WORKING FOR A BETTER PLACE

Standard shift in the automotive industry

-moving from petroleum to electricity

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"We can't solve problems by using the same kind of thinking we used when we created them."

- Albert Einstein -

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Nizam & Dotan

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Sammanfattning

Bilindustrin genomgår en unik standard krig mellan den konventionella förbränningsmotorn och de nya bränslen teknologierna. Hittills har investeringar i det sistnämnda alternativet har varit av mindre omfattningen och genomförts av statliga myndligheter eller av de etablerade aktörerna inom bilindustrin. Men ett extraordinärt projekt genomgås just nu av riskkapitalbolaget Better Place som avser att installera den första landsomfattande infrastrukturen för elektriska bilar. Empiriska studier har dock visat att ett standard skifte kan vara en komplex process som kan utspelas i flera årtionden (Ausubel, 1998). Den här uppsatsen har i syfte att identifiera de strategiska utmaningarna för BP i deras strävan efter standardbyte. Vi har använt oss av en kvalitativ undersökningsmetodik med en fördjupning i företaget Better Place. De teoretiska perspektiven är extern affärs miljö- och industri analys, ekosystem strategi, ”banbrytande” innovationer samt konkurrensfördelar. Vi fann att ett standard skifte stöds av flera rådande förhållanden i den externa miljön. Vi fann även att storskaliga investeringar är viktiga för att kunna koordinera nationella ekosystem och få med sig viktiga komplement produkter. Biltillverkarna har stor inflytande i ett standardbyte process genom att de förstärker effekterna av ”pathdependence” mekanismerna. Företag måste dock inkorporera flexibilitet i sin teknologi för att synkronisera med den snabb föränderliga EV-teknologin. Företag måste också förstå de negative påföljderna av ”över standardiserade” teknologier då den internationella standardiserings arbete fortfarande är i ett tidigt skede.

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Författare:	Nizam Arif & Dotan Hakim
Handledare:	Christer Kedström
Nyckelord:	standardbyte, banbrytande innovationer, ekosystem, hållbar konkurrensfördelar, elbilar.
Syfte:	Analysera externa affär områden som grunden till uppkommande industrier och kartlägga den nya industrin, samt identifiera potentiella utmaningar som innovativa företag möter när de försöker att ändra teknologier och behålla konkurrens fördelar.
Metod:	Studien har en kvalitativ ansats med fördjupning företaget ”Better Place”.
Teoretiska perspektiv:	Makro och Industri analys, Standard skifte, Banbrytande innovationer, Plattform strategi, Resursbaserad strategi
Empiri:	Studien har baserats på både primär och sekundär data. Primär data består av 6 intervjuer varav en är med fall företaget. Sekundärdata har inhämtats från diverse dokument men fokus har lagts på ett tiotal av dem. Urval och redogörelse av sekundärdata har presenterats i relevans med analysen.

Abstract

The automotive industry is currently witnessing a standard battle between the emerging propulsion technologies and the internal combustion engine. Almost all efforts, whether they are initiated by governments or established players of the automotive industry, have been deployed on a small-scale basis. However, an ambitious attempt is currently being made by the venture-backed company Better Place, which intends to build the first nation-wide recharging network for electric vehicles. Empirical studies show, however, that standard shifts are complex processes which can have the duration of several decades (Ausubel, 1998). This thesis aims to identify the most important strategic challenges BP face in their quest for standard shift. The research has been processed with a qualitative approach, with a case study of Better Place. The theoretical perspectives are external business environment and industry analysis, ecosystems strategy, disruptive innovations and competitive advantage. We have found that a standard shift is supported by many of the current macro circumstances. We also found that infrastructures of large scale are of most importance in order to coordinate ecosystems and attract complementary products. Car manufacturers are have major influencers on the standard shifting process since they empower the mechanisms of the path dependence. Furthermore, technology standards must incorporate flexibility in order to synchronize with the fast evolving EV-technology. Firms must also understand the danger of "overstandardization" since the international standardization work still is on an early phase.

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Authors:	Nizam Arif & Dotan Hakim
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Key words:	Standard shift, disruptive innovations, ecosystems, sustainable competitive advantage, electric cars.
Purpose:	Analyze external business environment as foundation to emerging industry and map the scope of the new industry, as well as identify potential challenges that innovative companies faces when attempting to disrupt technologies and maintain competitive advantage.
Methodology:	The research has qualitative approach with the case studying of the firm "Better Place".
Theoretical perspective:	Macro and industry analysis, standard shift, disruptive innovations, platform strategy, resource based view.
Empirical foundation:	The research is based on both primary- and on secondary data. The primary data contains of 6 interviews, one is with the case company Better Place. Secondary data has been collected from diverse documents but is mainly focused to some documents. The selection and the presentation of secondary data been made in relevance

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1. Introduction

1.1 Background

Governments all around the world have declared their strategic objectives to reduce the usage of fossil fuels. Investors, companies, and consumers have becomes more aware of the negative consequences that fossil fuel usage has brought upon the environment. Investors are now taking into account the climate change exposure when forecasting the company's profitability. Companies recognize the significance of lower emission in the approach of creating of higher costumer value. Thus, a reduction of embedded emissions in the value chain has direct impact on a company's current and future financial strength. (Lash J & Wellington F 2007)

Moreover, the discussed trends are not solely perceived as a necessity for operational rationalism in the value chain but also as a strategic opportunity for companies to derive its competitive advantage from. In order to do so, companies may approach the environmental issues in two ways; the "inside out" approach and the "outside in" approach. The first approach aims at understanding how a company and its value chain may affect the climate conditions whereas the second approach reflects upon how changes in climate and governmental regulations may affect the business practises of firms and industries. (Porter & Reinhardt 2007)

The environmental consequences and effects of fossil fuel usage are alarming the traditional practises of the traditional industries. The most affected one is the automotive and transport sector due to the pollution of carbon dioxide. The environmental issues and governmental regulations in addition to the financial crisis force these industries to revise their traditional business strategies in order to survive and prosper.

One of the trends within the automotive industry is the decreasing dominance of gasoline and the dawning of alternative propulsion technologies. Many industry experts are convinced that the automotive industry is going towards an intense standard war between the different technologies. However, car manufacturers and policy makers have not reached consensuses on a standard regarding the new technologies. The two most compatible propulsion technologies of today are hydrogen and electricity.

1.2 Electric Vehicle (EV)

1.2.1 EVs today

Electric vehicles (EVs) release no emissions during driving if it is solely powered by a sustainable energy source. However, the full driving range of EVs is perceived to be too small while production and maintenance of the necessary infrastructure is not in place. The purchasing price of new EVs is relatively high due to the high manufacturing costs of lithium-ion batteries and other components. (Karplus, Paltsev & Reilly, 2009)

There are three types of EVs; *Hybrids, Plug-in Hybrids* and *Pure Electric.*(Van Den Bossche, 2003)

Hybrids: On these types of EVs, the primary source of motive power is still an internal combustion fossil fuel engine, but with an additional electric motor that is utilized to provide power at certain occasions in driving, (such as low-speed in-town driving) thus leading to a reduction in fuel consumption. The gasoline engine provides most of the power to recharge the batteries, through regenerative braking and other energy-recovery techniques.
Plug-in hybrids: These vehicles have an internal combustion engine with a much larger battery pack than in a hybrid vehicle. The vehicle runs only on battery power for the first 30 kilometers. Once they are depleted, the gasoline engine takes over. When the car is parked, the owner "plugs-in" and the battery pack is recharged for the next usage.
Pure electric: This category of EVs produces no harmful emissions since they are entirely driven by an electric motor. These EV types rely on the constant recharging of the batteries, which can require 7-8 hours for a full charge. Furthermore, this category is greatly dependant on the availability of charging spots.

1.2.2 Better Place

Better Place (BP) is a firm that invests in the two last types of EVs. Their plan is to build a nationwide recharging infrastructure for plug-in vehicles. The business idea is to introduce a switchable battery pack, which will offset both the price and driving range constraints of EVs. The initial purchase price of an electric vehicle would become more affordable since the ownership of the battery will remain with BP and the carmaker. It also enables depleted batteries to be automatically replaced with charged ones in only a matter of minutes at the battery-switching stations.

BP has made covenants with governments to launch its pilot projects in Israel, Denmark, Australia, Hawaii and California. The first pilot project is to take place in Israel with building starting by 2009 and scaled to the mass-market by 2011. The project in Israel alone consists of totally 500 000 charging spots and more than 100 battery-exchange stations, the value of the projects is estimated to be 1, 2 billion dollars.

Car manufacturer, Renault-Nissan, is committed to supply vehicles in accordance with the platform technology of BP. Renault-Nissan plans to have several models available for sale in 2011. The vehicles will be equipped with an on-line computer system which will inform the drivers of the remaining power supply and the nearest charging spot.

Better Place's business model is similar to the model of mobile phone operators. Consumers will buy and own their car, while subscribing to energy consumption and battery usage on a per-kilometer basis. Subscribers will have the option to sign up for specific subscriptions tailored to their lifestyle.

The recharging network has two components; charging stations and swapping stations. Better Place intends to deploy charging spots at private homes, workplaces and public locations such as parking lots, streets etc. BP believes that most subscribers will use charge spots as their primary method of recharging since the majority of driving trips are shorter than the range of a fully-charged EV battery. However, there is a possibility to make use of the battery-switching stations when driving longer distances. The stations are designed to switch a depleted battery for a charged one in a matter of few minutes. The depleted batteries are placed in a storage room and recharged for further use.

1.2.3 Other EV-projects

Coulomb Technologies: CT provides a network of charging stations, but unlike BP, CT offer only charging spots. CT is working with existing gas stations and owners of parking lots with the intention of using them as location points for their charging stations. They have currently set up 40 stations within the San Jose and San Francisco Bay Area with plans for stations in the Netherlands as well (45 spots within 2 years, reaching 200 by 2012).

Vattenfall and Volvo: Energy producer, Vattenfall, and car manufacturer, Volvo, are launching a cross industrial joint venture to introduce plug-in hybrids to the market by 2012. Volvo and Vattenfall launched the project in 2007 with the goal of testing and developing plug-in technology. The development of the cars is been carried out and financed by the two companies. Volvo Corporation will manufacture the cars and Vattenfall will develop charging systems and supply the cars with electricity. Vattenfall will offer customers the opportunity to sign an agreement for renewable electricity sourced specifically from wind power or hydropower, as an alternative to the regular mix of electricity sources. The project will start with three demonstration cars which will be used to gather information about the users and the new technology.

Fortum: Energy Company Fortum began building charging poles in late 2009. Developing infrastructure and preparing the market for electric vehicles is a part of the long term goal in which only zero-emission vehicles will be driven in the Stockholm region by 2030. The project is a joint venture between Fortum and the environmental committee of Stockholm. The project aims to undergo a trial period during the first year in order to evaluate the project such as payment methods and security aspects.

1.3 Previous research

The business of EVs is a new and unproven phenomenon. Institutional research shows that new industries often lack the cognitive and socio-political legitimacy that is required in order to succeed. Cognitive legitimacy concerns a player's general knowledge of the new industry and its technological architecture and what is required in order to achieve success. Socio-political legitimacy refers to the value that is placed by cultural norms and political authorities in the new technology (Scott & Meyer, 1978). Aldrich & Fiol (1994) found that firms in new industries face significant difficulties since they lack role

models. They usually must carve out new markets, assemble resources, and recruit crucial factors such as capital, markets and granting of governmental subventions. They must interact with and convince sceptical politicians, suppliers, creditors and other resource holders. Furthermore, entrepreneurs with disruptive innovations must often deal with the latent demand for their offerings. Another challenge is the necessity for strategic partnerships in order to be able to undergo projects.

Empirical studies have pointed out that standard shifts are durable processes. The displacement of canals by railways, roads by air travel, coal by biomass and natural gas etc. are all good examples of extensive disruptive innovations that have taken several decades to displace previous standards (Ausubel, 1989).

Arthur (1994) found that the outcome of a standard war in markets with increasing returns does not only depend on technological competency but also on events that are randomly. The path-dependence theory emphasizes the importance of signalling effects, network externalities and learning curves in a standard race. Furthermore, Arthur illustrates his argument by pointing out "classical battle wars" and the associated difficulties to predict their outcome. Schilling (1998) has showed that the size of the installed base and the availability of complementary goods of a standard could be the most important key factors of a standard race.

By the term "Standard war" we mean the act or action by means of which two incompatible technologies tries to gain leadership in the market (Shapiro & Varian 1999).

1.4 Problem Discussion

The current scenario within the automotive industry is the reminiscent of a typical standard race, where many emerging technologies compete on becoming the dominant shared for light duty vehicles. However, the actors engaged in EV-projects believe that success requires different strategies. Established carmakers deploy a more careful approach relying on R&D and evaluation before scaling up the market. Better Place, on the other hand, believes that the commercialisation of EVs lies in enabling starting off with scale market and enabling the necessary infrastructure. We hope to understand the dynamics and the challenges associated with the later approach. The research has been processed with the help of five research questions which have been derived out of our five theory domains:

- Which are the circumstances in the external business environment that enable or prohibit a standard shift in the automotive industry?
- What is the structure like in the EV-industry and which are the main factors to influence a standard shift?
- Which factors are of importance to consider in the adaption of new standard and disruptive innovations?
- Which factors are to be considered in a platform leadership race?

- Which critical resources and competencies are of importance in order to achieve standard shift and sustain the competitive advantage?

1.5 Research purpose

Analyze external business environment as foundation to emerging industry and map the scope of the new industry, as well as identify potential challenges that innovative companies faces when attempting to disrupt technologies and maintain competitive advantage.

1.6 Target group

A natural recipient of the thesis is BP but also other innovative companies in similar position can make usage of this study's results. The paper is also dedicated to our colleagues within the academic world who may find use of any material for further research in this topic.

2 Method

2.1 Choice of subject

The need for change in the automotive industry is great and will probably be even greater in the future due to climate change, massive industrialization and population growth. We have developed a special interest in renewable energies sources and non-fossil vehicle fuels. Thus, we have chosen to make efforts for understanding the development of environmentally friendly solutions in the automotive industry. In the process of industry mapping we found the interesting case of "Better Place", a firm that is dedicated to revolutionize the conventional automotive industry through a unique concept of EV transportation.

2.2 Methodology Approach

We have chosen a qualitative approach for our research. This method helped us gain a wider understanding of the study object. Our aim was to gain a deeper insight into the work of BP in order to unearth the potential complexities and challenges of its strategy.

Further this research has used a deductive method, this reasoning works from the more general to the more specific. We began with reviewing theories that were of relevance for our phenomena and research purpose. We then derived that into specific hypotheses that we could test for each theory. These were narrowed down as we collected empirical data to address the hypotheses. This ultimately lead us to be able to test whether the hypotheses of our original theories was relevant on our research domain. We are aware that choosing a deductive method has its disadvantages, notably that the researchers can have a preconceived picture of the phenomena. The risk is that the research is concentrated on finding empirical data that supports the theoretical framework and could therefore miss crucial information (Lundahl & Skärvad, 1992).

2.3 Theoretic framework

We have chosen to research with the help of following theories: *macro analysis, industry analysis, disruptive innovation, platform strategy and sustainable advantage.*

Figure 1: Theoretical framework, Arif & Hakim 2009

External Business environment: The purpose of mapping macro factors is to understand which external conditions support or restrain the development of the EV industry?

Industry: We use the analysis framework of Porters and his "Five Forces" in order to understand the strategic positioning of BP. This framework will help us determine the power of balance and the structure of the EV industry.

Competitive strategy: This domain aims to map the theoretical challenges that BP may face in their attempt to displace an old technology. We believe that the frameworks of path dependence, push-pull theory, adaption life cycle and revolutionary innovation will help us map the mechanisms associated with case of BP and its technology.

Eco system: This theory domain aims at analyzing the platform strategy of BP and its strategic relations to the complementary partners. Furthermore, the objective with this part is to look on how BP must act in order to become platform leader.

Sustainable advantage: In this part we analyze BPs capability to hold on to the competitive advantage once a standard shift is enforced. This is done by mapping BP´s resources and putting them in comparison with those that the industry and the consumer market require.

2.4 Data collection

Primary data is information that the researchers collect themselves while secondary data is existing information that was collected by other researchers (Jacobsen, 2002). This research takes advantage of both data types. The primary data was required to gain a deeper insight of the studying phenomena. We have chosen to interview business developers from three different geographical locations; Sweden, Israel and Denmark. There are currently infrastructure projects being implemented in all three countries. We also gathered came in contact was made with from academic bodies and people with expertise in electricity and automotive industry. In addition we have interviewed officials from transportation and environment ministries in Denmark and Israel. We also interviewed energy companies that have direct interests in the technology of EVs.

