appendix D2: Interview Erwin Brakenhoff

Name respondent: Erwin Brakenhoff
Organization: GVB Amsterdam
Function: Project member Zero Emission
Date: 27-05-2016
Location: Amsterdam, The Netherlands
General

1. What is the core business of your organization?

We offer public transportation services within the city of Amsterdam and her region. We have busses, trains, subways, trams, and ferries in our fleet. They are all used to safely transport our passengers from point A to point B.

2. What is the strategy of your organization?

GVB connects the city of Amsterdam and contributes to the accessibility, the livability, and mobility of the citizens of Amsterdam and her region. We focus on our passengers and everything we are cost conscious in everything we do.

Purchase

1. What is the main reason to purchase electric busses instead of regular (diesel) busses?

The reason to purchase electric busses instead of regular diesel busses is on the one hand the sustainability goals formulated by the management team of GVB Amsterdam, who stated that GVB should have a leadership role in the transition towards zero emission, and on the other hand the introduction of environmental rules and regulations. In cooperation with the city of Amsterdam a sustainability covenant has been signed to emphasize the joint ambitions to replace the current fleet with zero emission busses as quick as possible. Our diesel busses have a product life of approximately ten years, and after ten years the busses are completely depreciated. The covenant states that all these busses will be replaced by electric busses.

2. What are important aspects when purchasing electric busses?

An important aspect is the charging technique, because that is a complete new technology. We are not familiar with these techniques and therefore market consultation should help us out. Electric busses cannot be implemented one-on-one in the current operations, so it is a really complex process. Research before the actual purchasing is essential.

3. Who are the stakeholders in the purchasing process?

Bus drivers are closely involved in the purchasing process, usually in the form of a delegation of the works council and a drivers committee. They cooperate with us how to design the busses and they participate in the construction of the list of requirements. In past projects we have also asked the three best producers to demonstrate their busses and to give our drivers the opportunity to test them.

Next to the bus drivers, the city of Amsterdam is also involved in the purchasing process. They are our client and we take their needs and demands into account as well. In our past tenders we have also
organized a sort of sessions with committee for elderly people and the committee for handicapped people. They can provide us with some other input and gives us insight in specific needs.

4. How many parties are offering the electric busses?

In principle we compare all the different techniques for charging and based on this evaluation we determine which producers can meet our demands. At the end of last year we have started a market consultation to check with producers how they think about are charging ideas. The idea behind the market consultation is to determine what is possible on the market and which producers are able to produce it. Next to the charging technique we were curious about financial aspect, because the introduction of electric busses involves additional costs in comparison with the diesel busses. With all this information we already anticipate on the upcoming European tender.

As GVB all of our tenders must be European tenders, therefore it is essential to determine the list of requirements in advance. We also formulate criteria that should point out the best producers at the end, and therefore we have limited space to choose for a specific producer. All criteria have been determined in advance and it is not possible to differ from these criteria during the tender process. The producer who scores the most points will win the tender. Our influence is limited to the beginning of the tender process.

5. Are there any substitutes regarding sustainable transportation?

Hydrogen busses are too expensive so far, so they cannot compete with electric busses. The availability of hydrogen is limited as well, at the moment there are only two hydrogen stations in operation. During our pilot project with fuel cell busses we had our own hydrogen station, but when the project ended the station was closed. There a lot of facets to take into account when producing hydrogen, with relatively high costs. From a financial perspective we won’t be able to run the operations with hydrogen busses and therefore we now focus on the introduction on the electric busses with a battery pack. We are in doubt and discussing which charging technique suits the most for us.

Performance

1. What are the benefits of electric busses in comparison with regular busses?

In the city of Amsterdam we have several bottlenecks with respect to air quality. Around these bottlenecks we have several busses in operation and the city of Amsterdam would like to see that we reduce the air pollution. With the introduction of electric busses we can meet this demand, so zero emission is the largest benefit of electric busses. Another benefit is the reduction in noise, because electric busses are quieter than diesel busses. For citizens living around the end of the route this might be a serious benefit. The introduction of electric busses contributes to the improvement of the livability in the city.

2. What are the disadvantages of electric busses in comparison with regular busses?

The biggest disadvantages are the limited driving range and the long charging time of the busses. These two disadvantages influence our timetable. It can be covered by putting more busses in operation, but
then the bus driver has to change from bus after every route. This leads to some impracticalities which are very difficult to solve. At the end, the introduction of electric busses into our current operations is quite difficult.

3. Does the use of electric busses require any adaptations within the organization?

We try to use the existing infrastructure of tram and subway, they all use green energy. This is exactly what we would like to use for the electric busses. We strive to enhance complete sustainability, but at the moment our focus is on the local demand of better air quality. In an ideal situation we have our own wind mill that provides us with electricity, but this won’t be able within this project.

Maintenance is done by our own maintenance personnel, and our aim is to do exactly the same for electric busses. We realize that we need specific training for our personnel, but we have an advantage that we already have knowledge from tram and subway. We will definitely going to use that with respect to the maintenance of electric busses.

4. Do the electric busses meet the expectations?

At the moment we don’t have electric busses in operation, but we had some projects with fuel cell busses in the past. These can also be categorized as an electric bus, because the complete drive line is similar to the drive line of an electric bus. The only difference between the two is that a fuel cell bus carries its energy in the form of hydrogen gas, which is transformed in the fuel cell into electricity. From 2003 till 2014 we tested these, initially in cooperation with Mercedes. That project was an European project and ten different European cities had three of these busses in operation. The project has been extended a couple of times, so afterwards we were looking for a partner who could move forwards with us. In cooperation with a daughter company of VDL we placed two fuel cell busses within our operation, and these two were operational from 2012 till 2014. Three identical busses have been delivered to a transportation authority in Cologne. We hope to create a transition towards electric busses, because these are less expensive.

Rules and regulations

1. Does the organization have to deal with environmental rules and regulations?

As stated before, we have signed a sustainability covenant with the city of Amsterdam to replace our diesel busses for electric busses. This is the result of the introduction of environmental rules and regulations which aim to reduce local air pollution. We already have a low emission zone (LEZ) in Amsterdam and most trucks are therefore not allowed to enter the city. It might be that busses also have to comply with the regulations for the LEZ, but we are not sure if this is going to happen before 2025. We have our own ambition to replace our complete fleet with zero emission busses before 2025.
2. Are there any subsidiaries involved for the use of electric busses?

We strive to a situation where costs for electric busses are equal with costs for diesel busses, so we are looking for financing of the additional costs. As a result of the sustainability covenant the city of Amsterdam subsidize a part of the additional costs. Recent developments in The Hague have shown that subsidiaries might be involved to improve the air quality in Amsterdam and maybe we can benefit from these subsidiaries as well. We are also looking for European subsidiaries that can fund our projects, but that is still under investigation.

Ending

1. Do you have any additions to the discussed topics?

No, I don’t.

2. Do you have any further remarks regarding this interview?

No, I don’t have any further remarks.
Appendix E: Internal interviews

Appendix E1: Interview Walter van der Pennen

Name respondent: Walter van der Pennen
Organization: RH Marine NL
Function: Consultant (Concept Design & Consultancy)
Date: 29-06-2016
Location: Rotterdam, The Netherlands

Value proposition

1. Which products and services does the organization offer to her customers?

We offer electric systems for ferries. We are not a large player on the traditional diesel ferry market, but we have done several projects in the past. These projects did not involve a large electric system, so therefore we were just slightly involved. As RH Marine NL we only offer electric systems, so we are more interested in the hybrid ferry market.

2. What is the added value that the products and/or services deliver for the customer?

Our systems are part of a complete system which allows the ship to operate. We install the standard distribution system and the electric distribution system. It might be that we have installed other systems too, but I’m not sure. Competitors are able to install these systems as well, but yards choose us because we are flexible or because we already have a good relationship with that yard. Another distinction between us and competitors is that parties like Siemens and ABB offer their own materials while we are supplier independent. It is possible for the end user to choose for a specific supplier for a certain system.

3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc.)?

Some yards focus on just building activities, while other yards offer after-sales to the end user. Those yards take responsibility of the complete life cycle of a vessel, including all the systems onboard, even when those systems are not installed by themselves. Some yards have no after-sales included in their offering, and as RH Marine NL we have direct with the end user without the involvement of the yard.

4. Are the products or services standardized or customized for each customer?

All projects are one-of-a-kind. The project in Scotland (hybrid ferries) is a series of three, which are more or less similar to each other. Those vessels have a sort of standard, but due to bankruptcy of the battery supplier the third ferry is equipped with a different battery pack than the other two. It requires certain adaptations within the system, so that makes it hard to standardize. Basically these three are more or less the same, but not real copies. In the maritime market we work with one-of-a-kind projects and therefore customization is above standardization.
Customer interface

1. What type of customers does the organization serve?

The yards are the direct customers and for systems installed on traditional diesel ferries it is not needed to have direct contact with the end user. For hybrid systems a completely different approach is required, because for those systems it is essential to have direct communication with the end user (operator). The choice to use a hybrid system is made relatively early in the design phase and based on the experiences we have so far, it is important to be present during the design process. Not being present results in most cases in not having the project. The yard is overall responsible for the project, but the end user might designate RH Marine NL as preferred supplier.

2. What are the core activities of the customers?

As stated before, a distinction can be made between yards that focus on just building activities and yards that take full responsibility of the vessel. This includes after-sales as well.

3. What are the customer’s demands and needs?

The yards strive to minimalize risks and reduce costs during the projects. They want to cooperate with reliable suppliers that deliver what they have offered. Those suppliers have to deliver within a certain time frame, as agreed at the start of the project. In most cases the yard tries to combine risk minimization with the lowest costs.

4. Can you describe the relationship with the customers?

As mentioned above, the yards are the direct customers and for systems installed on traditional diesel ferries it is not needed to have direct contact with the end user. For hybrid systems a completely different approach is required, because for those systems it is essential to have direct communication with the end user (operator). We show our systems to the end users and if requested, we participate in the designing process.

It is important to communicate with the right people. It could be that the fleet owner has specific and more costly demands, but at the end someone from the purchasing department overrules and chooses for the cheapest option. Therefore it is important to know who makes the final decision. Meetings with customer’s employees from the technical department are useful, and they maybe even recommend us as a supplier, but finally a completely different design is chosen. The cheapest option is then the way to go for them.

5. What contact points occur during the relationship with the customer?

The choice to use a hybrid system is made relatively early in the design phase and based on the experiences we have so far, it is important to be present during the design process. Not being present results in most cases in not having the project.
Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?

The supply chain is reasonably standardized. We have specific suppliers for certain main components of the system, for example the switchboard. If the end user requests other suppliers it is possible for us to make a switch between suppliers. Electric engines can be bought everywhere, so we do not have a specific supplier for that component. What we produce internally is standardized, and we have agreements with sub-suppliers for those components. As RH Marine NL we have a certain degree of freedom where we purchase our components.

External investors do not participate into our processes, because it is not relevant to have them. In the past we had Imtech and therefore more financial resources, for example for R&D. At the moment we do not have unpaid innovation and we are only able to develop during projects. So far we have enough knowledge gained about hybrid systems that we can financially benefit from it.

2. Which key activities are essential to deliver value to the customer?

Key activities are planning and communication. Planning to make sure that the projects are on schedule and communication to evaluate the project are crucial.

Financial model

1. What is the revenue model of ferries?

The main goal of the end user is to optimize its total cost of ownership (TCO), so their view on costs is different than the view of the yards on costs. The yards have offered a certain system to the end user, and their objective is to purchase it for the lowest price. Next to the lowest costs, the yard also prefers the lowest risk. For them it is essential to find the right balance between costs and risks.

We use fixed prices, so we have no performance based contracts. Although the use of performance based contracts is interesting, for example guaranteed uptime or guaranteed fuel reduction, I do not think we are ready for that type of agreements as RH Marine NL. It could be that performance based contracts are applicable for yards, because our systems are just an element of the complete system. From that view it might be more difficult for us to implement performance based contracts. For the battery pack it could be an option.

The project is a chain of activities. If we are not able to start ours because the yard is delayed with theirs, we can claim them. We face extra costs due to the delay and the yard is responsible for those costs.

2. Can you describe the cost structure?

Most costs are related to man hours and the purchase of components. Next to those costs, we have costs related to overhead, distribution, and travelling. Some staff has to work on location, so therefore we have
relatively large travel costs. Other costs may rise if we, as RH Marine NL, are not able to deliver the systems within the agreed period. The consequences that arise in that situation are fines for the delay.