The interview objects were contacted by telephone and e-mail and were pre-informed about the thesis and its purpose. This enabled the respondents to make preparations which would upgrade the quality of the response (Bryman & Bell 2005). Each interview was prepared with questions derived from the framework which we thought was of relevance for that specific interview. The quality and accuracy of our questions was obtained through the reading of secondary data and from our previous interviews. Furthermore, the interviews were recorded in order to capture the details and nuances of the answers, which consequently allowed for a more accurate analysis.

In addition to primary data, secondary data was used in both the early and late stages of the study in order to further strengthen our understanding of the studying phenomena. We used scientific articles from Lund University's database, homepages of the studied companies, reports from international organisations and even reports from consulting companies. Articles from the published media were also used to corroborate the primary sources.

2.4.1 Interview objects

In this section we present our interviewees. We also briefly discuss the objectives and limitations of each interview.

1. **Better Place**

Christian Egenfeldt, European Business Development Director

Better Place is our case company. The interview took place in order to complement the secondary data. We thought that the media had portrayed a harmonious picture of Better Place and their technology. Our objective was to give Christian the chance to respond to the critical aspects of their strategy. However, this interview did not fully live up to our expectations regarding the validity of the information. We believe this to be a result of the firm's keenness to not reveal information that could endanger its future strategy.

2. **Fortum**

Emilia Käck, Business Developer

Fortum is an energy company that has also invested in the electric vehicle. They had a different strategy for approaching EVs in the market compared to Better Place. We used similarly formulated questions for Fortum as we did for Better Place. The objective was to see how Fortum intended to tackle the problems of current EVs and also whether they thought there was sufficient electricity being produced today to power them.

3. **Vattenfall**

Johan Tollin, Programme Manager

This interview took place in order to understand the electric supply capacity required in order to fuel EVs. We also wanted to know their views on electric vehicles and the venture with Volvo as well as which challenges there are concerning green energy supplies and the deployment of a physical infrastructure.

4. **Israel Electricity Corp,**

Sagiv Ben-Arie, Business Developer

This interview had the same objectives as that with Vattenfall. It gave us the possibility to validate the material garnered from Vattenfall and also see what differences there are between the energy industries of Israel and Scandinavia.

5. **Amir Hertz, Ministry of Environment Protection**

The objective with this interview was to get the economic political view on EV vehicles. This interview also gave us the perspective of an environment-orientated body's view on BP and its technology.

6. **Professor Mats Alaküla, Volvo Hybrid Technology**

A major issue regarding EVs is the battery technology. We believed that the secondary data already answered most of our questions regarding this issue. However, the face-to-face interview with Alaküla would give us the possibility to ask specific questions that were not answered by the secondary data. We also discussed some of the issues concerning BP and its technology. However, it is important to point out that Professor Alaküla´s scepticism regarding BP was a result of his position as a competitor.

2.5 Analysis

The interviews were carefully analysed and the critical points noted. We thereafter summarized the recorded interviews in order to make the information more accessible. This made the process of finding possible patterns considerably easier. Structuring the empirical material according to our theoretical framework allowed us to begin the analysis process. Any gaps that could be supplemented with further data were duly noted. At a later stage we compared the empirical data with its respective theory, in order to spot differences between the two.

2.5.1 Analyses and Data collection

The theoretical framework was continuously revised during the entire research process. The changing of theories also affected which data would be required. However, this made it harder for us to compile the secondary data in an accurate way. After much iteration between theory and secondary data, we decided only to present data that was going to be used in the analyses in some way.

2.6 Validity and Reliability

As mentioned previously, we encountered a degree of unwillingness in the interviews concerning questions that were of sensitive nature for certain companies. We would also like to point out that respondent is subjective about question of the company which could lower the credibility of the gathered data. However, we used interviewed sources from several different interest groups and from different

countries in order to be able to describe the phenomenon as accurately as possible. By using sources from Denmark, Israel and Sweden we could determine the frequency of variables to a certain point. We even questioned the variety of information from the interviews by cross-referencing them with other sources. We regularly questioned the electronic secondary sources used in the research. Homepages and journals were examined carefully to discover potential subjectivity.

The person conducting an interview can have an effect on the interview outcome and thereby lower the reliability of the research (Jacobsen 2002).We believe however that our approach had no significant negative effect and therefore cannot see any significant events that would lower the validity of the results.

Some of the interviews were carried out by telephone, which also could reduce the validity. A respondent tended to shorten their answers resulting in less information. An alternative approach would be to carry out interviews face-to-face, but this was difficult due to the geographical distances and the constrained time frame. However the information sources that we used, both primary and secondary, were reliable and had a deep understanding of the subject matter. This factor increases the validity and compensates for the gap in primary data. Sources with potential subjectivity and clear motive were systematically compared to secondary sources in order to reject any differences.

We believe that our educational backgrounds had a negative influence on the validity. Both of us study finance and strategy, which can potentially give a one-sided perspective of the studied phenomena, thus missing the potential risk for some technical insight that could assist in assessing the competency of the technologies. This limitation was partly offset by also including scientific research.

The use of qualitative methods has limitations in reliability since this approach seeks to understand phenomena in context-specific circumstances. Unlike quantified researchers who seek casual determination, prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding and extrapolation to similar situations. We think that the context of our research is can be used in other contexts.

3 Theory Framework

Research Area	Aspects
3.1 External Business Environment	**Economic Cycles:** The life cycle of industries and economic crisis as a turning point for emerging technologies and industries. **Political Economy:** Political economy as trade protection. A tool to protect local markets from negative impacts of dependency on scarce resources and security of supply. **Externalities:** Internalization of external negative or positive effects that individuals impose on the environment. These effects are side effects to the main activity that has negative or positive economic incentives.
3.2 Industry Analysis	**The scope of the industry:** This framework assesses the relative strength of potential entrants, suppliers, buyers, substitutes, and rivals in an industry. Furthermore, this helps firms determine if an industry is attractive and if there are possible ways to successfully compete within the industry.
3.3 Competitive strategy	**Disruptive Innovation:** This theory is used when describing the nature and approach of new technologies. Furthermore this section attempts to describe the challenges and possibilities for revolutionary innovations to displace previous technologies.
3.4 Ecosystems	**Platform Leadership:** Company's market strategy is to allocate resources from the ecosystem by creating a common design and components shared by a set of products.
3.5 Competitive Advantage	**Resource based view:** This theory emphasizes within

	the organisation in order to identify the resources and strength and further to assess their competiveness. ?
3.6 Sustainable Advantage	**VRIO Framework:** Four criteria to assess the strength of resources and thereby estimate the company's competitiveness. **First Mover advantage:** The benefits from being first in the market in relation to technology change and market adaption.

Figure 2: Research areas and theories, Arif & Hakim 2009

3.1 External Business environment

The first step in the analysis of an industry is the external environment. Industries are operating within an uncertain macro environment that is continually changing. These changes affect the opportunities and risks in the supply and demand of the industry, which in turn affect the market equilibrium and the competitive advantage of the business. Each industry is exposed differently to the different macro forces. Thus, it is important to understand how these different macro forces influences an industry in order to analyze the dynamic between competing companies and their effect on strategy. (Hussey & Jenster, 1999)

3.1.1 Economic cycles

Crises, growth, recessions and account deficits in the world economy are factors that have affect on an industry. According to Schön, there is a clear course of events between periods of industrial growth and the rise of new industries to periods of crisis. Downturn in the economy is an important turning point for growing industries.

The course of events starts with a *structural crisis* where the old relations that characterise the industry changes. An industry that usually is regionally concentrated boosts high margin rates, thus leading to an increase in stock markets, which subsequently leads to unbalanced equilibrium due to the fast growth rate. The increased margins will bring further competition to the industry. The next phase is a financial crises with a collapse of the stock markets due to the unstable equilibrium. During the crisis the *transformation phase* begins. In this phase resources will be raised to new production areas with higher processing value. This change is characterised by the rise of new technologies that in turn lead to high investment demand, growth in the economy or the rise of new technologies (Schön, 2007). Furthermore, transformation phases often result in conflicts and unstable periods when old relations are weaken and are followed by

new ones. Wars or other armed conflicts can be seen, however, not as stimulation for transformation, rather as expressions for conflicts that transformation generates.

The crises- and transformation phase are followed by the *rationalization phase*, where existing technologies stabilise and higher efficiency is achieved. The entire cycle takes 40-50 years, where the structural crisis (including the financial crisis phase and the transformation phase) lasts between 15-25 years. The duration of the rationalization phase is also between 15-25 years. (ibid)

3.1.2 Political economy

Political economy and trade protection are common tools used to protect the local market from imported goods. Countries impose tariffs, a tax levied on imported goods or quotas, in order to support the local production and protect the domestic industry. The main arguments for such an act are national security, job creation and the infant industry. National security refers to the need for self-sufficiency and crucial goods while the job creation argument points out the importance of delivering competitive products. However, economists argue that industries with low productivity will fail in the long run regardless the efforts in political economy. The infant industry argument is points out those temporary protections are needed for new industries. (Krugman & Wells, 2005)

In addition, nations try to increase their financial value through trade protection to gain greater financial savings. Nations financial savings are total incomes minus nation's total expenses which are shown in the *current account*. This account is defined as net transactions with other countries or in other words, the sum of net export (NX) and primary incomes plus net transfers from abroad (F).

National financial saving = nation's incomes – nations expenses = DBNI – (C+I+IL+G) = NX + F = Current Account.

Thus, a nation's fortune is determined by its natural resources, other material assets and by financial assets and net foreign assets position. Increase in national fortune can be achieved by 1) increasing its real assets through net investments, 2) increase its natural resource 3) improve its financial net position by positive current account, 4) increase the value of real capital, financial net position and natural resources. (Fregert & Jonung, 2005)

In order to estimate the real cost of a product or service, we can use the opportunity cost of this specific item. That means that the real cost of an item is its opportunity cost; what you must give up in order to get it. In addition, the price of a resource will be determined according to its availability and accessibility. If a resource is scarce, and the quantity is therefore not large enough to meet the present or future demand, then the price of this resource will be higher. (Krugman & Wells, 2005)

In addition, there is a need to understand the interdependency between supplier and buyers in order to analyze the opportunity cost of future action. Game theory is an analytic tool measuring outcomes of

situations where two or more sides affect one another by their actions. Thus, the reward or punishment of one party does not only depend on the firm's own actions, but by the actions of other firms as well. This interdependency could be analyzed by the Payoff Matrix, which shows how the payoff of the participants in a two player game depends on the actions of both players. The Game Theory has many applications not just for economics but also for military strategy, politics etc. (ibid)

A player's *dominant strategy* is an action that is taken regardless of the other player's action. This strategy is dependant on the structure of the payoff in the game and does not exist in all games.

Nash equilibrium is the outcome of a player's action in the game, which maximizes a player's payoff in relation to the action of the other player. This action ignores the effects on the other player's payoff. It can be a strategic manoeuvre in order to influence the future behaviour of another firm. A strategy *Tit for Tat* involves the engagement of the two partners to play cooperatively at the beginning but then doing what the other partner did in the previous period. Thus, the Game Theory is a set of tools to analyze a few strategic situations and the mechanism between two partners used in order to gain superior position. (Krugman & Wells, 2005)

3.1.3 Externalities

Externalities are costs or benefits that individuals impose on the environment. These effects are side effects to the main activity which could have either negative or positive effects on the economy. One must compare the additional marginal benefits with the additional marginal costs of the activity in order to measure the accurate effect of an activity. The pollution caused of a transport industry is highly debated subject as it is being considered to be major externality (Krugman & Wells, 2005)

Governments use *Environmental Standards* in order to protect the environment by specifying regulations to producers and consumers. A familiar example is the introduction of the catalytic converter which reduces the emissions of cars. Government also regulates the market by *Emission Taxes,* this is used to cover the expenses of possible externalities and reduce the quantity of emissions. Regulation by tax emissions has a more balanced effect on individuals that carry the burden of taxes because of the relativity in marginal benefits to the individual polluter. There are however, costs by imposing economy of tax collection. Often the quantity falls when consumption decreases which creates deadweight and inefficiency. The drop in quantity depends on the elasticity of demand and is different from case to case. The same mechanism applies when taxes are reduced in order to support activities with positive externalities, which makes consumption have a positive effect on society. (ibid)

3.2 Industry Analysis

A firm may deliver greater value to customers when end-customers are willing to pay a price which is above the cost of production. However, the firm usually doesn't collect the full economic profitability of that value. Instead, the share of the firms profit is determined by the relative strengths of the industry

actors. Michael Porter and his framework *"The Five Forces"* (Porter, 2008) will be used to analyze the profitability of the industry. The framework describes the five profit drivers of an industry; *threats of entrants, power of suppliers, power of buyers, threat of substitutes* and *rivalry among existing competitors*.

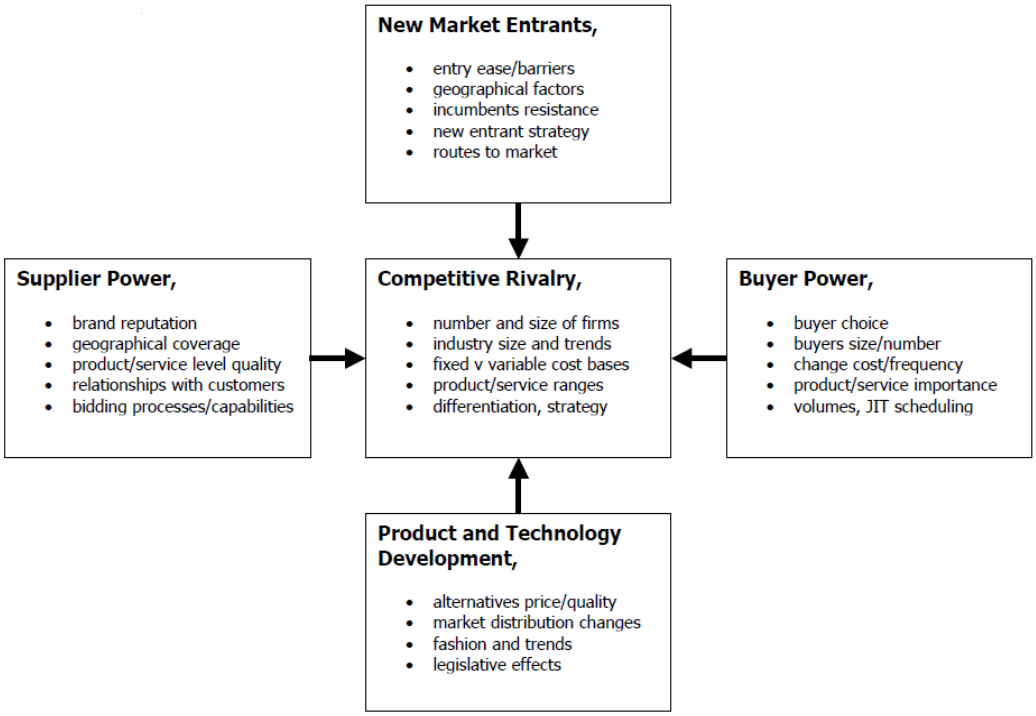


Figure 3: Five forces - the profitability of an industry, Porter 2008

3.2.1 Porter's five Forces

Threats of entrants

Profitable industries will attract other firms to enter them. Entrances will continue until the average returns levels up with the firms´ capital cost. Entering firms harm established firms since they usually bring new capabilities and put pressure on prices and costs. This forces the established firms to undertake additional investments in order to sustain their advantage. The possibility to enter an industry depends on the strengths of the entry barriers.

- *Economies of scale* - Established firms usually manufacture larger volumes than newly-started firms. Established firms use more efficient technology and can also spread the fixed costs over more units. The larger operations also enable them to request better trade-terms from their suppliers. This puts pressure on newcomers, forcing them to start big scale operations in order to be competitive. (Porter, 2008) Ghemawat (1986) argues that benefits of size can be distinguished in three ways:
-*Scale of economies*. Firms that operate in big markets have the advantage of cost pressuring.

-*Experience effects.* Firms usually grow in size as time progresses, as production accumulates and the average unit cost goes down, illustrated by the experience curve. Experiences have shown to increase the operating reliability of processing plants, the success rate of product introductions, and the marketability of high-tech products.

-*Scope economies.* A sustainable advantage in one market can lead to build sustainability in another. To achieve economies of scope, a firm must be able to share resources across the markets, while keeping the cost of the resources largely fixed.