Ending

1. Do you have any additions to the discussed topics?
No, I don’t have any additions.

2. Do you have any further remarks regarding this interview?
No further remarks.

Appendix E2: Interview Douwe van der Meer

Name respondent: Douwe van der Meer
Organization: RH Marine NL
Function: Sales Director Ferries
Date: 30-06-2016
Location: Rotterdam, The Netherlands

Value proposition

1. Which products and services does the organization offer to her customers?

We can distinguish three types of ferries, known as diesel-direct ferries, diesel-electric ferries, and hybrid ferries. The third category is the diesel-electric version combined with a battery pack. For each type we have done projects in the past, but we have the most feeling with the hybrid version. This category also generates most revenues for us. Hybrid ferries are not always equipped with a battery pack in advance, it is also possible to install a LNG (Liquefied Natural Gas) tank and engine. The most common problem however is the space required to install the tank and engine, because it requires serious space. All space needed for installation cannot be used for material or passenger transportation and is therefore not the most practical hybrid option.

The products and services we offer to our customer are our knowledge of propulsion and system integration, and provide all types of activities related to it.

2. What is the added value that the products and/or services deliver for the customer?

There are competitors who state that they are able to deliver the same services as we do. Recently we have received an award for our third hybrid ferry, in cooperation with a couple of other parties. Our contribution is system integration for the complete vessel, think for example of the electricity generated from the generators. One time it comes from the diesel engines while the other time it comes from the battery package. We have developed an algorithm that takes multiple factors into account like current
and wind, and then determines which input needs to be selected. The system more or less decides for the operator which input is the best option for that specific situation. The algorithm is definitely an added value and sets us apart from competitors, because multiple parties are able to deliver the battery packages but without that smart technology.

3. Are (after-sales) services integrated in the sales (periodic maintenance, service repair, etc)?

Usually there is a warranty period for all our products and services, but after that period a service and maintenance contract has to be signed. Normally each supplier is responsible for their own systems. Sometimes the yard takes full responsibility of the vessel and is intermediate between RH Marine NL and the operator, sometimes we have direct contact with the operator. In case of the hybrid ferries projects for CMAL, we communicate directly with CMAL. If they have problems with the hybrid propulsion they will directly contact us.

4. Are the products or services standardized or customized for each customer?

In the maritime market there are many variations for the same vessel type due to the different demands of owners and due to the differences between yards. However, owners choose often the same systems for their new build vessels, because then there is no need to re-train the crew. Sometimes owners choose for series production (3-5 vessels), but for special vessels new requirements will be formulated for each new vessel. The same base, but with modifications.

Customer interface

1. What type of customers does the organization serve?

We can distinguish two important actors on the market. First, there is the yard who is always seeking for the lowest costs and second, the operator who is more interested in the savings during the lifetime of the vessel. In the case of CMAL (hybrid ferries) we have contact with the yard as well as the operator. The contact with the yard is to discuss the price, while the contact with the operator is related to fuel savings and emission reduction. You could say that there is a clear distinction between OPEX and CAPEX between the two parties. There is less contact with the operator when the ferry is a diesel-direct ferry, since it is only an investment price.

2. What are the core activities of the customers?

The yard is responsible for the construction and completion of the vessel, while the operators are responsible for passenger transportation.

3. What are the customer’s demands and needs?

As stated above, the yard is always seeking for the lowest price. They will only buy what was agreed with operator, while the operator is interested in fuel savings and emission reduction.
4. Can you describe the relationship with the customers?

The communication with the yard is essential. When we have an order to deliver cabling services for a vessel, then all metal work must be finished. If it is not and our crew is ready to start with the cabling activities, we face scheduling problems. Unnecessary costs are made so therefore we can claim those additional costs at the yard. It is exactly the same if the yard has finished the metal work and we are not ready to start the cabling activities. Then they can claim their additional costs.

Before the project start we always communicate with the yard about technical aspects of the vessel, the amount of space available at the yard, the other systems that needs to be installed, etc. All these things needs to be known before we start with the planning, and is also needed to determine who is responsible for which phase. Most projects are a chain of activities, so delays are not unusual at all. The approved planning is our guide during the project. We have contact with the yard on regular base during the projects to discuss the progress.

5. What contact points occur during the relationship with the customer?

We are involved in the designing process of the vessel. The owner has specific demands which are formulated in the list of requirements (specifications, costs, etc.), and that list forms the input for the naval architect. The naval architect designs a vessel based on the list of requirements, and in the end it leads to an approved ship by the owner. Then the owner contacts several yards to ask for a budgetary quotation for the vessel, which is compared to the price the owner already has in mind. If that levels more or less, the yard is asked to offer a final quotation. From the phase of the budgetary quotation we are involved in the process until the engineering phase.

Supply chain

1. What stakeholders are involved in delivering the value proposition to the customers?

Which suppliers we use depends on the project. For example, we selected a battery supplier for the CMAL ferries. However, after the second ferry this supplier went bankrupted so we were forced to contract another supplier. The battery market is a young and immature industry, so we have to check the stability of a supplier before signing the contract. We definitely aim to standardize the supply chain, because a long-term relationship leads to better agreements and makes things much easier. Sometimes, as the example shows, we have to seek alternatives when suppliers are no longer able to provide the services as requested and agreed.

We are also supplier independent. ABB delivers engines, generators and drives and they offer a complete package including electric equipment to their customers. Their package only consists of ABB products. We, as RH Marine NL, are able to select the best option for the customers since we are not attached to a specific supplier. If the end user demands zero emission we will use other suppliers than when the end user asks for lowest costs. The list of requirements really depends on the operational goal of the owner.
Supplier independency is not directly giving us a better position on the market, the main reasons to choose for us are our experiences and knowledge.

2. Which key activities are essential to deliver value to the customer?

Key activities are planning and communication. Planning to make sure that the projects are on schedule and communication to evaluate the project is crucial.

Financial model

1. What is the revenue model of ferries?

The yards are really price sensitive and always strive to purchase the systems for the lowest price. The end user is able to place RH Marine NL on the preferred supplier list, which indicates that we are the preferred suppliers for specific systems. This might happen when the end user has faith in our competences or experiences, or when we already have done projects for them in the past. Normally the preferred suppliers list increases the price, when the yard has a cheaper alternative (a competitor with the same systems/services but for a lower price). Although it might increase the price, quality and security could be the reason for the end user to still choose the preferred supplier.

We do not use performance based pricing in our contracts. Hybrid propulsion is a young product, so in the future performance based pricing might be an interesting concept. It could be related to fuel savings or a decrease in emission. In that case we will be paid for our activities (fixed price) and we will receive a percentage of the savings. At the moment performance based is not realistic, because the technology is relatively new and we are not sure what the real savings will be in practice. The real savings are unknown.

2. Can you describe the cost structure?

The costs depend on the project. The best projects are when the balance between labor costs and material costs are 50/50. Just material costs or just engineering costs are not interesting, so make sure that you have projects with the right balance between these two.

Ending

1. Do you have any additions to the discussed topics?

No, I don’t have any additions.

2. Do you have any further remarks regarding this interview?

No further remarks.
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

Appendix F: Coding interviews

Appendix F1: Coding interviews producers

Table 12: Coding interviews producers

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Interview 1 (WL)</th>
<th>Interview 2 (MK)</th>
<th>Interview 3 (AdJ)</th>
<th>Interview 4 (FK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value proposition</td>
<td>- The organization offers electric busses to her customers.</td>
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<tr>
<td></td>
<td>- Benefits for the customer are emission reduction and economic benefits.</td>
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<tr>
<td></td>
<td>- After-sales are extremely important, because the technology is relative new. Service contracts are included within the purchase or lease.</td>
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<td></td>
<td>- The electric busses are a combination of standardization, like the drive line and battery pack, and customization, like the design of the bus.</td>
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<td></td>
<td>- The production of electric busses is the result of the knowledge available on foreign markets. By creating the busses we have created the demand, since we have showed governments that electric busses are possible. Of course demand is also created by environmental rules and regulations.</td>
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<td></td>
<td>- Environmental rules and regulations play an important role. Recently an agreement has been signed that states that</td>
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<td></td>
<td>- The organization offers e-mobility solutions to her customers.</td>
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<td></td>
<td>- Electric busses are just the product, we offer a complete system.</td>
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<td></td>
<td>- Initial investment costs are no longer the issue, highest costs are related to the performance of the driver. The number of busses purchased is therefore no longer interesting, but how can you deploy your drivers as optimal as possible is the question that rises.</td>
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<td></td>
<td>- Benefits for the customer are less noise, zero emission and therefore no local air pollution, more efficient and lower energy consumption, and the possibility to use more alternative energy resources.</td>
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<td></td>
<td>- We use standardized modules for the most important components of the bus, like the driving line and the battery pack. It is possible to vary within those modules to offer our clients the best possible solutions for their operations.</td>
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<td></td>
<td>- We offer busses to our customers, like diesel busses, hybrid busses, and electric busses.</td>
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<td></td>
<td>- Due to new environmental rules and regulations the need for electric transport is increasing.</td>
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<td></td>
<td>- Main benefit for the customer is that electric busses are zero emission, so it fits within the new environmental rules and regulations.</td>
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<td></td>
<td>- After-sales cannot be underestimated. The process of e-mobility consists of three steps, and services are completely integrated to the whole process. Differences between you and your competitor can be made by the length of the respond time, because everyone already expects services.</td>
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<td></td>
<td>- We have a modular approach for e-mobility. Within each module it is possible to vary, and by linking the best variations we can offer our customer the best option for</td>
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<td></td>
<td>- Bluekens offers maintenance and repair services to her customers.</td>
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<td></td>
<td>- Not active in the sales area, so we are an independent maintenance organization.</td>
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<td></td>
<td>- Main benefit for the customer is that maintenance completely taken care of, so they are able to focus on their core business.</td>
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<tr>
<td></td>
<td>- After-sales are important due to new technology and lack of knowledge of the user. We provide those after-sales services.</td>
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<td></td>
<td>- Feasibility of e-mobility will increase when busses and charging infrastructure can be standardized.</td>
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<tr>
<td></td>
<td>- Electric busses are the result of new technology as well as the demand from operators. The combination has led to the introduction of electric busses.</td>
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<tr>
<td></td>
<td>- Recently new environmental rules and regulations have been introduced which states that from 2025 all public transportation should be zero emission. Within city</td>
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</tr>
</tbody>
</table>
| Customer interface | from 2025 all public transportation must be zero emission. It forces operators to shift from diesel busses to electric busses. | Customization is often related to design.  
- Recently a zero emission agreement has been signed between the Dutch government, provinces and public transport operators (PTO’s) that states that from 2025 all public transportation must be zero emission. This means that the paragraph ‘environment and emission’ becomes more and more important within tenders. | their needs.  
- The electric busses are the result of technology development and increased demand by rules and regulation. All elements of the bus are not new, but the combination of all elements makes the product unique.  
- New rules and regulations state that from 2025 all public transportation must be zero emission within city boundaries. One city reacts quicker to these new regulations than the other, so the market for electric busses is therefore influenced by environmental rules and regulations. |

| Customer segments | Distinction between public transport operators (PTO’s) and public transport authorities (PTA’s). PTA’s issue concessions to PTO’s, which is normally eight to ten years.  
- PTO’s is the first market segment, because they order the busses for their operations.  
- PTA’s may force PTO’s to use zero emission busses (as a result of environmental rules and regulations), so they are able to influence the customer.  
- The second market segment is the tour operator, although this | The electric busses are sold to the end user, namely the public transport operators (PTO’s). They operate on behalf of local governments or the province (via concessions).  
- The second market segment that can be identified is the segment tour operators. They are not directly interested in electric busses, they prefer diesel-electric busses.  
- The difference between the two segments is the driving range. Relatively small for | Distinction between public transport operators (PTO’s) and public transport authorities (PTA’s). The province or cities outsource public transportation to PTO’s.  
- First segment that can be identified are PTO’s.  
- PTA’s may force PTO’s to use zero emission busses in their operation. This is the result of stricter environmental rules and regulations.  
- Second segment is ‘closed’ transportation (tour operators). Their busses need to be electric |

| | Producers conclude service contracts with the users of electric busses, but outsource maintenance and repair services to external parties.  
- Direct customers are producers, indirect customers are operators. | | |

boundaries this should be feasible, but for regional transportation I think it is too complex. The reason is on the one hand the financial aspect and on the other hand the charging infrastructure aspect.
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