- *Capital requirements* - Some start-ups require significantly high levels of funding in order to finance production facilities, equipment, and for the cost of construction work. Access to initial funding can be challenging, especially when the capital is unrecoverable, such as the funding of up-front advertising and R&D. However, if capital markets work efficiently, investors are likely to fund profitable businesses anyway.
- *Incumbent advantages independent of size* - Some established firms may already posses an advantage which makes further entrances non-profitable. The firm's superior performance may be achieved through the usage of proprietary technology (patents, etc.). Other ways are by having preferential access to a specific input that is scarce or by incorporates high quality. Furthermore, entry barriers can be obtained through the reservation of the most suitable geographic locations (Porter, 2008). Firms can obtain a substantial advantage by getting access to customers or critical resources. A firm may tie up the critical inputs, especially if the supplying actors can only produce a limited amount. Entering firms are held back by an investment asymmetry which means that they would suffer a penalty if they tried to imitate the leader. Furthermore, if a firm wants to have sustainable advantage through access, two criteria have to be met; first they have to be secure in the long run, e.g. when competitors enter the market, and secondly the advantage has to be enforceable in the long run. This can be done through ownership, by contract or absence of high switching costs. Other advantages could also gained by established brand identities, reputation or cumulative experience. (Ghamawat 1986)
- *Access to channels of distribution* - Some businesses requires complex distribution channels. It is important for consumers to be able to get access to goods and services whenever and wherever they need them. Firms need to look over their distribution channels in order to overcome the obstacles of time, place and possession gaps that separate goods and services from the consumers. Firms can occupy the majority of the distribution space thereby stopping other firms from entering.
- *Threat of integration* - Buyers can threaten to integrate backward and produce the product, this is if they have the know-how and resources to do so.
- *Restrictive government policy* - governments can hinder or assist new entrances in an industry, for example a new airline can only operate if it has landing slots (governmental permission), and as there are limited numbers of these it is rare for there to be spare slots available. An example of governmental interference is aiding a firm through the requirements of licensing or by restricting foreign investments. Government intervention always affects the working of markets, and being on the right side of public policy can give

companies sustainable advantages. The actions of the governments can determine the firms competitive positioning in an industry. Examples are patents (to protect innovation) and antitrust laws (prevent large business's from being aggressive towards smaller competitors). However, firms should be aware that this kind of advantage is only sustainable if governments only support on a long-term basis. (Ghamawat 1986)

- *Exit barriers* - Some organizations cannot leave the industry without accepting exceptional losses. This concerns organizations with highly specialized assets, which could be impossible to sell. These firms may therefore continue to operate for as long as there is cash to support it. The stronger these exit barriers are, the more intense competition is whenever industry conditions are bad. Thus, it is in the interests of the established actors to raise the entry barriers of the industry whenever this is possible. However, a new entering firm may try to avoid many of the barriers through alliances or acquisitions.

The power of Suppliers

The power of a supplier is determined by their possibilities to "pass on" costs to customers or revise the quality of the commodity without suffering in sales. The following criteria determine a suppliers' power:

- *Concentration and dependency* - Suppliers are regarded to be powerful if they are more concentrated than the buyers. Suppliers may want to keep a reasonable pricing to protect industries that are buying a bigger share of the supply. The suppliers may also engage in assisting the industry through activities such as R&D and lobbying. However, less buying industries exercise less dependency on the suppliers overall sales, hence less favourable terms are given to small-buying industries.
- *Switching costs* - A firm can suffer high costs, if the buying firms want to change to another supplier. The result of this is that the buying firms will be less inclined to change their supplier. A change may require additional investments and loss of profits during production shutdowns. Switching costs are significant in cases with heavy investments in secondary equipment or when the learning process of using suppliers' equipment is highly advanced.
- *The in-put a supplier offers is not substitutable* - When an input is not substitutable or the supplier is the only producer of that input, then the supplier is regarded to have great bargaining power.
- *Threat of integration* - Some suppliers have the possibility to advance and operate further ahead in the value chain. This is likely to happen when the buyers' profits relative to the suppliers are significantly higher and the supplier has the know-how to do so.

The power of buyers

Powerful buyers have the possibility to demand more quality and push down the prices. They have leverage relative to industry participants, especially if they are price sensitive. The power of the buyer can be determined by the same criteria that applies to the suppliers:

- *Dependency and switching costs* - Industries have different ratios of buyers. This factor determines the buyer's power relative to the sellers. Some industries have few key-buyers, which makes their buying more exposed to the selling firms' profits. In cases with many similar-sized buyers the power is divided among them all, making each buyer less powerful. Furthermore, certain products can involve high switching costs, making a change to other alternatives less attractive.
- *Substitutions* - Are there other products available that can satisfy the buyer in a similar way? If there are, then buyers have bargaining power as they can switch to other alternatives.

The threat of substitutes

Substitute products are those that the customer views as alternatives and which give consumers the same or similar value. Substitutes are always present and available, but get overlooked because they can appear different from the existing products. The presence of substitutes enforces a ceiling price. Firms should upgrade the quality or differentiate their offerings in order to avoid this. Furthermore, strategists should keep an eye on other industries and on their evolvements. Improvements in technology can lead to potential substitutions for the firm's own products.

The threat of a substitute's product depends upon the following factors:

- If a substitutes product offers an attractive price-performance trade-off, its threat is increased. Thus, the better the relative value of the substitute, the tighter the lid on an industry's profit potential.
- The size of switching costs. Higher switching cost makes byers less willing to change supplier.

Rivalry among existing competitors

Intense competition puts pressure on prices, even to the extent that prices can drop below costs, and thus incurring industry-wide losses. In other industries price competition is not visible and the rivalry is based on innovation, advertising, and other non-price dimensions. A high degree of rivalry can result in a drop in profit margins. The extent of this drop depends upon the following factors.

- *Exit barriers* - High exit barriers mean that established actors are less willing to leave the industry. This is because they have invested in equipment that is highly specialized and therefore impossible to sell. These exit barriers will in turn keep the firm operating, even if the returns are in a permanent decline.
- *Concentration* - This refers to the number and the size of the firms competing within a market. In industries with one leading firm, the dominant firm has the power to have considerable discretion over the prices it charges. When many similar-sized firms dominate a market, price competition becomes restrained by outright collision.
- *Perishable products* - Perishable products (short life-span products) need to be sold quickly and at a lower price in order to retain market value

- *Diversity of competitors and offerings* - Competing firms may avoid price competition if they have different origins, objectives, costs and strategies. In contrast, the greater similarity there is between offerings of differing firms, the more open customers are to substitutes, making firms more likely to cut prices to increase the sales. In contrast, when the firms' products are indistinguishable the price is the only competition factor.
- *Excess Capacity* - Profitability depends on the balance between supply and demand. Not being able to meet the demand means that firm have to make additional investments in fixed assets, while over loading the market-demand means there is an excess capacity. Firms with excess capacity are encouraged to offer price cuts in order attract new business. This would enable them to spread fixed costs over greater sales volume. Excess capacity can be cyclical and it may also be part of a structural problem resulting from overinvestment and decreasing demand.

3.2.2 Additional Factors

Porter also discusses the distinction between factors and forces. As already discussed, forces determine the industry's long term profit potential because they tell us how the economic value is divided. It is however important to not mistake forces with factors, which are generally short term-based and can trick companies (Porter 2008). The following factors should therefore be taken into consideration if a company is to succeed.

- *Industry growth rate* - High growth rate in an industry doesn't necessarily mean high profitability. Fast growth can put a firm in a powerful position, and high growth will consequently lead to more entrants being tempted to join, especially if the entry barriers are low. Strong customers or available substitutes offset further high growth.
- *Complementary products* - Economic theory identifies two types of products, substitutes as already discussed and complementary products, which are used together with another product in order to increase the value of an offering. In the engineering and science sphere it is known as "circular reference", in which complementary products are required in order to establish the parameter itself. Complements can be important when they affect the overall demand for an industry's product. The presence of complements can affect the five forces of an industry either positively (as when they raise switching costs) or negatively (as when they neutralize product differentiation). Porter mentions that complementary products should not be considered as the sixth force, since the presence of complementary products is not necessarily bad or good for industry profitability. Furthermore, Porter agues that the strategist must look for the negative and positive influence of complements on an all five forces. Where two products compliment one another, profit will mostly go to the one supplier that builds the strongest market position. (Porter, 2008)

3.3 Competitive Strategy

3.3.1 Disruptive innovations

Incremental innovations are the result of small modifications in the design or functionality of an existing product or service, e.g. updated versions. Significant for this innovation is that consumer markets usually expect it and it´s valued most by the high-demanding customers. Disruptive innovations, in contrast, do not try to bring better products to an identified market. Rather, they disrupt and redefine the trajectory by introducing products and services that do not necessarily perform as well as existing products. Instead, the product can offer the benefit of being cheaper and could therefore appeal to new or less-demanding customers. (Christensen, 1997)

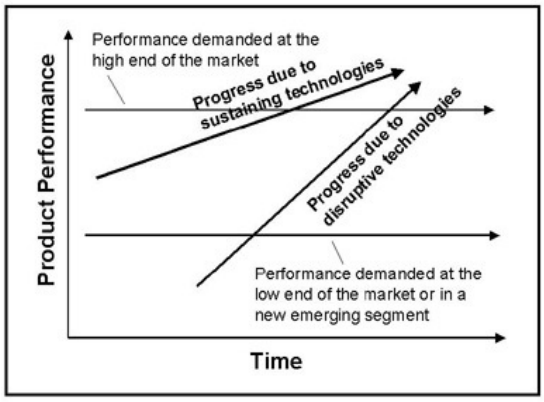


Figure 4: The affects of disruptive innovations on market and competition, Christensen 1997

Push-Pull theory - Incremental and disruptive innovations differ also in that way that they are approached in the market. This distinction is made by two marketing strategies; *market pull* and *technology-push*. In the first approach products and services are developed by R&D in response to an identified market need. In the approach of technology push, the invention is "pushed" through R&D, production, and sales functions onto the market without any consideration as to whether or not it will fully satisfy the customer. This approach is often as a result of the industry not yet having agreed upon a dominant standard, and thus there are several competing technologies available in the market.

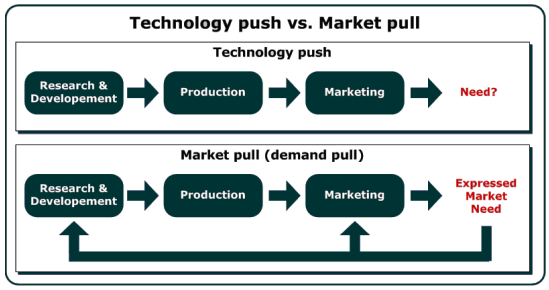


Figure 5: Two market technology approaches, Martin 1994

This is decreases the pressure on supplying the best-performing product with the most powerful and sophisticated features. Instead a product should be designed to satisfy the end-user as best as possible.

The early stages of a technology push should inform the firm on what can be achieved and what cannot be omitted in the technical domain. Furthermore, it should show what technological attributes to target in development, how to define and configure the product, and how to resolve the many trade-offs that occur in the course of development (e.g. cost vs. performance vs. weight vs. power.). Ming explains this same argument with the help of the evolving cell in an ecosystem.

"The technology- push sequence is similar to that for biological organism which has experienced a genetic mutation. The success or failure of each is determined by a trial and error selection process – the first in the marketplace and the second in the ecosphere…" (Martin, 1994)

This could be illustrated with the PC-launch from IBM in 1980. The product did not feature the latest technology available, but it did however manage to satisfy the end customer. IBM became the leading PC-firm thanks to its reputation in the industry, its service support and marketing abilities.

Furthermore, the technology push-pull framework also gives managers the idea of which competencies are required in each of the approaches. The two approaches require different management skills in order to be successful. The approach of technology-push technologies requires scientific, technical and engineering skills in order to open up new areas of major innovation. Technology-pull innovation requires entrepreneurial, managerial and marketing skills. (Martin, 1994)

3.3.2 Setting Standard

Standard can be defined as the list of technical specifications that can be used by producers, either implicitly or as the result of a formal deal. Standard settlements enable firms on the supply side to achieve economies of scale (some products enable this on the demand-side as well, known as the network-effect) Schilling (1999). David (1995) discusses four different standards; these are sponsored, unsponsored, agreed, and standards that have been enforced by governments. The first standard refers to technologies which no company or person promotes. Sponsored technologies are promoted by a specific firm or firms. Agreed standards are set by an organization consisting of several firms while government standards are set with the help of an enforcing law. The first two standards don't involve lawmakers; instead a union of commercial actors sets them. This means that there may be several different standards available in the industry. In such scenarios where there are many competing standards, market forces will adopt one dominant design. (Brunsson & Jacobson 2005)

Schilling (1999) writes that a standard design could be embodied in a product design that ultimately restricts the possible configurations of the end product (i.e. the internal combustion engine, which defines the characteristics of the conventional-driven automobile). Furthermore, a system of a family of products or a process by which products and services are provided could also be standardized.

The fundamental base principles of successful standardization can be summarized in a few points. These criteria can be reflected by the activities of standardization bodies:

- The standardization work should represent the interests of all stakeholders concerned, as well as producers as consumers; it should not be purely academic, but in close touch with practical requirements.
- Standards should not be proclaimed "ex cathedra" like articles of faith but should be the result of a democratic process based on consensus of all concerned.
- Standardization bodies should undertake their work only when there is specific demand for it.
- Standardization work should be at all times subject to revision, in order to incorporate improvements and to reflect the evolution of technology.

The last two points put the focus on the imminent danger of "overstandarnization". Standards should serve recognized needs: there is no need for standardization for the sake of standardization". Furthermore, standards should not "crystalize", ultimately arresting further developments. (Van Den Bossche, 2003)

3.3.3 Revolutionary innovation

George R White has developed a framework in order to analyze and understand the potential of technology to succeed in the market. This framework is suitable to revolutionary products. The definition of revolutionary innovations is similar to that of technology push: "…*often induce major changes in social as well as engineering practices and attends, sometimes creating new industries"*

The framework is made up of four analyzing points: inventive, embodiment, operation and market merit.

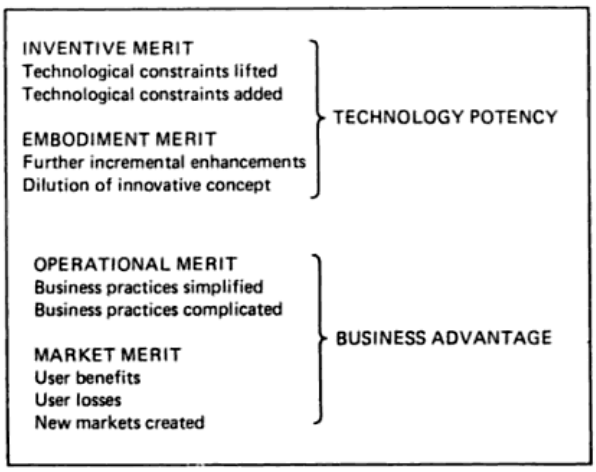


Figure 6: The competency of the new technology, Martin 1994

Inventive merit - A revolutionary innovation is derived from R&D and can have the potential to displace existing technology. The new technology may erase or decrease previous constraints in the old technology. Furthermore, new technology can also add or increase a constraint on the existing technology.

Embodiment merit - R&D derived inventions are innovated in a technological vacuum; furthermore they can be integrated into larger technological products (for example the engine of an automobile). This process of embodiment (integration) may give opportunities for further incremental enhancements which were previously technologically or economically impossible or unattractive.

Operational merit - A revolutionary innovation can be expected to change business practices. It is therefore necessary to identify the extent to which the innovation will simplify or complicate such practice. Complicating the traditional practises can weaken the possibility to create consensus among industry players.

Market Merit - How well is the revolutionary innovation filling the need of customers compared to other alternatives? In assessing the product process opportunity, managers may ask themselves what its features, competitive advantages and user benefits are. Market merit refers to revenue opportunities that can be substantially greater. This occurs in situations where innovations are clearly more attractive to customers than existing competitive offerings. (Martin, 1994)

There can be tradeoffs between these four merits. For example the form of the product may decrease the value of the inventive concept. Inventive merit and embodiment merit are related primarily to the technical potency of the innovation, whereas operational merit and market merit are more concerned with the business advantage provided by the new product. (Morris, Pitt & Honeycutt, 2001)

3.3.4 Adoption

A basic model for understanding the adoption of a disruptive technology is the adoption life cycle (Rogers, 1964). The framework discusses how a new innovation or idea penetrates the market consisting of different category adaptors. The groups are distinguished from each other by their characteristic's response to the innovation. Each group has a unique physiographic profile that makes its marketing responses different from the other categories.

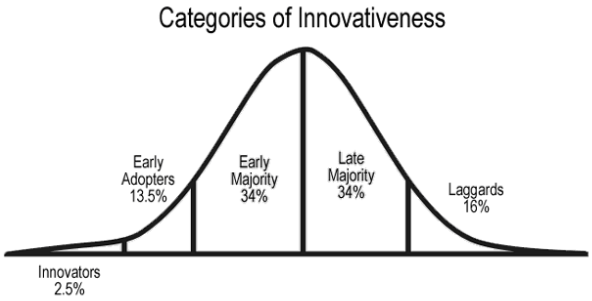


Figure 7: Diffusion of new technologies and the different adopter's category, Rogers 1964

This way to market high tech disruptive technologies is achieved by working the curve left to right, focusing first on the innovators, growing the market, and so on, to the early majority, late majority and even to the laggards. In this model, companies must use each captured group as a reference base for the next group. (Moore, 1995)

"The idea is to keep the process moving smoothly, preceding something like passing the baton in a race or imitating Tarzan swinging from vine to well-placed vine. It is important to create maintain momentum effect in order to create a bandwagon effect that makes it natural for the next group to want to buy in" (Moore p. 78)

George Moore however says that moving becomes problematic when the product should be adapted to the early majority. According to him, a potential pitfall is that new inventions often fall to penetrate the early majority group. So if companies are located in the chasm it is a bad thing. This attracts few, if any, new customers – only those who have somehow got off the safe thoroughfares. Thus, the chasm-phase is characterized by the lack of new customers, low return on investment, increasingly negative cash flow and hardened competition. Therefore penetrating early majority group is a challenge that requires revised marketing strategy. If the firm wants be successful by achieving a critical mass and become standards winners they have to sell to their mainstream consumer. The strategy for this is to divide the mainstream market into niches and reference-groups. To be able to cross the chasm firms need to target a very specific niche market where they can dominate and then use it as a base for larger operations. Thus, to convince the pragmatic customers and gain wider market acceptance the key is focusing on one specific market niche. Companies just starting out, as well as any other marketing programmer dealing with scarce resources, must operate tight markets to be competitive (Moore, 1991). Chesbrough & Rosenbloom (2006) point out that few development programs can offer more than what is absolutely necessary to serve the intended market because of limited resources.

3.3.5 Path dependence

Path dependence theory discusses the importance of random events that can determine the outcome of a standard race in economies with increasing return. The winning standard does not have to be the most efficient one. Furthermore, the outcome of the standard race cannot be predicted from known market information; such as knowledge of supply and demand, and it cannot be easy affected by standard tax or subsidy policies. (Arthur, 1994)

This first advantage will in turn lead to the technology getting the opportunity to make further improvements relative to its competitors. This is referred to as a positive feedback loop, whereby the efficiency of the technology continues to improve as more people adapt to it. This is the result of following three mechanisms; *learning curves*, *network effects* and *signalling effects* (Schilling, 1990)

Learning curves - Learning curves can be tracked on two levels. Firstly, at the individual firm level as it finds ways in using the technology more productively. Secondly, on the aggregate level, when the technology is being used by an entire industry, thus also making improvements to complementary technologies. Learning curves are considered to be strong sustainable advantages since they are path dependent (in comparison to network effects and signalling effects), cumulative, and often have socially complex or tacit elements.

Network externality effects- In markets characterized by network externalities, a users benefit is enhanced as more users start consuming the same good. Network externalities can be both of positive and negative kinds. Positive network externalities appears when the value of each consumer increases as new customers join. Classical examples of this effect occur in physical networks such as railroads or telecommunications. Network externalities also rise when the complementary products or services are important. Technical standards emerge where there are network effects and the users have a need to connect with one another (Schilling, 1990). The same logic applies for *Network Externalities* when the customers benefit from other customers using the same technology or service. Negative network externalities appear, for example, within designed and exclusive products, where costumer's value increases due to the uniqueness of the product. (Grant 2008).

Network externalities arise due to several reasons:

- When the product users are linked to the same network and therefore use the same applications. The television and telephone are classic examples of products with total network effect.
- The availability of complementary products and services to support the main product. Complementary products are essential in creating the solution to a popular problem, by making it easy, accessible and cheaper for the customer.

- Economizing on switching cost. By using the most common technology, the customer lowers its future risk when wanting to shift to a different technology.

Signalling effects - This large installed base may serve as a signal to consumers about the quality or value of a good when those attributes are uncertain or difficult for the consumer to measure. This effect occurs when a certain technology has many subscribers and may alone, even in the absence of network and learning curve, become the dominating standard. For many products, the actual performance of a product is almost impossible for consumers to observe and evaluate. Furthermore, even if the consumer has the possibility to test the product, they may take an extended period of time before they can make a fair judgment of the products performance. Signal effects are of importance in situations where consumers face big switching costs, there are many users of a certain product, or technology can be of help in the buying decision. (Schilling, 1990)

The outcome of the standard race could be that one technology could take a great lead. This means the other technologies would be "locked out" from the market (whereas the winning standard will be locked in). In order to fully understand the outcome of a standard competition, one has to do a standard analysis. Arthur speaks on the need of doing dynamic analysis and not static analysis, where one is forced into leaping small events during the adoption time. (Arthur, 1994)

3.4 Ecosystem

According to institutional theory, new industries lack the legitimacy of mature industries; that is cognitive and socio-political legitimacy. (Scott & Meyer, 1994) Entrepreneurs with completely new ideas must often deal with the latent demand for the product or service and competitive pressure from other industries, both rising and mature. Challenges are to carve out a new market, assemble resources, and recruit crucial factors such as capital, markets and granting of governmental subventions. In order to do so firms need to engage in strategic alliances to convince sceptical politicians, suppliers, creditors and other resource holders. (ibid) Schilling (1990) argues that the availability of complementary goods may be the most important factor determining whether a standard will be a success or not.

3.4.1 Platform

A platform is a strategically motivated and operationally coordinated modular product or process. The platform architecture is designed so that it should create special forms of strategic flexibility, which will be the defining power of a market strategy in order to achieve a set of business goals. (Ron S. 2004)

A platform is created by a common design and the components are shared by a group of products. A good platform is a core of closely related product families in a similar market segment. These products have different features to meet different costumer's demands, but also share standardized components.

These standardized components are to meet and satisfy the requirements of the *family of products*. (Raviraj U. & Wei & Timothy 2000)

An example of platforms in the infrastructure sector is railroads that were built to meet a specific standard and the architecture which train-vehicles are built upon. The task of differentiation concerning speed, appeal, weight and performance is left to the train producers. Other examples of platforms are DVDs, the Windows operating system and games consoles where other companies develop differentiated products for these platforms. These platforms rely on other companies to develop films, software program and games respectively. This relationship between the platform and complementary components can be seen therefore as strategic because of its powerful impact on the competitive advantage of the companies.

A platform strategy consists of the following four elements:

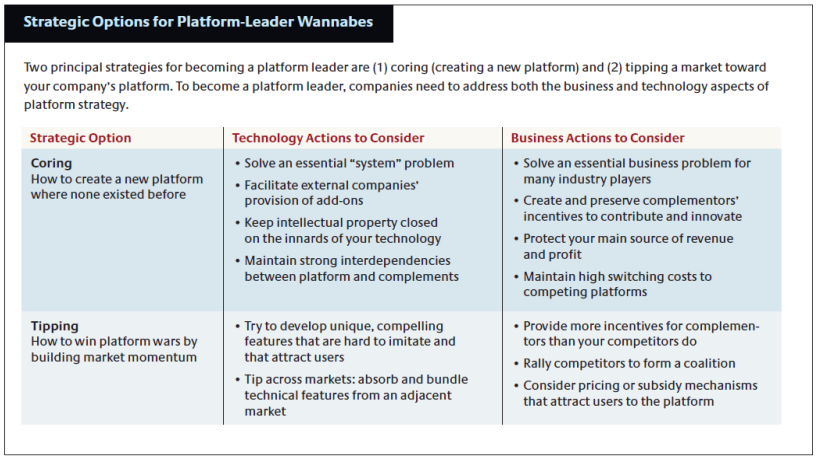
- *Scope* .The amount of innovative technology the company creates internally and how much it gives to outsiders.
- *Product technology*. The platform leader should decide how the platform's architecture is to be designed. The main concern is how modular the interface should be and which information should be shared with outsiders.
- *Relationship with external complementary products*. How cooperative or competitive relations between complementary products should be. In this stage the producers work on a consensus to clarify the expected behaviour when complementariness turns from having collaborative position to competitive.
- *Internal organisation*. The firm should have an internal structure that helps them manage conflicts of interest by keeping groups with similar objectives under the same management. (Michael & Annabel, 2002)

3.4.2 Platform leadership

Firms should consider both technological and business aspects when designing the platform architecture in order to obtain platform leadership. The technological aspect is about the right design of the architecture, design of the right interface and disclosing property rights. The business aspect concerns the incentives needed in order to attract complementary products. (Michael & Annabel, 2008)

The developing firm should decide early, whether it will choose a platform strategy or a product strategy. A failure in choosing the right strategy development can cause difficulties in governing the ecosystem and technology evolution, crucial to maintaining superior position in the market. Firms can choose to achieve leadership in platform strategy by one of two methods, namely coring or tipping. Coring strategy is easier

when developing platforms with a technological orientation. Tipping on the other hand is based on using incentives and business orientation to attract complementary-components from other platforms. (ibid)



Strategic Options for Platform-Leader Wannabes

Two principal strategies for becoming a platform leader are (1) coring (creating a new platform) and (2) tipping a market toward your company's platform. To become a platform leader, companies need to address both the business and technology aspects of platform strategy.

Strategic Option	Technology Actions to Consider	Business Actions to Consider
Coring How to create a new platform where none existed before	• Solve an essential "system" problem • Facilitate external companies' provision of add-ons • Keep intellectual property closed on the innards of your technology • Maintain strong interdependencies between platform and complements	• Solve an essential business problem for many industry players • Create and preserve complementors' incentives to contribute and innovate • Protect your main source of revenue and profit • Maintain high switching costs to competing platforms
Tipping How to win platform wars by building market momentum	• Try to develop unique, compelling features that are hard to imitate and that attract users • Tip across markets: absorb and bundle technical features from an adjacent market	• Provide more incentives for complementors than your competitors do • Rally competitors to form a coalition • Consider pricing or subsidy mechanisms that attract users to the platform

Figure 8: Strategic options for platform leader, Michael & Annabel 2008

Coring: To find partners and develop supporting ecosystem to develop complementary applications is the main challenge of "platform wannabes". Platform leaders have to therefore create financial incentives in order to encourage other companies to innovate the platform over time. On the other hand, a platform must sustain economic profit that enables stability even in the future. This very balance between protecting its own profit and enabling other companies adequate profit, is probably the greatest challenge of the "platform leader wannabes".

Tipping: It is not unusual that there are several competing technical standards. Well-known examples of standard wars are Microsoft operating system and Apple, or JVC versus Betamax for videocassettes. To win this standard war, the companies use the "tipping" approach, whereby the competition from other standards requires the use of a more active management than in "coring strategy". Firstly the firm should gain power over an installed base and license its intellectual capital. Another important strategic objective is creating pricing systems to support one end of the platform in order to encourage the supply to the platform of developers. One problem however, is "over openness" which can expose the platform to imitations and risk and consequently, the property rights and their unique offer. The other end of the platform, the demand side, can also be encouraged to increase the demand through lower pricing. This however, can create an unhealthy and short-term solution. Coalition is also used in tipping strategy as a defence mechanism to fight entry to a new market or to protect existing platforms.

Platform leadership is not necessarily for big companies, but the question is whether the size of the company affects the chances of becoming platform leader. It is true however, that implementation of

coring strategy can be easier for smaller companies. Bigger companies with wider, already existing, ecosystems tend to favour tipping. (Annabelle & Michael, 2008)

A platforms dependency on its ecosystem is very great. The platform leader's dependency on relationships with external complementary components is great. These ties to complementary innovators, who give value to a platform's innovation, play an important role. The launcher of the platform has to rely on the key complementary products continually innovating as fast as possible in order to maintain the market advantage.

Evolving technology is critical for platform development and a long lasting leadership. Platform leaders should develop a vision that goes beyond the current business operations and technical capabilities in order to extend its ecosystem to future solutions. (ibid)

3.4.3 Two sides Platform

A two-sided market brings together groups of users to the two sides of the platform. Two-sided platforms have a major difference from the traditional value chain, where one side of the product or service is cost and the other is revenue. In two-side market theory, cost and revenue exist on both sides, to the left and to the right. One side is the supplier's side while the other side is the costumer side. Two-side platforms aim to minimize cost for both sides while increasing service and can thereby collect revenues from both sides. (Eisemann & Parker, 2006)

Even here "network effect" is great. Users from both sides of the platform give value to one another by increasing the number of users from both sides of the platform. Platforms can therefore grow when demand and supply grow, in order for the equilibrium to balance both sides. Successful platforms enjoy increasing returns to scale where users will have greater value and margins will grow together with the platform base. The mechanism of increasing return to scale is unique to two sided platforms, whereas in regular traditional business growth goes beyond a certain point that usually leads to diminishing returns.

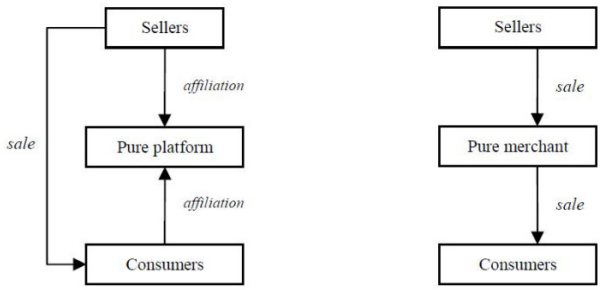


Figure 9: Two sides market, Eisemann & Parker 2006

Pricing the platform is a great challenge for platform leaders that have to create balance between the two sides while encouraging the greater growth of one side in order to create higher equilibrium. The platform leader should determine which group in which side has to be encouraged by subsidizing it and how much of a premium the other side of the platform should pay. Pricing should also consider *same side network effect* where the effect on a user's base is created by the same side. For example it is easier to change video games if many use the same technology.

Furthermore, platform leaders should consider other factors before subsidizing one side of the platform. They should think about their ability to capture subsidy effect so that the value will not migrate to competitors. The leader should also have a good understanding of the price sensitivity of the users in comparison to quality. The platform leader should also consider the negative same-side effect that the subsidy might create. (Eisemann, & Parker, 2006)

3.4.4 Innovation by Ecosystem

Collaboration and partnerships adds great value to the offering of the company, but adds complexity as well due to interdependency and adaption challenges. The complexity of collaborations and partnerships in ecosystems can be discussed with two main attributes: interdependency and adaption within the ecosystem. The aim of these two categories is to determine performance expectation and possible future risks.

Interdependence - Dependency on other's success can have important strategic implications. Innovators in innovation ecosystems work in a complex environment and are greatly dependent on all the other components in the system. Thus a company depends not only on its own success in delivering a creative solution, but is also depends on the deployment of other companies towards the same goal. If the dependency on other components has a major effect on the company's core competences, the strategic importance of this component will be higher and so is the risk level. In addition, if this risk level is high and there are no other alternatives, the dependency on this component will be even higher which will increase the risk level even more.

Integration - Dependency of companies on other firms within the innovation ecosystems involves risks not only because of the ability to innovate but also the ability to adapt within a certain time frame. Before any company can start innovating by developing its product or service, it might have to modify its solution with companies that are still in the developing stage. Delays due to late adaption from both sides of the value chain may create delays in the entire ecosystem and harm all companies operating in it. Thus risk management has to take into account both the dependency level and the ability to deliver, while also looking at the adaption phase in the relevant time frame (Adner 2006).

3.5 Sustainable Advantage

Different efforts have been made to describe sources and approaches to a firm's competitive advantage. The Industry Based View (Porter, 2008) believes that firms can obtain this by positioning themselves advantageously in an industry. The Resource Based View (Barney, 1991) defines competitive advantage as the ability to implement a value creating strategy that has not been simultaneously implemented by other organizations. Thus, the first theory encourages managers to look outside the firm's boundaries, whereas the latter theory believes that the source of competitive advantage is embedded within the organization.