<table>
<thead>
<tr>
<th>Customer relationships</th>
<th>Channel partners</th>
<th>Supply chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>segment is relatively small in the Netherlands. They are more price sensitive as well than operators. Their needs are also slightly different than the needs of PTO’s.</td>
<td>PTO’s and much longer for tour operators.</td>
<td>PTO’s support is crucial within the business. We are a full partner to our customers, more than our competitors can be.</td>
</tr>
<tr>
<td>- Bus drivers are an important factor for the success of the electric busses. We therefore organizations demonstrations and invite bus drivers to test the busses. PTO’s strive to familiarize the drivers with the new technology. - After-sales are important, so short links with the customer are required.</td>
<td>- All types of stakeholders are involved during the purchasing process, like finance but also the bus drivers. - We invite stakeholders to show them the production process. - We give sometimes the bus drivers the opportunity to test the electric busses and evaluate the performance.</td>
<td>- Customer relationships are crucial within the business. We are a full partner to our customers, more than our competitors can be. - We analyze the operations of our customers. Therefore we have contact on a regular base.</td>
</tr>
<tr>
<td>Channels</td>
<td></td>
<td>- Direct contact with producers as the external maintenance organization. - Evaluation meeting with the user, the producer, and with us. Evaluation of maintenance activities from the last period, and discuss possible improvements for the upcoming period.</td>
</tr>
<tr>
<td>- No specific distribution channels. - Most customers (PTO’s) are known and therefore direct links to the customer are established.</td>
<td>- We visit fairs where we show our latest developments and inform potential customers about our approach. - We have short links with the most known operators. They already purchase our diesel busses.</td>
<td>- We already sell diesel busses and have a good name in the business. Most customers know how to find us. - We visit fairs where we present ourselves and explain our approach of e-mobility.</td>
</tr>
<tr>
<td>Key partners</td>
<td></td>
<td>- We have a history in converting diesel busses into electric busses. We have knowledge of electric busses and can offer the best services to our customers. When you have established your name in the business, customers will find you.</td>
</tr>
<tr>
<td>Governments Governments finance via innovation funds to develop the technology. It is a form of stimulations. - External investors A reliable and sustainable technology might attract investors to let the business grow.</td>
<td>VDL Financing VDL Financing supports with financing activities when operators prefer to lease. - Knowledge institutes Cooperation with knowledge institutes to develop knowledge and technologies. - Governments</td>
<td>Suppliers Due to all developments on the battery market, we are continuously searching for the best partner. We switch regularly between partners. - Governments Governments introduce rules and regulations, but also</td>
</tr>
<tr>
<td>- Suppliers Suppliers produce the bus and they contact us for maintenance and repair services.</td>
<td></td>
<td>- Governments Seeking for fewer suppliers so that we are able to have components in stock.</td>
</tr>
<tr>
<td>- Suppliers Suppliers produce the bus and they contact us for maintenance and repair services.</td>
<td></td>
<td>- Governments Seeking for fewer suppliers so that we are able to have components in stock.</td>
</tr>
</tbody>
</table>
## Key activities
- Suppliers
  For each of the components of the bus we have one or more suppliers.
- Governments determine environmental rules and regulations and participate in pilot projects with subsidiaries.
- Suppliers contribute to several projects with subsidiaries and support.
  - VDL Financing
    We do not have external investors, because we are wealthy enough to finance projects ourselves. We also support start-ups in the transportation sector with investments.
- Governments provide subsidiaries to finance pilot projects.

## Key resources
- Knowledge on the new technology.
- Production facility with skilled personnel.
- Governmental subsidiaries to develop the technology and external investors for realizing business growth.
- Knowledge on technology.
- Production facilities to produce/assemble the bus.
- Workshops for maintenance and repair.
- Knowledge on the technology.
  The components are not new, it is the combination of the components that is innovative.
- Production facilities to produce/assemble the bus.
- Workshops for maintenance and repair.
- Knowledge on the technology.
  - Skilled personnel.
  - Subsidiaries to cover a part of all additional costs.

## Financial model
- Battery pack and driving line are the most costly elements of the bus. The battery pack therefore determines more or less the price.
- We strive to achieve break-even, since we are only a development organization. The profit can be gained at the end of the value chain.
- The battery pack and the driving line are the most costly components of the bus.
- Costs with respect to maintenance personnel.
- Costs with respect to purchasing components or parts.

<table>
<thead>
<tr>
<th>Suppliers</th>
<th>Governments determine environmental rules and regulations and participate in pilot projects with subsidiaries.</th>
<th>Suppliers contribute to several projects with subsidiaries and support.</th>
<th>Governments provide subsidiaries to finance pilot projects.</th>
</tr>
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<td>Suppliers contribute to several projects with subsidiaries and support.</td>
</tr>
</tbody>
</table>

## Long-term planning is essential.
Choose a dot on the horizon and determine the path to achieve the desired results.
- Analysis of the customer’s operations. Based on the results the best solution for e-mobility can be offered.
- The development of an optimal infrastructure.
- Demonstration and testing of electric busses.
- The transition process from a diesel bus to an electric bus.
- The phase that a pre-series bus is developed till a series production bus.
- The approach of e-mobility, meaning that electric transportation is more than just an electric bus. It is a complete e-mobility system.

## The conversion from a diesel bus into an electric bus provided us with additional knowledge and new insights.
- Seeking for fewer suppliers so that it is possible to have components in stock. As a repair organization quick response time is crucial.

## Test periods for bus drivers to become familiar with the new technology.
- The approach of e-mobility, meaning that electric transportation is more than just an electric bus. It is a complete e-mobility system.
- The conversion from a diesel bus into an electric bus provided us with additional knowledge and new insights.
- Seeking for fewer suppliers so that it is possible to have components in stock. As a repair organization quick response time is crucial.