However, obtaining a temporarily competitive advantage is not a guarantee for long term profitability in today's competitive environment. The competitive advantage should be sustainable; this will enable firms to survive against competition over a long period of time. (Ghemawat, 1986)

In order to obtain a sustainable advantage, managers need to analyze the industry and the competition, as well as the resources and competencies it possesses. Only then will a firm be able to address the optimal strategy. (Mahoney & Pandian, 1992)

3.5.1 Resource based view

The principle of the resource-based view is that firms differ in their resources, firstly due to imperfections in the factor market and secondly due to discretionary managerial decisions on how to strategically use them. Thus, the sources to a firm's competitive advantage lie primarily in how the management make use of the firm's unique resources. (Amit & Schoelmaker, 1993)

A way of presenting resources is by categorizing them in tangible and non-intangible ones. Non-tangible regards tacit knowledge, corporate cultural, managerial talents and relationships, whereas the first group is made up of physical assets (Barney, 1991). Wernerfelt (1984) makes distinctions between human and non-human resources in order to illustrate that resources can be embodied collectively in organizations but in individuals as well. Another distinction is made between critical and non-critical resources. Critical resources render the company and give rise to the competitive advantage. The critical resources are classified as: fixed assets (physical and human), blue prints (non-physical) and cultural (team/network effect).

Some scholars (Collis & Montgomery, 2005) give an extended list of specific resources; intellectual property, trade secrets, contracts and licenses, databases, information, networks, know-how of stakeholders, reputation and culture. Resources are not things or materials; they are a set of capabilities or competencies.

Competencies - Some scholars choose to distinguish competencies from resources. They argue that resources are something that can be acquired on the factor market, while competencies are internally acquired, making them harder to copy. Furthermore, they tell us how a firm's resources and competencies must

interact; that it is the activities and processes through which resources are deployed that generate competitive advantage. A way of putting this discussion is saying that a firm does not achieve higher returns because of its resources, but rather how its core competencies contribute in making use of them (Enders, 2000). Hamel and Prahalad (1990) argue the organisations should be derived from competencies. In order to be able to reinvent the industry, the organization must identify its core competencies and concentrate on obtaining an advantage that is derived from competencies. Furthermore, they use a Core Competencies Model that helps managers to define and acquire core competencies. They have three questions that will help firms decide whether they are qualified to be core competencies or not:

- Does it provide the firm access to other markets as well?
- Does it make any significant contribution to the perceived customer benefits of the end product?
- How difficult are the core competencies for other firms to imitate?

The dynamic approach of RBV - The firms must take into consideration changes in the environment and simultaneously make durable and irreversible investments otherwise it can erode the advantage of their earlier investments (Ghemawat, 1986). The dynamic capability perspective extends the resource-based view by discussing how valuable, rare, difficult to imitate and imperfectly substitutable resources can be created and how these can be updated in changing environments. It is important to consider the changing nature of the external environment and the role of strategic management. This principally concerns continuously adapting, integrating and reconfiguring internal and external organization skills resources and functional competences toward the changing environment (Teece, 1997).

"The manager of a firms competitive position is defined by a bundle of energy of unique resources and relationships and the task of a manager is to adjust and renew these resources and relationships as time, competition, and change occurs" (Rumelt , 1981).

The RBV alone could not increase the full understanding of how firms could show dominance during a long period of time even though the conditions in the environment change rapidly. The dynamic capability, on the other hand, focuses on the capacity of an organization to create new resources, to renew or increase the value of its resources in a rapidly facing environment. In addition, the dynamic capability theory argues that the standard resource based view not only concerns the bundle of resources, but also the mechanisms by which firms learn and accumulate new skills and capabilities, and the forces that limit the rate and direction of this process. (Teece, 1997)

3.5.2 VRIO Framework

The VRIO-framework (Barney 1991) is a four criteria tool developed for managers to use when assessing the competiveness of their resources. The stronger these elements are, the more strategically valuable these resources are to the firm and thus they increase the probability and possibility to obtain a sustainable advantage.

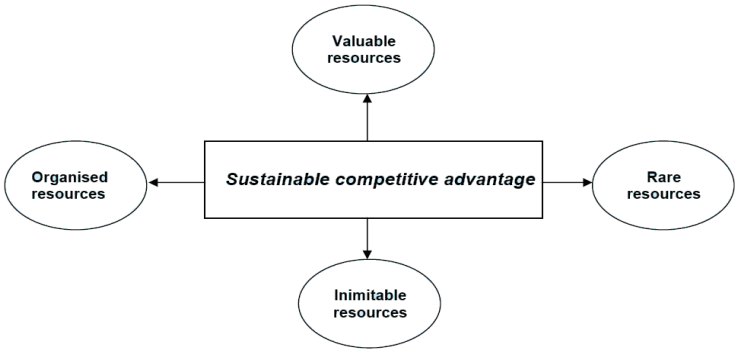


Figure 10: Four criteria for assessing the competitiveness of firm's resources, Barney 1991

Value - A resource is considered to be valuable if it helps the organization to meet an external threat or exploit an opportunity. Managers should reflect on how a resource helps the company by trying to incorporate them into a common competitive foundation; efficiency, quality, customer responsiveness and innovation. Efficiency is the amount of output for any unit of input. Innovations are new products or services (product innovation) or new ways of producing or delivering goods or services (process innovation). Product innovation is of direct benefit to the organization because an organization can have at least a temporary monopoly on the new product. Process innovation generally influences efficiency rather than having a direct effect on value. Quality means that the offering of the products is well within its purpose. Customer responsiveness is simply meeting the needs of the customers exceptionally well. If a resource brings any of these four factors, then it is considered to be valuable. (Collins, 1994)

Rarity - A resource is rare if many firms do not possess it. Abundantly available resources can be acquired by any other firm and consequently copy the firm's competitive advantage. Rare resources or competencies can come from several years of experience; such as deriving from relationship building with crucial stakeholders. Further, rarity also depends on how transferable the resource is. A resource or competence is considered to be highly rare if it is embedded in one or few individuals, working in the firm. However, individually possessed resources are not considered to be highly sustainable since the individual can leave the firm. In order to maintain sustainability, the firm must instead focus on recruiting, motivating and training to keep these within the firm. Core competencies can also be embedded in culture, which can make parties with similar cultures and backgrounds engage in collaboration with each other. Rare competencies can also damage the company. The danger of such a competence could be redundancy, as the capability may become obsolete. (Scholes & Wittington, 2005)

Non-imitable - A resource is inimitable and non-substitutable if it is difficult for another firm to acquire it or substitute it with another resource. Some resources are easier to imitate than others. Tangible resources that are available on the market are relatively easy to imitate. However imitation of intangible resources such as historical, ambiguous, or socially complex processes are often implicitly harder to imitate (Collis & Montgomery, 1995). Managers should try to asses the time it may take for other firms to imitate or

substitute a specific resource. The resource-based view argues that imitation is difficult due to four reasons. Firstly, imitation is constrained by time compression diseconomies, which refer to the customer's inability to successfully acquire the resources and capabilities of a firm. The second reason is path dependence, which argues that the outcome depend on small historical events that occur randomly. The third reason is casual ambiguity, meaning that some resources or competencies are not easily determined or visible for others. This obstacle is often part of socially complex structures, which can be hard to detect. The fourth reason to limited imitable ability is economic unprofitability. This occurs when the competitors have the ability to imitate a successful resource, but choose not to do so due to limited market size and large capital investments. (Scholes & Wittington, 2005)

Organized - An organizations should be able to actually use the specific resource; otherwise there's no use in the company possessing it. A resource is regarded as organized if it can be used to its full potential. The question is how the resources and competencies should be organized in order to gain the full potential from them. For example complementary products do not require involvement from the firm responsible for the platform and therefore cannot fully control important aspects of their production, such R&D and quality.

3.5.3 First mover advantage

A "first mover advantage" is achieved by firms that are first to operate in a new industry. It can be achieved in two different ways. One way is to develop technological edge over competitors. Secondly, it can be achieved through pre-empt later arrivals to scarce assets and by building an early customer base, making further entrances to costly. Furthermore, in order to understand the future outcome of a first mover advantage, one must consider the pace of change in the industry environment in combination with the pace of change of the market. (Suarez & Lanzolla, 2005)

The figure below illustrates the four possible scenarios. The *calm waters*, in the upper left, illustrate gradually evolving market and technology. The *market leads*, in the upper right, illustrates that technology development is slow when the market expansion is fast. The *technology leads*, in the lower left, appear when technology evolves rapidly while the market growth is slow. The *rough water*, in the lower right, appears where both the technological change and the market growth are evolving fast.

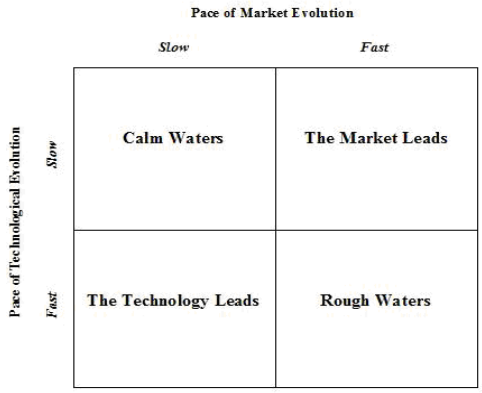


Figure 11: The matrix of first movers, Suarez & Lanzolla 2005

- *The water is calm* - A slow technological change makes it harder for later entrants to differentiate their product, consequently leaving the first mover with its technological advantage. A slow market growth can also be beneficial for the first mover since it has sufficient time to satisfy available segments and capture upcoming segments. The first mover has therefore greater possibilities to maintain its advantage and create a dominant position in the market. A steady advantage is likely to occur and can with certainty, be profitable. A key resource that is required is brand awareness, while fast resource development is less critical.
- *Market leads* - Technological change has a minor effect when the market is rapidly growing. Thus, the product's features remain the same while the market is quickly adapting to the new product. Firms need to have great resources and scale capacity in order to satisfy growing market segments and maintain the market lead. A short life cycle is very likely but can be prolonged by holding on to customer base. The fast in-out strategy can work for short-term profits. Profitability is likely but depends on the company's possibility to address different market segments by increasing resources.
- *The technology leads* - In the reverse situation, where the technological change is faster than the market evolution, first movers may face flat sells and operating losses while the new technology brings competition. New competition can gain market share by new product or service features. In this scenario, where technology is evolving faster than the market growth, a short life strategy is unlikely due to the need of holding on to specific segments. Durable profitability is therefore at risk from later movers that have up to date technology. Key resources required are large financing capabilities and intensive R&D.
- *Rough water* - In this last scenario the market development and the technological development are rapid. In such conditions, it is very difficult for companies to maintain first move advantage. The risk for the first mover is losing the lead to a newcomer that is pushed forward by new technology generation. The leader will be challenged by new competitors that try to exploit the existing technology through the use of better production or marketing capacity. A quick-in-quick-out strategy is likely if the company has limited resources and capacity. Long-term profitability is rare in this scenario even if the company is well prepared

to meet both challenges. Key resources required are scaled production, marketing capacity and intensive R&D.

3.6 Theory Summary

In this part the theories and related aspects that were presented in the theory chapter will be summarised. In addition, these theories will be connected to their respective goals in the analysis.

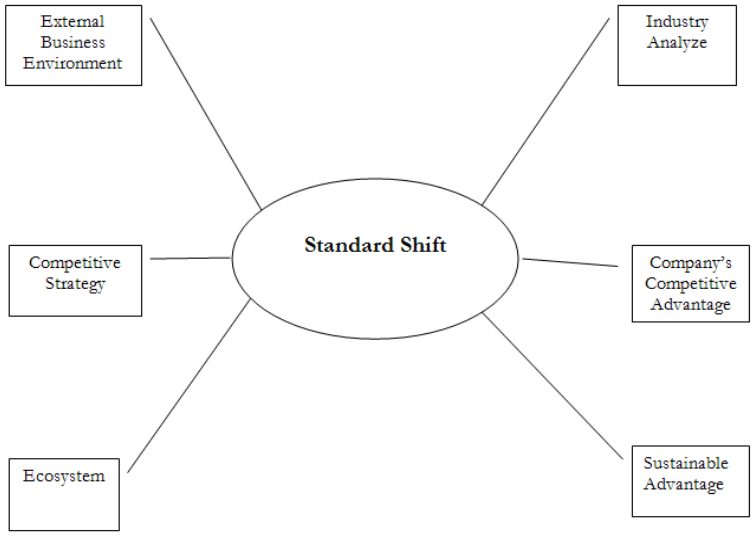


Figure 12: The different framework perspectives, Arif & Hakim 2009

External Business Environment

Economic Cycles - This aspect will be used in the analysis in order to estimate life cycle in the automotive industry and the economy and that can have possible affects on the need for renewal in the industry in order to achieve sustainable growth.

Externalities - Internalization of external negative and positive effects will be used to estimate the possible contribution that a new standard can have on the society by reduction of negative side effects.

Political Economy - Negative impacts of dependency on scarce resources and security of supply will be assessed in the analysis in order to estimate a possible contribution of a new standard.

Research objective: *Which external environment factors enable a standard shift in the automotive industry?*

Industry Analysis

Five Forces - An industry analysis determines the balance of that may affect the profitability of the firm. By having a deeper insight into the industry, firms can strategically position themselves and thereby increase the possibility of successfully shifting the standard. The five forces of Porter are entry barriers, power of suppliers and buyers, substitute products and industry rivalry. Entry barriers could be the result of economies of scale, scarce resources, patents, copyrights etc. The power of suppliers and buyers will determine how big share of the profit that will fall in their hands. The availability of substitutes means that the possibilities for consumers to change product is high. The last force, industry rivalry looks on the competition landscape.

Research objective*: Which actors affect the EVs infrastructure industry and how does rivalry affects BP's possibility to displace the standard?*

Competitive strategy

Disruptive Innovation: Disruptive innovation can be a product or a process that enables goods or services to be delivered in a new way. This theory can help us to get a deeper understanding of the effects of the EVs innovation.

Push-pull theory: This framework discusses the two ways a new standard technology can be entered onto the market and which requirements a firm must consider for each approach. This theory will help us to determine and understand which considerations are required in order to succeed a standard shift.

Revolutionary innovations: This framework assesses the competencies of a technology by looking at the four merits; Inventive merit, Embodiment merit, Operational merit and Market Merit. This framework will enable us to understand which aspects of the technology may be advantageous or disadvantageous in the standard race.

Path dependence: The theory aims at understanding the processes of a standard race in increasing markets with increasing returns. Further it will be used to look at whether signalling, learning curve and network externalities play crucial roles in a locked-in market mechanism.

Adoption Life: This theory maps the different groups of adopters before a standard becomes the dominant force.

Research objective: *What process follows a disruptive innovation and how is the new standard being adapted?*

Ecosystem

Platform Leadership: Platform theory will be used to analyze BP platform leadership. This aims to allocate resources in order to deploy the ecosystem towards one standard. A different platform strategy will be

taken into account. We aim to determine the interdependency rate and possible risks and opportunities that such a strategy involves.

Research Objective: *How do strategic relations of innovating company help to disrupt old technologies?*

Company's competitive advantage

Resource base view: Firms can internally develop different resources such as physical or non-physical or critical or non-critical assets. Assessment and identification of resources and competencies that BP has will contribute to a deeper understanding of BPs competitive advantage and the possibility of changing the standard.

Research Objective: *Which factors are to be considered in order for BP to establish a competitive advantage?*

Sustainable Advantage

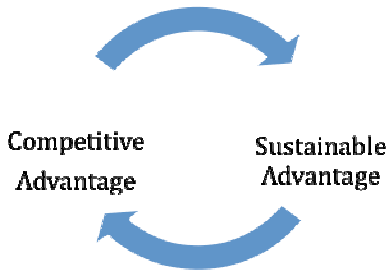


Figure 13: Achieving sustainable advantage, Arif & Hakim 2009

VRIO Framework: This framework discusses the competitiveness of the resources and capabilities by assessing their value, rarity, imitation and organization. By assessing BPs resource strength, we can determine whether it is possible to sustain the advantage even in the future.

Dynamic capability approach: The capability of the firm to shifts in its internal competences and to fit an evolving environment. BPs ability to upgrade its current resources and competencies to keep ahead in the standard race will be analyzed.

First Mover advantage: BP benefits from being first in the market will be analyzed through comparisons between future technological development of possible dominant standard and market development through adoption.

Research objective: *Which factors are to be considered in order for BP to sustain a competitive advantage?*

4 Analysis

4.1 External Business Environment

Economics Cycles

According to Schön there is a clear course of events in periods of industrial and economic growth and period of crisis. The course of events starts with a *structural crisis* where the old relations that characterised the industry undergo a change. Indeed, the automotive industry has been undergoing a long-term structural crisis in recent years. High profitability was the ground for increased competition in the global market. This has gradually resulted in shrinking revenues in this very competitive business environment. The low margins, high fixed costs, and over capacity led this industry into a deep crisis. (Commission of the European Communities, 2009)

The structural crisis reached not only the automotive industry but the energy industry as well. Periods of high oil prices have forced a structural change in the energy market, a change that continues until today. This has meant a slow, but sure replacement of crude oil. A good example of shifting energy sources is apparent between 1973 and 2004, where oil's share of global electricity generation plunged from 24.7% to 6.7% as oil became too expensive (Kendall, 2008).

The next phase according to Schön is a financial crisis with a collapse of the stock markets after extreme high growth and due to unbalanced equilibrium. This crisis starts the *transformation phase*. Indeed the year 2008 was the beginning of a global crisis in the world economy that had a great impact on all industries which started a global recession (IMF, 2009).

The crisis was a remarkable transformation phase in the automotive industry as well. The trend of increasing sales of larger and heavier cars, including sports utility vehicles (SUVs), was broken in favor of smaller and more energy-efficient cars. The economic crisis not only led to an increasing interest in small and fuel-efficient cars, but it also caused a sharp decline in total vehicle sales (Commission of the European Communities, 2009).

This transformation phase is characterised by the rise of new technologies leading to high investment demand growth in the economy or in a certain industry. An example of this would be the extraordinary investment in the clean energy industry, which is clearly connected to the will and need for new growth. In the US a $60 billion was made by the American Recovery and Reinvestment Act in order to support the American economy and encourage growth in this industry. In addition to the $60 billion, the program invested $2 billion towards the development of the next generation of batteries to store energy (US Government, 2009).

Schön mentions as well the connection between transformation phases to political relations between countries. Schön states that the relationship linking wares and conflicts to transformation can be seen as

stimulation for transformation, but also as an expression for conflicts that transformation phases generates. Thus, the new economic strategy to reduce global warming and increase energy security has a connection with global conflicts. The US presence in the Middle East is a strategic decision that was made to insure energy supply (Furman & Bordoff & Deshpande & Noel, 2007). We will discuss national security issues in greater details, at the chapter "security of supply".

Summary of economics cycles

The automotive industry is going through a structural crisis after a long period of low margins, overcapacity and high competition. In combination with the structural crises in the energy industry (due to high oil prices and great dependency on a few suppliers) the need for massive change is increasing dramatically.

The financial crisis was the turning point that started this transformation phase in both the automotive industry and the energy industry. The new direction of both industries is clearly energy-efficient cars and new energy sources. Investment in new technologies in order to develop the clean energy industry and energy storage methods marks a clear transformation point according to the theory. This turning point towards energy efficiency and sustainable energy consumption and production - while reducing energy supply dependency - has in addition its sources in world conflicts. It can even be seen as a reason for world conflicts.

Externalities

Taxation on vehicles should, in an efficient market economy, cover the negative effects being created by the usage of these vehicles. Thus, there is an economic justification for higher taxation when there are negative effects or lower taxation when there are positive effects. In Europe, the EU commission launched a program which aims to develop long term strategic policy to minimize major negative effects of air pollution on human health and the environment (Clean Air for Europe, 2005). A substantial number of scientific research projects were launched in order to develop methods of internalizing external costs resulting from transportation. The European Commission has commissioned IMPACT, Internalization Measures and Policies for All external Cost of Transportation to summarize both existing rapports and existing knowledge (IMPACT 2008).

In august 2009, Israel adopted the "green law" which internalizes the negative costs by changing the taxation on polluting and non-polluting cars. Israel and EU propose to internalize costs from transportation. However the effects and costs in each place are slightly different due to the number of cars on the road, differences in urban area, different car fleet and climate differences. Thus, the emissions may be the same in different geographical locations but the costs may vary due to different external effects. Internalization methods can also be affected by other strategic objectives, such as scarce supply, political objectives and effects on the working market.

We will in this analysis concentrate on the externalities that EVs can solve, their price and other external effects that have to be considered and may affect this industry in the future. Fundamental differences between Israel and Europe, specifically Denmark and Sweden, will be compared in order to achieve deeper understanding on the complexity of developing a common formula to calculate externalities in the transport sector.

The external negative effects are divided into 7 different categories. EVs may solve the negative external cost like: pollution, climate change and noise but not accidents, delays due to density of vehicles on the roads and nature and landscape usage.

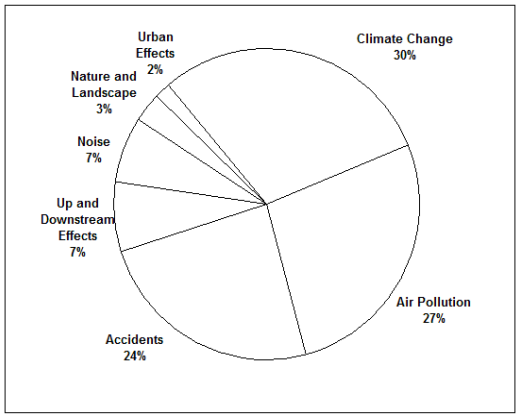


Figure 14: External cost from transportation, European environment agency 2004

It is clear that air pollution has the biggest share of the total external negative cost both in Israel and in Europe. However, solving the air pollution by using "zero-emissions cars" will solve only a part of the total cost caused by transportation. EVs also solve the noise problem in cities but they will not solve the overcrowding problem, car accidents and road maintenance costs. Even problems associated with global warming and pollution (that arise as a result of our dependency on fossil fuels) will not be solved until the electricity used by EVs will come from sustainable sources.

Overcrowding, accident rates, usage of nature and landscape and maintenance costs will only be reduced by making changes that not only affect the car industry, but transportation systems in general. The changes that are being suggested in order to internalize these problems will possibly help minimize their negative effect, but it will also create new challenges for EVs. Abundance fees in peak hours in order to minimize the use of private transportation will negatively effects the usage of EVs in the cities. Parking redemption, brought about by increasing incentives to workers that give up their parking place. These two examples, parking fees and abundance fees, will have the added effect of decreasing the demand for EVs in the future. It is important to mention, however, that private transportation is a major means of transportation, especially outside cities, and does not have a direct substitute.

Internalization of negative external cost due to emissions is very important and supports EVs. It is, however, very important to take into account the other external costs created by transportation in order to foresee future challenges. In order to measure the effects of the new law on pollution created by transportation, there is a need to quantify the relative pollution that private cars cause. Figures 17 and 18 show the two methods used to calculate cost created by pollution for each transportation sector.

According to the figures, the share of private vehicles which contribute to the total pollution from transportation is only 11%- 58%. The remaining share of pollution, depends upon the calculation method, is caused by heavy vehicles like buses and Lorries. The relatively small share of pollution from private cars does not necessarily indicate the importance of transforming them into low or no emission vehicles. It is however an indication that there is much more that is needed to be done in order to revolutionize the transport industry. Buses and Lorries should also receive governmental incentives in the future in order to support the move towards lower emissions transportation. There is a need therefore to widen the internalization programs in order to minimize the negative effects. According to professor Mats Alakula, the best solution for other polluting vehicles will be bio fuels and not electricity. Thus a different revolution has to come in the near future.

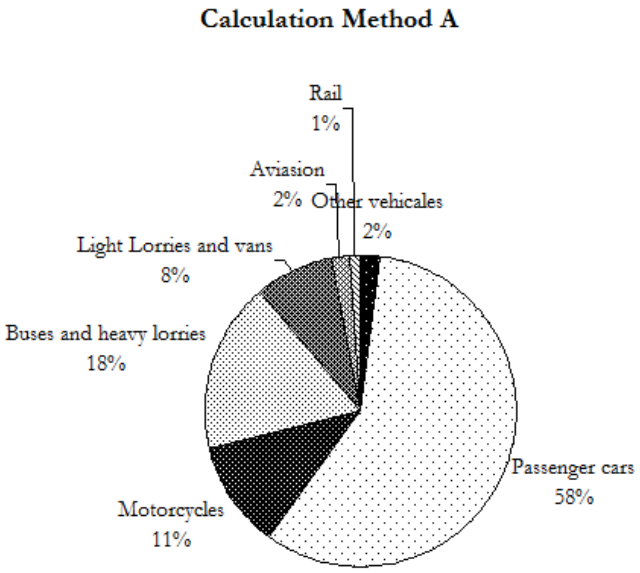


Figure 15: Sources of pollution from transportation, IMPACT 2008

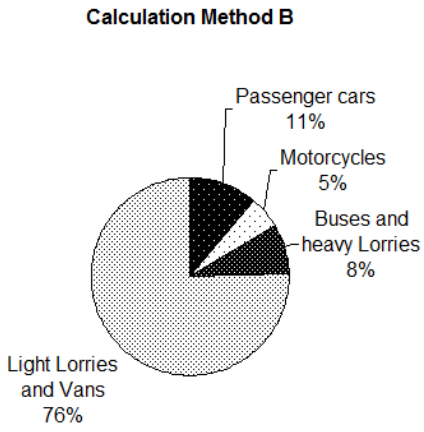


Figure 16: Sources of pollution from transportation, The Central Bureau of Statistics, Israel 2008

In order to accelerate the adoption of EVs or other low emission cars, there is a need to internalise the real cost of polluting cars in order to encourage environmentally friendly vehicles. In august 2009 the Israeli government changed the taxation rate on the purchase of new cars with different tariffs depending upon whether the vehicle emitted high or low levels of pollution. The outcome has been greater support to EVs and other zero or low emissions cars. The following formula in figure 15 will be used to determine the level of pollution that a particular car is causing. Each one of the following instances will be taken into account along with the use of "green indicators" in order to calculate the purchasing tax. Cars with pollution levels 1 or 2 will receive massive tax benefits, while the other levels will receive a relatively small tax deduction. EVs will have only 10%-30% of the total purchasing tax.

Tax Reduction In INS	Purchasing Tax Level	Green Grade	Pollution Level
	%30-%10	*50-0	1
	%92-%30	**130-51	2
15,000		130-51	
13,750		150-131	3
12,000		170-151	4
10,500		175-171	5
9,250		180-176	6
8,250		185-181	7
7,250	%92	190-186	8
6,500		195-191	9
5,500		200-196	10
5,000		205-201	11
4,000		210-206	12
3,250		220-211	13
2,000		250-221	14
-		400-251	15

$$\frac{500\times CO+900\times HC+10{,}000\times NO_x+20{,}000\times PM+30\times CO_2}{30} = \text{Green Grade}$$

Figure 17: Different pollution levels, Green tax committee 2008

An example of the calculation of taxation level is: A Toyota Yaris will be level 3 and receive a green grade level of 149. This will credit the owner with a taxation of 13,750 NIS. A Volkswagen Touareg on the other hand will get a green grade of 315 and pollution level of 15, will gain no tax benefits and prochoice tax will reach a maximum level of 92%.

Conventional	Hybrid	Zero Emission	Year
75%	30%		In the past
92% With tax reduction according to the Green Grade	30%	*10%	8/2009-2012
	45%		2013
	60%		2014
	92% With tax reduction according to the Green Grade	30%	2015-2019
		92% With tax reduction according to the Green	2020

Figure 18: Future taxation level, Green tax committee 2008

Figure 16 shows the future planning of taxation levels for lower emission cars. The minimum 10% tax will increase to 30% in 2015, which may affect the profitability of EVs or other low emission cars and influence thereby the adoption rate. In 2020 the taxation level on all cars will be 92%, which will leave low emission cars without any governmental incentives

Denmark intends to reduce CO2 emissions by 20% by 2020 as a part of the EU strategy to move towards a sustainable economy. As part of this policy, the taxation on vehicles in Denmark is calculated by the emissions each car is producing. The tax rate for new cars is 180% and 0% for EVs. This taxation level will help to increase adaption of EVs.

In addition to the lower purchasing tax benefits, there are additional points that may support zero emission cars. Increasing depreciation to 25% annually will help to shorten the economic life cycle of cars and will accelerate the transformation to a new generation of cars. Car scrapping will as also help to increase the usage of newer cars and fasten the shift to environmental friendly vehicles. A higher taxation on liquefied petroleum gas due to its high emission levels can possibly help new standards, like the EVs. It is still however not clear if the Israeli or the Danish government will adopt further actions.

Summary Externalities

The negative external cost from transportation differs from country to country due to different factors such as population, urban area or open space. These factors lead to differences between the costs that countries internalize and affect therefore the subventions to low emission transportation. Internalizing external negative cost from transportation by supporting the move to different technologies may have however, high costs. This cost may risk long-term programs aimed at reducing the price of EVs. The tax reduction program in Israel for example will continue until 2020. After 2020 there is risk for decreasing adoption rates due to higher purchasing price of EVs.

In addition, further external costs from other transportation means such as lorries and buses are not included in the internalisation process. This may force additional internalization programs which may affect the internalization process of passenger vehicles. One more obstacle that may reduce subventions to low-emission cars is the fact that pollution is not the only negative external cost made by transportation. In order to minimize the rest of the external cost there is a need to increase the price of using passenger cars, for example with higher parking prices or congestion charges. This will increase the price of using cars and may reduce the profitability of using EVs.

Security of Supply

Road transportation accounts for about half of the worlds oil demand. In developing countries a relatively large part of the oil used is for electricity generation, but even there the biggest share of oil consumption goes to the transport sector. Moreover, approximately ninety-five percent of the primary energy consumed in transport is derived from crude oil (OPEC 2006).

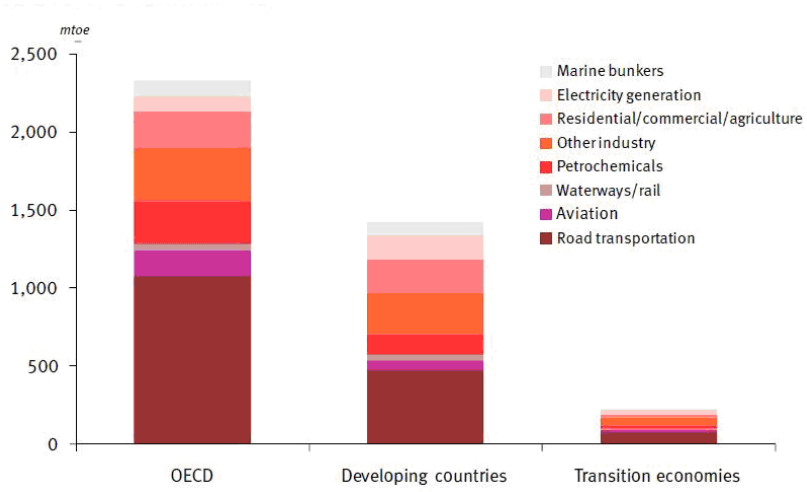


Figure 19: Oil demand by sector, Energy information Administration 2009

The reliance of the transport sector on oil is enormous. OECD countries and developing countries are therefore greatly dependant on oil. The combination of great dependency of the transport sector on oil and its relative high share of world oil demand puts the transport sector in a first priority in reduction the world's dependency on oil.

ORIGIN	2000	2001	2002	2003	2004	2005	2006	SHARE 2006 (%)
Russia	112.4	136.8	154.7	170.8	188.9	188.0	189.0	33.5
Norway	115.9	108.1	103.1	106.4	108.6	97.5	89.1	15.8
Libya	45.5	43.8	39.2	45.9	50.0	50.6	53.2	9.4
Saudi Arabia	65.1	57.5	53.1	61.5	64.5	60.7	50.9	9.0
Iran	35.5	31.4	25.9	34.7	35.9	35.4	36.4	6.4
Other, Middle East	54.7	48.3	43.2	27.8	28.5	30.0	32.1	5.7
Kazahkhstan	9.9	9.1	13.4	15.9	22.2	26.4	26.8	4.8
Nigeria	22.4	25.7	18.4	23.2	14.9	18.6	20.2	3.6
Other Origin	54.3	54.3	64.2	56.5	56.1	66.1	66.9	11.8
Total Imports	515.8	514.9	515.3	542.9	569.5	573.3	564.6	100.0
in Million barrels	3 765	3 759	3 761	3 963	4 158	4 185	4 121	

Figure 20 : Crude oil import to EU, European Commission 2009

The EU's dependence on foreign oil supply and the declining production of energy inside the EU, are increasing the concerns of meeting future energy requirements. Declining production means that by 2030 up to 75% of the EU´s oil and gas will have to be imported. Moreover, the import of these crucial yet scarce resources will be from a limited number of countries, which may bring even more security challenges. These countries are represented by OPEC (Organisation of the Petroleum Exporting Countries) an organisation that regulates oil prices by controlling oil supply (European security strategy, 2008).

In addition to the great dependence on some producing countries, the oil market is being controlled by limited number of companies. When comparing gross domestic product, (GDP), of nations to modern multi-national petroleum companies, the magnitude of the control and dependency problem becomes even clearer. The biggest corporation in the world, Exxon Mobil, has revenue of US$ 347 billion, which is 26th in the world GDP ranking. The revenues of the six biggest petroleum companies in the world total US$ 1.5 trillion, which is equivalent to the combined GDP of the worlds eight richest nations (WWF, Kendall, G. 2008).