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- The approach of e-mobility, meaning that electric transportation is more than just an electric bus. It is a complete e-mobility system.
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### Arrange a green business model to benefit from an innovative market given environmental rules and regulations

<table>
<thead>
<tr>
<th>Revenue streams</th>
<th>Production takes place in Asia.</th>
<th>Do not underestimate costs related to the charging infrastructure.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- PTO’s prefer lease models, because they do not want the bus as an asset on the balance sheet.</td>
<td>Costs related to consultancy work.</td>
</tr>
<tr>
<td></td>
<td>- We only sell busses. Lease contracts can be signed between the PTO and the lease company.</td>
<td>Fines if the busses do not meet the agreed level of up-time.</td>
</tr>
<tr>
<td></td>
<td>- After-sales might be incorporated in the sales contract (price per kilometer).</td>
<td>- PTO’s have the option to lease or to purchase the busses.</td>
</tr>
<tr>
<td></td>
<td>- We sell individual parts of the electric buss as well.</td>
<td>Revenues with respect to consultancy work.</td>
</tr>
<tr>
<td></td>
<td>- Subsidiaries to develop the technology.</td>
<td>- As stated, we offer after-sales services like maintenance and repair.</td>
</tr>
<tr>
<td></td>
<td>- PTO’s only purchase the electric busses if they are financially capable enough. Most PTO’s prefer a lease model.</td>
<td>- Subsidiaries used in ‘green’ projects for the development of the technology and subsidiaries for demonstrating the technology.</td>
</tr>
<tr>
<td></td>
<td>- In cooperation with VDL Financing we offer lease models as well as purchase models.</td>
<td>- Which price mechanism is chosen depends on the customer. A fixed price per period or a price per kilometer driven.</td>
</tr>
<tr>
<td></td>
<td>- All sales contracts contain service contracts for maintenance and repair.</td>
<td>- We make use of subsidiaries to cover some additional costs. Subsidiaries are the base of most pilot projects.</td>
</tr>
<tr>
<td></td>
<td>- We offer consultancy to the customer to arrange the paragraph ‘environment and emission’ within tenders in the best way.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Subsidiaries to develop the technology and scale-up to series production. We do only participate in subsidized projects as long as it contributes to the path we already have determined.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix F2: Coding interviews users

Table 13: Coding interviews users

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Interview 1 (GN)</th>
<th>Interview 2 (EB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drivers</td>
<td>▪ Electric buses are not purchased for profitability, because they cannot compete with diesel buses regarding total cost of ownership (TCO).</td>
<td>▪ One of the drivers is that sustainability goals have been formulated by the management team.</td>
</tr>
<tr>
<td></td>
<td>▪ One of the drivers is that sustainability goals have been formulated by the management team.</td>
<td>▪ The second driver is the introduction of environmental rules and regulations. A sustainability covenant has been signed in cooperation with the city of Amsterdam.</td>
</tr>
<tr>
<td></td>
<td>▪ The other driver is that clients demand that zero emission busses are used in operation.</td>
<td>▪ The charging technique is a crucial aspect in the purchasing process, because we have to deal with complete new technology. We are not familiar with these techniques and therefore we use market consultation should help us out.</td>
</tr>
<tr>
<td>Important aspects</td>
<td>▪ One of our bus drivers has been trained by VDL. He now trains our other drivers.</td>
<td>▪ We have to realize that electric busses cannot be implemented one-on-one in the current operations.</td>
</tr>
<tr>
<td></td>
<td>▪ The attitude of the bus drivers is crucial. They will lose some flexibility, and it is important to manage their role in the project.</td>
<td>▪ The charging technique is a crucial aspect in the purchasing process, because we have to deal with complete new technology. We are not familiar with these techniques and therefore we use market consultation should help us out.</td>
</tr>
</tbody>
</table>
| Stakeholders | ▪ Technical department  
  The technical department is responsible for the technical specifications of the busses.  
 ▪ Purchasing department  
  The purchasing department guides the complete purchasing process.  
 ▪ Implementation team  
  In case of implementation we have also an implementation team.  
 ▪ Steering team  
  In case of implementation we have also a steering team.  
 ▪ Project committee  
  In case of implementation we have also a project committee.  
 ▪ Management team  
  Close communication with the management team is also required, since large amounts are involved. | ▪ Bus drivers  
  They are closely involved in the purchasing process, usually in the form of a delegation of the works council and a drivers committee.  
 ▪ City of Amsterdam  
  The city of Amsterdam is our client and their needs and demands is taken into account as well during the purchasing process. |
| Offerors     | ▪ Different charging techniques are available on the market, but there is no producer that offers them all.                                  | ▪ A market consultation has been executed to find out what is possible within the sector of electric busses and how much it will cost. |
|              | ▪ The choice for a certain charging technique eliminates several suppliers in advance.                                                             | ▪ Different charging techniques are available on the market.                                                      |
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

<table>
<thead>
<tr>
<th>Performance</th>
<th>- The choice for a specific producer out of the remaining producers is established by TCO. The final decision is financially driven.</th>
<th>- As GVB all of our tenders must be European tenders, therefore the list of requirements is crucial. Based on the list of requirements and the criteria, the final producer will win the tender.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substitutes</td>
<td>- Hydrogen busses are a substitute product, but we have no experiences with these busses so far. They are not competitive enough with electric busses based on TCO.</td>
<td>- Hydrogen busses are zero emission as well, but are too expensive. The availability of hydrogen is limited as well.</td>
</tr>
</tbody>
</table>
| Benefits | - Most important benefit is the zero emission aspect. The reduction in CO₂ as well as other gasses is the driver for implementation of the busses.  
- Another benefit is the reduction in noise, but this is more a bonus benefit. At the end it is all about zero emission. | - The most important benefit an electric bus has, is the reduction of air pollution.  
- Another benefit is the reduction in noise for citizens living close to end points of routes. The noise reduction is a benefit for passengers as well. |
| Disadvantages | - The limited driving range of electric busses is significantly smaller than the one from a diesel bus.  
- The charging time is relatively long, especially in comparison with refueling a regular diesel bus.  
- Large investments in a charging infrastructure are required. | - The limited driving range of electric busses is a serious disadvantage.  
- The long charging time is the second disadvantage we can distinguish. |
| Organizational adaptations | - Zero emission has become more important within our organization and therefore I have been assigned as program manager zero emission.  
- The guidance of bus drivers within the project is more intense, since they will lose some flexibility.  
- We outsource all maintenance, so we have no need to retrain maintenance personnel. The external maintenance organization has to train their personnel with the knowledge available of the new technology. | - We strive to use the infrastructure of tram and subway and they all use green energy. This is what we would like to use for the electric busses too.  
- Maintenance will be done by our own maintenance personnel. We already have some knowledge from tram and subway, and that will be used for the training of our personnel. |
| Expectations | - The first electric busses were conversions of diesel busses, and we had several problems with these. However, we expected these problems in advance.  
- The second project was the introduction of electric busses on Schiermonnikoog. They meet the expectations, but we have to realize that we cannot copy the situation one-on-one to a city like Venlo.  
- The implementation of electric busses within Den Bosch meets the expectations. The problems we have faced so far cannot be linked with the electric drive line. | - No electric busses are in operation at the moment, but our projects with fuel cell busses were positive. The project has been extended a couple of times. |
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

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**Rules and regulations**

**Influence**
- A political agreement has been signed that from 2025 all public transportation should be zero emission.
- In worst case we don’t exist anymore in 2025, because most concession last for eight to ten years. Of course we don’t expect that to happen, but it could be possible. It all depends on our clients.
- The introduction of zero emission busses is a phased process. We still offer diesel busses to our clients, because a replacement in once is not realistic.

**Subsidiaries**
- Past projects have been subsidized by governments. They are involved in such projects and take care of most additional costs.
- European funds are available as well, and can be used for pilot projects and the introduction of electric busses.

---

**Subsidiaries**

- We have signed a sustainability covenant with the city of Amsterdam to replace our diesel busses for electric busses. This is the result of the introduction of rules and regulations which aim to reduce local air pollution.
- We have a low emission zone (LEZ) in Amsterdam and most trucks are therefore not allowed to enter the city. It might be that busses have to comply with this regulation as well, but it is not clear if this will be realized before 2025.

---

**Appendix F3: Coding interviews producers**

**Table 14: Coding internal interviews**

<table>
<thead>
<tr>
<th>Interview 1 (WvdP)</th>
<th>Interview 2 (DvdM)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value proposition</strong></td>
<td></td>
</tr>
<tr>
<td>Distinction needs to be made between traditional diesel ferries and hybrid ferries.</td>
<td></td>
</tr>
<tr>
<td>We offer electric systems for ferries. Therefore we are less involved in the traditional ferry market, because these do not have large electric systems on board.</td>
<td></td>
</tr>
<tr>
<td>We are flexible and some yards might choose us because we already have a good relationship with them.</td>
<td></td>
</tr>
<tr>
<td>Some yards take full responsibility of the ship and function as mediator between us and the owner when it comes to after-sales. Sometimes we have direct contact with the owner of the vessel to offer our after-sales.</td>
<td></td>
</tr>
<tr>
<td>All projects are one-of-a-kind, customization is preferred above standardization. Sometimes there is some series production, but due to external factors it is really hard to make exact copies. Some</td>
<td></td>
</tr>
<tr>
<td>Three types of ferries, known as diesel-direct ferries, diesel-electric ferries, and hybrid ferries. The third type is a diesel-electric version combined with a battery pack.</td>
<td></td>
</tr>
<tr>
<td>Focus on hybrid ferries, because it generates the most revenues.</td>
<td></td>
</tr>
<tr>
<td>RH Marine NL offers products and services related to propulsion and system integration.</td>
<td></td>
</tr>
<tr>
<td>Distinctive profile in comparison with competitors by the development of an algorithm which determines based on several external factors as wind and current, the best option for the operator to use.</td>
<td></td>
</tr>
<tr>
<td>Warranty period for all products and services, but after that period a maintenance and repair contract has to be signed. It depends on the project if the yard acts as a mediator.</td>
<td></td>
</tr>
<tr>
<td>Many variations of the same type of vessel on the market, so less standardization. However, owners often choose for the same</td>
<td></td>
</tr>
</tbody>
</table>
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

<table>
<thead>
<tr>
<th>Customer interface</th>
<th>ferries are more or less similar to each other, but there are still some differences/modifications.</th>
<th>systems for their new build vessels, because the crew is already familiar with that type of system (no re-training is required).</th>
</tr>
</thead>
</table>
| **Customer segments** | - The yards are our direct customers. They are responsible for building the vessel and the integration of systems on board.  
- For hybrid systems it is recommended to have direct contact with the owner of the vessel as well. The owner has a complete different view on costs than the yard has. | - Two important actors on the market, yards and ferry owners.  
- Different needs and demands between the two. Yards are seeking for the lowest price, while the operator is interested in the savings during the lifetime of the vessel.  
- Two important actors on the market, yards and ferry owners.  
- Different needs and demands between the two. Yards are seeking for the lowest price, while the operator is interested in the savings during the lifetime of the vessel. |
| **Customer relationships** | - Regular contact with the yard to discuss the progress of the project.  
- Contact with the operator to discuss the benefits of the product and to show how the product optimize the operational goal of the operator. | - Contact with the yard is essential. It is needed to schedule all the activities and to discuss the progress of the project.  
- Contact with the ferry owner to discuss the benefits of the product and to show how the product optimize the operational goal of the operator.  
- Contact with the yard is essential. It is needed to schedule all the activities and to discuss the progress of the project.  
- Contact with the ferry owner to discuss the benefits of the product and to show how the product optimize the operational goal of the operator. |
| **Channels** | - We are known in the market for our expertise, so yards know how to find us. Although they know how to find us, we invest in good relationships with the yards. | - Good relationships with the yards.  
- Cold acquisition.  
- Good relationships with the yards.  
- Cold acquisition. |
| **Supply chain** | - Supply chain is reasonably standardized. Specific suppliers for the main components.  
- We are able to switch between suppliers if the owner demands another supplier.  
- No external investors involved. | - Which suppliers are selected depends on the project. The battery market is a young and immature market, so before we select a battery supplier we always check the stability of the organization.  
- We are supplier independent and we are able to switch between suppliers. It depends on the operational goal of the operator.  
- Which suppliers are selected depends on the project. The battery market is a young and immature market, so before we select a battery supplier we always check the stability of the organization.  
- We are supplier independent and we are able to switch between suppliers. It depends on the operational goal of the operator. |
| **Key partners** | - Our R&D has to be done during each project, since we have no unpaid innovation in the organization.  
- Communication with the yard to discuss the project schedule.  
- Communication with the owner to discuss the benefits of the products/services. | - Planning of the complete project.  
- Communication with the yard to discuss the progress.  
- Communication with the owner to discuss the benefits of the products/services.  
- Planning of the complete project.  
- Communication with the yard to discuss the progress.  
- Communication with the owner to discuss the benefits of the products/services. |
| **Key resources** | - Knowledge of hybrid propulsion  
- Skilled personnel | - Knowledge of hybrid propulsion  
- Skilled personnel  
- Knowledge of hybrid propulsion  
- Skilled personnel |
| **Financial model** | - Most costs are related to man hours and the purchase of components.  
- Staff working on location also leads to relatively large travel costs.  
- Claims if we are not able to deliver according the agreed schedule. | - The costs depend on the project.  
- Best projects are when the balance between labor costs and material costs are 50/50.  
- The costs depend on the project.  
- Best projects are when the balance between labor costs and material costs are 50/50. |
| **Revenue streams** | - Different view on costs by yards and owners. Yards are seeking for the lowest costs and less risk, while operators strive to optimize the total cost of ownership (TCO). | - Yards are price sensitive and always strive to purchase the systems for the lowest price.  
- Yards are price sensitive and always strive to purchase the systems for the lowest price.  
- Yards are price sensitive and always strive to purchase the systems for the lowest price. |
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

| – No performance-based pricing, although it could be really interesting for the future. It might be difficult to realize, because the systems we deliver is just an element of the complete system. | – Ferry owners can place suppliers on the preferred supplier list, although it might increase the price for them if the preferred supplier is not the cheapest option for the yard. – No performance-based pricing in our contracts, because the technology we use is relatively young and we are not sure what the real savings are. |
### Appendix G: Solution design