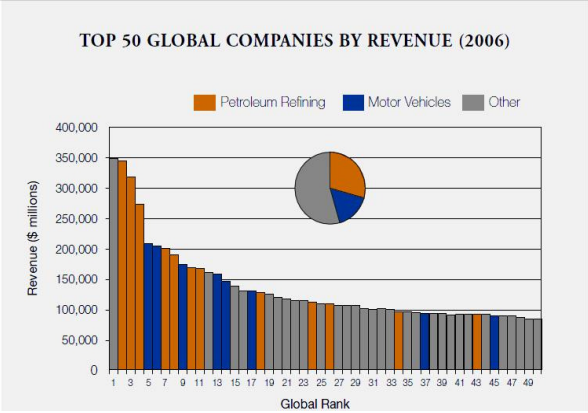


Figure 21: Top global companies by revenue, WWF 2008

The monopolists in control of the petroleum market make the dependency on a few supply sources even greater. These countries and companies can regulate the prices by influencing the supply side. When the alternatives are so few, the alternative costs are rising and force the market to accept the high prices. With a GDP that is equivalent to the eight richest countries in the world and control of energy for 95% of the transportation sector, these massive petroleum companies have enormous political influence on a global level.

In order to solve this problem, the EU has responded with internal and external policy that will meet future challenges regarding the scarcity of natural energy resources. The policy aims to achieve higher efficiency between the member countries in terms of transportation while the external policy aims to maintain good relations with the countries in charge of supply, particularly Russia. In addition to this, the European security strategy points out the need to diversify energy sources through the development of renewable energy sources, lower carbon technologies and energy efficiency. The *strategic energy technology plane* is a part of a wider framework that addresses the self-sufficiency problem that the EU faces. Indeed, the main proposal is to meet the growing demand for sustainable and self-sufficient energy supplies for transportation but it takes into account the local job markets and job creation (Commission Of The European Communities, 2007).

This interdependency between the EU and the rest of the world and OPEC and other oil suppliers can be analyzed by the Game Theory. The theory is a tool to measure the outcomes and rewards of actions taken by both partners. In our case it is OPEC that regulates oil prices through control on the supply side and fuel consuming nations. In order to see the effect of the petroleum supplier's dominant strategy, we use a payoff matrix that shows the result of this dominant strategy. Now OPEC is standing on *Nash Equilibrium* 20/5 (illustrative random number) which maximizes its profit, while liquid oil consumers are dependant on the outcome of OPEC's dominant strategy.

OPEC's actions ignore the consumer's payoff, although they use prising methodologies to maximise the demand. In order to influence the dominant strategic behaviour of OPEC, the EU chose to move to point 13/13 in which production of substitutes to oil increase the strategic position of the union. Other combinations in this example do not seem rational now. The EU cannot supply all of its oil demand or other substitute energy for transportation and certainly not supply to others outside of the onion.

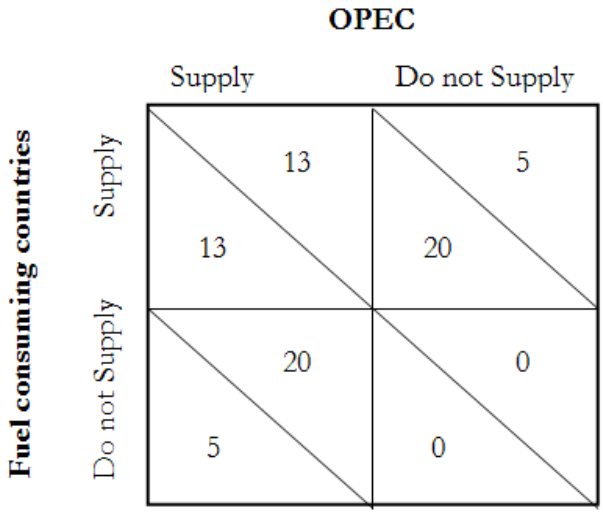


Figure 22: Payoff matrix, Arif & Hakim 2009

Given the information in the previous chapter where we described the dependency of the European Union on foreign oil suppliers, we shall see in this category the effect on countries, or in this case the European Union. In order to do so there is a need to compare the export capabilities and the import needs of crude oil.

Due to limited oil reserves, a major share of oil consumption in the European Union is imported. Figure 23 shows the great differences between the import and export of crude oil, which has a negative effect on national financial savings. There is, therefore, an additional reason to promote alternative energy to the transport sector in order to improve the financial savings of the EU.

Imports (kt)	020 04	020 05	020 06	020 07	020 08
Crude Oil & Feedstocks	7984 73	8673 91	8726 97	8627 82	3322 13
Gas / Diesel Oil	1045 55	1170 23	1233 16	1062 66	438 56
Kero - Jet Fuels	141 31	249 60	256 85	260 29	097 42
Motor Spirit	259 29	215 84	213 45	239 30	091 22
Naphtha	282 86	287 88	307 64	310 52	102 70

Residual Fuel Oil	535 69	632 57	616 94	647 86	248 62

Exports (kt)	020 04	020 05	020 06	020 07	020 08
Crude Oil & Feedstocks	287 72	703 88	684 16	689 85	285 68
Gas / Diesel Oil	600 64	707 86	705 60	663 30	276 40
Kero - Jet Fuels	110 73	127 04	128 32	100 77	045 21
Motor Spirit	484 67	559 13	526 41	585 68	234 23
Naphtha	172 29	165 05	166 11	140 47	054 18
Residual Fuel Oil	418 25	520 33	526 66	514 22	197 62

Figure 23: Import and export of crude oil to and from EU, European Commission 2009

Summary Security of Supply

A major share of oil consumption is consumed by the transport sector. Moreover, the dependency of the transport sector on oil is enormous. The dependency is even greater when looking at the supply of petroleum. The oil supply is limited and controlled by a few countries. This cartel of countries has great influence on the transport sector. In addition, global petroleum corporations have enormous revenues and control the monopolistic market.

This interdependency creates a strategic dominance for the OPEC countries while maximizing their financial profits. In order to reduce this strategic position of oil producing countries, consuming countries have to produce a substitute to oil. Indeed, the EU´s policy intends to improve internal and external relations in order to ensure future energy supply. The EU aim to reduce the interdependency and increase the security of supply by diversification of energy alternatives and their use. This policy is increasing the development of alternative energy sources for transportation and creates a great opportunity to the EV market.

The reduction of interdependency and the improvement of consuming countries strategic positions will have a great impact on the financial situation. By following self-supply policy in the form of implementing alternative energy sources in the transport sector, countries will improve their current situation and increase the financial strength of the countries that follow the electrical vehicle revolution.

4.2 Industry analysis

Industry and Actor definition

In this study, the term *industry* refers to the firms installing a physical recharging infrastructure for electric vehicles. BP and other firms in this business category are responsible for the maintenance and functionality of the equipment. Furthermore, the analysis will regard the energy companies that produce and distribute electricity, as the *suppliers*. The *buyers* are defined as the drivers while the vehicle and battery-component are viewed as *complementary products*. *Substitute offerings* are those commercialized alternative technologies requiring something other than pure electricity.

Entry barriers

The high cost of building plug-in infrastructure is one of the greatest barriers to companies entering this market. According to Johan Tollin from Vattenfall, the cost of a single plug-in station in the city can cost up to 30.000 Swedish crowns. When scaling the market the cost is great. However, entry to the industry does not necessarily require a large-scale infrastructure. Many infrastructure projects of this kind initially only build a small number of recharging facilities and then scale up the number as the adoption of EVs increases.

The scope of the investment determines the strength of the other barriers. Small-scale investments, such as the building of only a few charging poles, can be set up independently. "Coulomb Technologies" for example, has signed agreements with gas stations allowing them to install charging stations within their facility-zone. However, large-scale investments such as BP's nationwide network require governmental permission before construction can begin, as building work will be carried out on public land and in commercial areas, such as shopping malls.

According to Porter, entry barriers can also be the result of scarce resources. In the EV industry there are two limiting factors. The first scarce resource is the availability of land for recharging facilities, especially in inner-city areas where there is a limit on the density of charging poles. The other constraint is the supply of "green" electricity since BP, as with many other EV-projects, only permits the consumption of electricity generated from zero-emission sources. Shai Agassi says that it is important to "create a zero carbon footprint end-to-end" in order to lessen a dependency on oil (TED, 2009).

All of our interviewees mentioned that the supply of green electricity could be problematic. According to professor Mats Alakula, green electricity supply depends on the weather conditions.

The problems occur in times of "peak demand". This is referred to as the challenge of balancing temporary production with the consumption of electricity. Mr Sagiv Ben-Arie from the Israel Electric Corporation says that current supply capacity can barely meet the demand during peak periods. Adding

the consumption of the transport segment would lead to further imbalance in the energy supply. Christian Egenfeld from BP illustrates the problem with a possible scenario:

"Imagine yourself a Saturday night, Denmark are playing against Sweden at home in an important qualifying game for the world cups. Likely the Danish will sit in front of their TV's while plugging the car charge. The question is whether the current capacity will be enough to deliver green energy at this specific moment when the consumption will be extraordinary."

Another potential entry barrier is attracting carmakers to supply vehicles in accordance with the technology, which is crucial since most of the firms currently invest in proprietary technology. The challenge lies in convincing carmakers to invest in production plants and build the cars based on common technology. There are different technologies that have to be co-engineered with the carmakers in order for this to work. The fact that many carmakers have different cooperative strategy regarding alternative technologies, contributes also to strengthening this entry barrier. Most carmakers still view it as too early for full-electric adoption and therefore too risky to make further commitments, and instead invest in R&D to improve the current performance of standard petrol-based engines.

Suppliers

According to Porter, the supplier's power is determined by its ability to charge prices without decreasing profitability. A few players have previously dominated the energy markets in Sweden and Denmark. As a result of the deregulation of 1996 in Nordic countries, consumers can choose among several electricity retailers. In other states such as Israel, the electricity market is monopolistic.

The power of the supplier is strengthened since electricity is not substitutable with other inputs. A possible scenario is that fossil fuel generated electricity will be used in cases when there is a deficit in the supply. Another important factor in determining a suppliers' power is whether they have the possibility to move ahead in the value chain. This is the case if electric producers or resellers operate the infrastructure and the related services. The joint venture company formed between carmaker Volvo and energy company Vattenfall is an example of this. Other examples are Fortum projects in the Stockholm area and Vattenfall charging stations in Germany.

We have currently discussed factors that benefit the bargaining power of the suppliers. A short discussion will now be made on the factors that benefit the buyers. At the moment, energy companies are dealing with unstable electricity flow generated from renewable energy sources, giving rise to both under or over excess capacity. This problem occurs since electricity is a perishable commodity and it cannot be stored for later retail; it has to be consumed directly, otherwise it goes to waste. Under-capacity occurs during daytime when consumption is at its peak, while excess-capacity usually occurs at night time when consumption is at its lowest. Dong energy, which supplies green electricity, says that the unstable energy generation calls for a solution that would accommodate unstable wind production. One opportunity is to

store excess electricity in EV batteries. The following graph illustrates the unstable flow of electricity. (Dong Energy, 08)

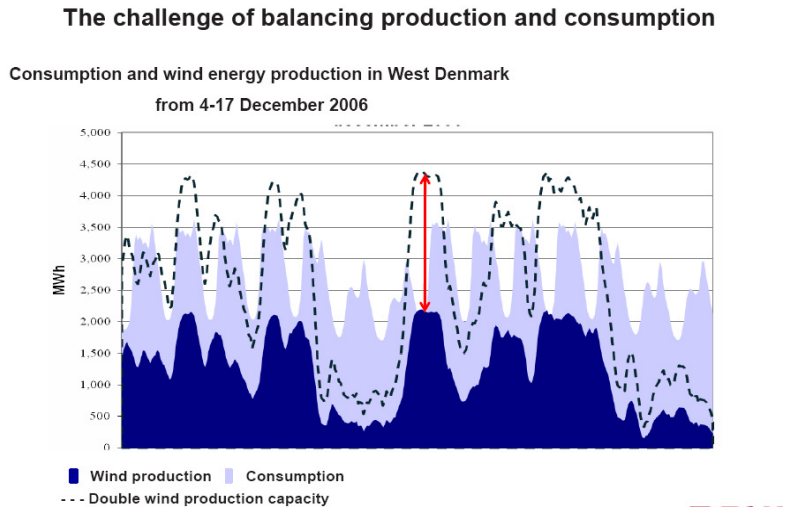


Figure 24: Consumption and production of windmill energy, Dong Annual report 2006

Christen Egenfeld from BP said that the energy companies have big incentives to work with BP since they can fill the capacity of the electricity. Furthermore, he mentions that EVs are the potential dominant standard of the future, making them big buyers of electricity and thereby increasing their bargaining power.

Rivalry among existing competitors

The greatest rivalry at this point comes from the established oil industry, which resists the development of alternative fuels. Christian from BP spoke on this subject during the interview:

"Some of the forces that oppose the new technologies are controlled by OPEC countries and have clear interest in preventing such development that may harm their income sources."

This discussion is also made by the statistics in figure 21 which show that the nine biggest corporations in the world consist of 3 car makers and 6 oil companies.

OPEC stated that crude oil reserves are sufficient and will last more than 85 years. Despite the exorbitant current price of oil, exporting governments of oil continue to look for new petroleum sources, rather than new energy alternatives. This results in two scenarios for rivalry within the automotive industry. Firstly, fossil fuels will not disappear immediately. Secondly, a gradual movement from fossil fuels to alternative fuels is more likely to occur rather than an abrupt transition away from gasoline. The adoption of hybrid

vehicles illustrates this, as new purchases of gasoline decrease. Peter Ganjbar, press chief for Volvo cars says that:

Within a few years, we will see more hybrids that run on electricity in combination with other fuel, mainly by diesel or ethanol. The driving of zero-emission vehicles is likely to dominate in the long run. Looking at regions outside Europe however, buyers still choose gasoline-driven vehicles. (Eriksson, 090804)

The established carmakers make efforts to keep hold on the combustion engine by increasing the fuel efficiency and lowering the fuel consumption. Modern cars have therefore significantly lower emissions of undesirable gases than those of a few decades ago, and are more fuel-efficient. Although great improvements have been made in reducing emissions from internal combustion engines, the ever-increasing numbers of vehicles, the size/style of the vehicles, and the increasing number of miles driven have combined to negate any progress in emission control.

Besides improving combustion efficiency, other technologies are emerging in a standard race. Currently, most alternative technologies are still in a test and prototype phase. Commercialisation is expected to take place in 2010-2011 at the same time that EVs will be introduced in a larger scale.

Substitutes

Many substitutions to internal combustion vehicles have emerged over the last ten years but as previously mentioned none of them have been deployed on a large scale. The substitutes are only relevant within the light duty vehicle sector. According to professor Mats Alaküla, heavy vehicles such as buses, goods transporters and aircraft are out of the question for alternative technologies. Instead these sectors will continue to be dominated by the internal combustion engine.

The increasingly high oil prices have increased the popularity of other more affordable alternatives such as cycling and public transportation. However we should regard these as semi-strong substitutes, since end-users may find them less convenient, less reliable, and less significant as status symbols.

Factors – complementary products

One important success factor of the plug-in infrastructure is the importance of the availability of complementary products. Christian from BP mentioned the importance of solving the "chicken and egg problem" where infrastructure enables EVs and EVs enable infrastructure.

There are two categories of complementary components to the plug-in infrastructure; the vehicles and the batteries. The first category is considered to the most challenging since carmakers are limited in numbers and often have business strategy of their own. Many carmakers must invest heavily in production lines while having high risk from the demand side. It is hard even to sign agreements with battery

manufacturers. The rapid growth of hybrids has meant that the supply of rechargeable lithium batteries is currently lagging behind the production capacity (Hitachi Ltd, press Release 090702).

Summary of industry analysis

Entry barriers: We have found that entry-barriers are directly related to the investment size. This concerns the capital required as well as third party suppliers and governmental licensing. Entry barriers consist also of limited resources in the markets such as renewable energy and building ground. The limited worldwide supply capacity of batteries is another entry barrier.

Strength of the suppliers: Electricity is not a substitutable input and is only available through a limited number of suppliers such as; large scale producers of green energy. Suppliers have the possibility to deliver and operate the infrastructure as well, while the reversed possibility of BP producing electricity is less likely. However, the production of energy from sustainable sources, is currently suffering from excess capacity.

Substitutes: Customers have other alternatives to light duty EV transportation. There are both strong and semi-strong substitutes. Substitutes are transportation modes that offer convenience and the affordability of free flexible driving such gasoline and hybrids. The semi-strong substitutes are buses, bicycles and train travel, but theses offer less convenience.