Table 15: Transfer of case study findings to the hybrid ferry market

<table>
<thead>
<tr>
<th>Environmental rules and regulations</th>
<th>Case study (electric busses)</th>
<th>+</th>
<th>Hybrid ferries</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Recently a political agreement has been signed, which states that from 2025 all public transportation must be zero emission. It means that the regular diesel busses are no longer allowed.</td>
<td>- Important benefits of electric busses are the zero emission aspect and noise reduction.</td>
<td>- Rules and regulations in the maritime market focus on emission reduction, however there are projects with full electric vessels (zero emission).</td>
<td>- Important benefits of electric busses are emission reduction, noise reduction, and fuel savings.</td>
<td></td>
</tr>
<tr>
<td>- After-sales are extremely important, because the end user is not familiar with the new technology.</td>
<td>- Standardization of the drive line is preferred above customization, because it enhances series production. Customization is only relevant when it is related to adjustments of doors, seats, etc.</td>
<td>- After-sales are important as well for the hybrid ferries, since the operators are not familiar with the new technology.</td>
<td>- Standardization cannot be applied in ferry projects. Projects are often one-of-a-kind based on the different types of customer needs and based on the different types of yards, since each has their own approach to a project.</td>
<td></td>
</tr>
<tr>
<td>Value proposition</td>
<td>Electric busses are just like diesel busses, but with a battery pack that can be charged overnight and an electric drive line.</td>
<td>Hybrid ferries are diesel-electric ferries with a battery pack that can be charged overnight and when the ferry is offloading cars and passengers.</td>
<td>- The e-mobility approach is difficult to implement in the maritime market, since hybrid ferries sails</td>
<td></td>
</tr>
<tr>
<td>- E-mobility approach includes the analysis of the current operations of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Arrange a green business model to benefit from an innovative market given environmental rules and regulations

<table>
<thead>
<tr>
<th>Customer interface</th>
<th>from point A to point B. It differs with electric busses, which follow a specific route during the day with multiple stops.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- First customer segment are the PTO's. Second customer segment are the tour operators.</td>
<td>- Clear distinction between yards and end users. End users are often related to governmental institutes for hybrid ferries, while PTA's in public transportation sector outsource public transportation to PTO's.</td>
</tr>
<tr>
<td>- The analyses of the current routes of operators require intimate customer relationships.</td>
<td>- Just one segment can be identified, the yards. Other important actors are the operators, who are able to influence the purchasing process bij placing suppliers on the preferred supplier list.</td>
</tr>
<tr>
<td>- Bus drivers are crucial for the success of electric bus implementation.</td>
<td>- It is not needed to analyze the route since most ferries sail from point A to point B instead of following a complete route schedule.</td>
</tr>
<tr>
<td>- No other distribution channels can be identified for electric busses.</td>
<td>- Ferry captains might play an important role, so these should be involved during the implementation process.</td>
</tr>
<tr>
<td></td>
<td>- Use the same distribution channels for hybrid ferries as the diesel and diesel-electric busses. Visiting fairs should be done to generate additional awareness.</td>
</tr>
</tbody>
</table>

Bus drivers are crucial for the success of electric bus implementation. Ferry captains might play an important role, so these should be involved during the implementation process. No other distribution channels can be identified for electric busses. Use the same distribution channels for hybrid ferries as the diesel and diesel-electric busses. Visiting fairs should be done to generate additional awareness.
<table>
<thead>
<tr>
<th>Supply chain</th>
<th>Financial model</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Most important key partners are governments, external investors, and suppliers.</td>
<td>- Most important key partners are governments, and suppliers.</td>
</tr>
<tr>
<td>- Development of sustainable technology is done in cooperation with knowledge institutes and universities.</td>
<td>- Development of sustainable technology can be done in cooperation with knowledge institutes and universities.</td>
</tr>
<tr>
<td>- Key activities are demonstrating busses to operators and governments, but also give bus drivers the opportunity to test.</td>
<td>- Key activities are demonstrating ferries to operators and governments, but also give ferry captains the opportunity to test the hybrid propulsion.</td>
</tr>
<tr>
<td>- Key resources are knowledge on the technology, production facilities, workshops for repair and maintenance, skilled personnel, and subsidiaries.</td>
<td>- Key resources are knowledge on the technology, skilled personnel, and subsidiaries.</td>
</tr>
<tr>
<td>- Most costs are related to the battery pack and drive line.</td>
<td>- The balance between purchasing components and personnel costs is 50/50.</td>
</tr>
<tr>
<td>- Costs related to consultancy work.</td>
<td>- Costs with respect to consultancy activities during the design phase (hybrid propulsion integration).</td>
</tr>
<tr>
<td>- Revenue streams are the sales of electric busses, the lease of electric busses, maintenance and repair services (after-sales), consultancy services.</td>
<td>- Revenues streams are the sales of hybrid propulsion systems, after-sales, consultancy services.</td>
</tr>
<tr>
<td>- Subsidiaries for the development of the technology and for pilot projects form another revenue stream.</td>
<td>- Green project with respect to sustainability can be used to test, to benefit financially, but also to develop knowledge.</td>
</tr>
<tr>
<td>- External investors are not used, only by operators to finance the construction of the vessel.</td>
<td>- Production facilities are only used for small production work, because the installation is done at the yard. Repair and maintenance is usually done at the customer.</td>
</tr>
<tr>
<td>- High costs with respect to travelling, since personnel work on side.</td>
<td>- Lease models are not very common in the maritime market. Although the model is sometimes used, the ferry owner is often also the operator.</td>
</tr>
</tbody>
</table>
Arrange a green business model to benefit from an innovative market given environmental rules and regulations