Degree of rivalry: Established oil companies and car makers have large and special investments in productions facilities. This means in turn that they face large exit and switching costs since the investments are harder to re-use in other operations. The automotive industry is currently characterized by unprofitability. We are seeing that actors from automotive industry are investing in increasing efficiency of current combustion technologies.

4.3 Competitive Strategy

Standard

Van den Bossche argues that the standardization work of EVs has been so far dominated by safety and security aspects, such as risk from electric shocks from the recharging plug-in stations and even from the battery itself. The interfaces and designs of technical components has however, not yet been standardized to the same extent. The standardization process has been delayed for three reasons. Firstly there has been insecurity over which committee will take on the task of standardizing EVs**,** the International Organization for Standardization (ISO) or the International Electro technical Commission (IEC). However, the parties have recently reached consensus on this matter, giving ISO the task of handling electric vehicles, while IEC will handle work related to electric components, electricity supply and infrastructure. The second reason is the evolution within battery technology and power electronics that has made it hard to fix standards in propulsion technology. The third reason is that the scope of the

standardization has focused on the term *electric vehicles,* which includes battery-electric, hybrid and fuel cell vehicles. All these electrically propelled vehicles use electric motors, drives and controllers (Van den Bossche 2003).

Cheng writes that standardization in the competitive automobile market has never proven successful because the standardization protocols have not been accepted by competing manufacturers. As a result there are many competing standards within EV-technology. An example is the two charging technologies currently been used to connect to the EVs, conductive and inductive. EVs will only use one of these technologies since they are incompatible with each other. A vehicle using one technology typically cannot be connected to a charger with the other technology because they employ different connectors. Even the interfaces on the two ends, the electric wire on the car and the plug in station, are not yet fully standardized within the two types of connectors (Cheng, 2008).

BP for example is attempting to set the concept of switchable batteries and a pay-per-mile model, similar to the cellular-operator model, as the standard in the EV industry. They have chosen to collaborate with the governments of their markets by relying on gaining licensees in order to undertake nationwide projects. Furthermore, BP is considered to be highly proprietary since it is based on a unique platform technology. Another similar attempt is Coulomb Technologies that like BP is also trying to set a standard in infrastructure, but instead of relying on a unique platform, it uses a technology that makes charging available for all electrically propelled vehicles. Energy producer and Supplier, Fortum, is working with local authorities, the council of Stockholm, and with national organisations such as Elforsk, with the aim of reducing emissions within the Stockholm area and set a national standard. Other approaches are being initiated by small private actors that follow a standard without any direct assistance from governments.

Disruptive innovation

Bandivadekar (2008) writes that the technology of the light duty vehicle has steadily improved over the past 20 years and the efficiency of the propulsion technology of the internal combustion engine has increased. However, the average fuel consumption of new vehicles sold each year has not changed since the higher efficiencies have been offset by increasing weight, size, power and acceleration. This has meant that the gains in efficiency over the past twenty years have been used to improve other vehicles attributes such as power, weight and additional safety features, while aiming to keep the vehicle fuel consumption constant. Thus, the carmakers have dealt with a trade-off between performance, size and fuel consumption. Kassesris and Heywood (2007) discuss the possibility of decreasing the fuel consumption drastically if fuel consumption is prioritized instead of performance. They write that if the performance and size of the current Toyota Camry vehicle is kept constant, the relative on-board fuel consumption of such a vehicle in 2035 could reduce by 5/8 of its current fuel consumption.

Thus, a 50 percent emphasis on reducing fuel consumption would mean that a 2035 vehicle would realize a reduction of road-fuel consumption of 13,2 percent. If the fuel efficiency benefits are used fully to

reduce fuel consumption, the LDV fleet fuel use can be reduced by as much as 26 percent. If carmakers go beyond their current efforts and invest an additional 20 percent in lowering the fuel efficiency then it would be 31,8 percent lower by the year 2035.

	Different Degree of Emphasis on Reducing Fuel Consumption (ERFC)					
	0%	25%	50%	75%	100%	120%
2035 LDV Fleet Fuel Use (in billion liters)	765	715	664	614	563	522
% Reduction from No Change	0	6.5	13.2	19.7	26.4	31.8

Figure 25: Future reduction in fuel consumption, Bandivadekar 2008

These same efforts are made with the alternative technologies. Car manufacturers are relying on incremental improvements in technology efficiency within electricity and hydrogen.

Revolutionary innovation

Innovation merit: The primary constraints of today's electric vehicle are the relatively short range of approximately 160 kilometers and the requirement of approximately 7-8 hours for a full charge. The separation of the car and the battery opens up the possibility to offer drivers the feeling of unlimited driving. Thus, the question of whether batteries become more durable or faster charging becomes less important in this case. Another debate is how to charge for the fuel and services that are offered. BP will be able to easily separate the high intensity driver from the casual driver, through analysis of the different subscriptions and the recording of battery swapping activity. Coulomb Technologies, which uses a fixed battery pack, has a more complex system that verifies every user and records every charging-occasion and can therefore offer a more precise charging fee to the customer.

Operational merit: The concept of switchable batteries imposes changes on the conventional business practices of the automotive industry. Traditionally, carmakers have seen the vehicle as a bundled component that they develop, and can therefore be sure meet all the design and performance attributes of the carmakers' brand. In the case of BP, the propulsion source is being treated as a modular component. Furthermore, this means that carmakers have to coordinate with network operators as well as battery manufacturers in order to secure supply and ensure quality. BP will supply the infrastructure and the related service, Renault Nissan will supply the vehicle components and independent battery manufacturer A123, is supplying the batteries. This businesses model is complicated and can hinder the carmakers profit control of new vehicle sales. Ridell (2009), points out this is a potential challenge for BP; he questions what the value of a car will be without the battery and whether the carmakers are ready to accept that scenario. Furthermore, this model also requires further practical requirements in the form of storage areas for batteries located at the swapping stations.

Market merit: The switchable battery enables the separation of the battery from car ownership. Thus, the customer only owns the vehicle component, whereas the battery is the property of the network owner. This means that the initial purchase price will be minus the cost of battery production, as the driver will lease the battery. However, General Motors and other automobile companies have discussed the possibility of leasing the battery while keeping it bundled with the vehicle. The battery leasing option will make plug-in models more competitive on the mass market. The car manufacturer is considering leasing the batteries for its upcoming vehicles as part of a comprehensive "mobility pack." For a monthly fee, drivers will get maintenance, replacement and, in some countries, electricity and insurance, all managed with an online interface. The separation of ownership will mean that the responsibility for the battery will shift to the battery owner, thus decreasing the initial cost and stress over the technological aspects associated with this new technology. Another advantage of the switchable battery is that it enables the installation of a new battery in place of the original. This is significant since the battery is perceived to be a consumable product.

Switchable batteries do bring limitations to the market merit. The main obstacle is "overstandardization" Van der Bossche, 2003 regarding the switchable-battery concept. Mats Alaküla is skeptical as to whether the battery packs on a technical level could be standardized in size for automated battery changing. This would mean that standardization of batteries is traded off against customer differentiation, since the batteries will determine the performance attributes, and these have to be manufactured in accordance with the platform technology of BP.

Merit	**Switchable battery**
Innovative	-Switchable battery vs. Fixed battery. -Elimination of battery constraints and the feeling of infinite driving. -Diminishing the value of scientific enhancements. -New business model. Similar to operator model. -Pay-per-mile cost of driving related to the amount of driving.
Operational	-Requirement of coordination between carmakers and infrastructure layers. -Battery component treated as modular - outsourced to specialized battery suppliers. -Requires system for storing and maintaining large bulk of batteries.

Market	-Lower initial purchase price as cost of battery not included. -Less physiological costs for the technological risks. -Less differentiation of the vehicles.

Figure 26: The competency of BP's technology, Arif & Hakim, 2009

Path dependence

The winning technology, pure electric, plug-in hybrid or other fuels will not necessarily be the most efficient technology. Instead, the outcome of the standard war is determined by small initial factors that may give a particular technology a head start. The competition among the several standards is currently about achieving economic of scale. A leap ahead will lead to the pressing down of the manufacturing cost of batteries, obtaining lower prices and taking further leaps toward other technologies. Signalling effects, learning curves and network externalities will all play an important role in this standard race (Arthur, 1994).

Learning curves: BP will gain information about the competency and constraints of the new technology. The information will be valuable for BP and its partners as well for the entire emerging EV-industry. The EV-technology will be evaluated once it is put in practice allowing the identification of hotspots in which companies can further focus their resources. Many projects emphasize the importance of trial periods before engaging in mass commercialization. Fortum is currently undergoing a large-scale project consisting of tens of charging spots in Stockholm. The purpose of this is to get ideas about the performance and security aspects as well as suitable business models for charging the customer. Volvo and Vattenfall launched a minor joint project in 2007 with the aim of testing and developing plug-in technology before scaling-up the manufacturing process.

Signalling effects: Signalling effects are very important in the case of electric vehicles. This is because the average driver has insecurities regarding the competency of technology that can give rise to physiological costs. The signalling effects of EVs are important in two aspects. Firstly whether electricity is efficient for light duty vehicles and secondly whether EVs can compete with current conventional vehicles in convenience and affordability (Van Der Bossche 2003).

Network externalities: The market for electric cars is reliant upon an important network externality component in form of the necessary battery charging or switching infrastructure. For electric cars to achieve wide-scale deployment, these new battery service networks must be competitive with the existing gasoline fuelling infrastructure in terms of price, range and reliability.

Summary of competitive strategy

This section has aimed to understand the mechanisms following a disruptive innovation and the crucial challenges and success factors in a technological standard race. There have been different approaches in setting a standard, both through cooperation with governments and joint ventures between commercial firms. However, we have seen that standardization work is at an early stage and much work remains. We have discussed that fact that car manufacturers have been choosing to improve the performance attributes of the vehicles in favor of lowering the fuel consumption. BP's product is disrupting the automotive industry by enabling vehicles that are more affordable and appeal less demanding customers. We have also found that all three factors of path dependence; signaling effects, leaning curves and network externalities play a vital role for EV-adoption. The revolutionary innovation has helped us to look at how BP's concept and business model differs from the traditional concept for a fixed battery. It shows many advantages but also potential challenges.

4.4 Platform Management

General awareness to EVs, or specifically, to Better Place's solution, is limited. This lack of knowledge and understanding is common for new industries where the technology is still not familiar. The lack of awareness to EVs is also driven by norms and values that are being shaped by culture and socio-political factors. The limited understanding that BP and the EV industry may face, affects the resource allocation that is needed to successfully execute their strategy. BP has, however, raised capital for its activity and even received governmental incentives and subventions but they still have to gain support from the new industry and the mature automotive industry. And indeed we see that BP, Vattenfall and Fortum have all engaged in strategic alliances with other partners in order to overcome political resistance, gain faith from customers and allocate resources. The infrastructure for EVs can be seen as a platform that creates a common design that is shared by all producers. Platform design is not only a technical solution to charge the batteries, but also a strategic architecture, which will power the market strategy. The platform has a common design so all cars can plug in to it. In this way the platform should create a family of products with both a common and different side such as different vehicles.

The swapping stations that BP is intending to build will however be limited to cars that share their technology. These cars will be built by Renaults-Nissan and will include 9 different models, according to Shai Agassi (TED, 2009). That will limit the diversity of complementary innovations that increases costumer value and may harm BP's competitive advantage and its unique solution. According to Schilling, these complementary products like cars and supporting technologies are the most important factor to determine whether BP's approach will win the standard war.

BP has limited technology development inside the company. Battery development, car development, electricity production and other supporting technologies are all outsourced to companies that corporately work with BP in order to design the product according to the platform architecture. The platform is

therefore modular. The relationship with external complementariness and the collaboration capability of BP will be tested in the following chapter.

Platform Leadership

In order to achieve a sufficient quantity of complementary products and services, BP should combine business, technological and strategic approach when designing the platform. On a technical level BP has to design their swapping stations so the interface with other cars will be possible. At the business level the challenge is creating incentives for potential complementary products, mainly cars. BP had to decide in the very early stages whether it wanted to develop a platform or just a product. When choosing platform there is a greater need to govern the ecosystem of battery producers, automotive manufacturers and even electricity producers, in order to create and maintain a superior position in the market. There are two strategic options for the platform leader, namely coring and typing. Coring strategy option is possible when the platform creation is being done in an unfamiliar place where no platform existed before. This is the case for BP, although they still have to overcome other platforms and standards.

At the technological level there is a need to solve a "system problem" which is an essential solution for most companies. They need to protect their intellectual property and create a strong interdependency. BP representative Christian Egenfeld told us that the swapping stations will be open to all users, but the property rights will be kept by BP. The interdependency and high switching cost is also fulfilled by the swapping-station solution that BP is building. The plug-in spots however, are built according to international standard and can be compared to any other electricity infrastructure. Managing the ecosystem in regard to complementary factors is easier due to an international standard that all EVs and plug-in hybrid manufactures are following.

The tipping strategy is implemented to win platform wars by building market moments. These are focused on incentives and coalition building. BP should according to this theory attract car manufacturers by providing a pricing mechanism that is superior to that of their competitors. According to Christian Egenfeld, that car manufactures do not receive incentives from BP but have negative incentives in form of losing market share.

Evolving technologies is crucial for long lasting platform leadership. If the ecosystem will not follow BP, the risk for lower complementary innovation is great. BP has developed a vision and wants to drive the whole industry beyond its current technical capabilities and business solutions. Shai Agassi, the founder and CEO of BP succeeded in winning the Israeli president's trust and support and in return received the promise of using Israel as a test bed for EV vehicles. This gesture shortened the route to gaining the trust of car manufactures. Renault Nissan shared the vision of ending oil use and started to develop EVs.

Ecosystems

The platform leadership that BP is developing enables the creation of additional value to users, although this cannot be delivered by BP alone. This strategy brings great interdependency but also involves greater risks. Thus, BP's infrastructure for EVs in the form of swapping stations and plug-in stations is greatly dependant on other innovation ecosystems systems that have to deliver relevant solutions in time.

When looking into the components that create the greatest value for BP, it is clear that the importance of Renault Nissan in the success of the project is vital due to the fact that it is the only company currently supplying cars. Hence when assessing the risk for possible future failures, a question mark arises due to this interdependency. In order to decrease this risk while still increasing the possibility of overcoming future challenges in delivering value to end costumer, BP should reduce this interdependency problem by increasing the number of car manufacturers.

In addition to interdependency risk, BP may face integration risk. According to Ron Adner (2006), getting from concept to production of cars takes in average three to four years. Thus car manufactures that don't start designing EVs with swappable batteries until 2011 (after BP and Renault Nissan have already introduced their new solution) will not be ready for mass production until 2015. This is just one example of how important it is to have the same developing rate across the ecosystem.

There is no doubt that BP is a frontrunner in the EV standard war. However, delays in BP's plan would give other companies a chance to catch up. There is also the risk if other innovation ecosystems overtaking BP by developing greater value. Thus, not only do BP and its ecosystem have to move together, they also have to do it faster then other ecosystems.

Two-sided platform

BP is a good example of a two-sided platform where the revenues can come from both sides of the platform. One side of the platform, as previously mentioned, is all products that build on the customer side, in this case cars and supporting services. The other side of the platform is the supply side, which in this case is electricity. BP can generate incomes from both sides by connecting electricity sellers to electricity consumers through the platform. Thus, BP will be an intermediary that connects buyers and sellers and gets incentives from both sides by increasing profitability for both of them.

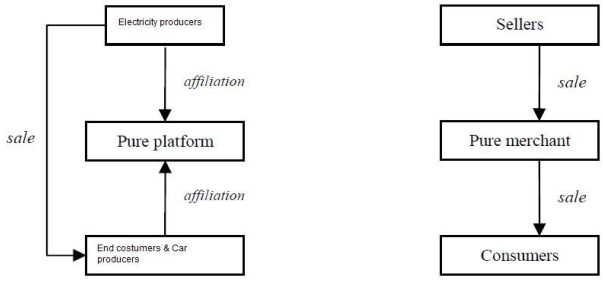


Figure 27: Two sided platform, Arif & Hakim 2009

The joint venture with Dong Energy in Denmark, an electricity producer and supplier, can be seen as the first income from the supply side. BP gets incentives from electricity suppliers in this early stage and will possibly continue to see revenues even in the future. In Israel, however, the electricity corporation is a governmental company and less business driven. According to Sagiv Ben Arie, the Israeli electricity corporation sees BP as any other big costumer and would be happy to supply them with electricity.

The other side of the platform is, as mentioned in the previous section, the customer and car producer side. The revenues in this side come from costumers that pay per km. According to BP's home page, the customer will also be able to buy the cars directly from BP. This revenue stream will be in addition to receiving payment per km.

Pricing the platform is usually difficult and has trade-offs to one side. Increasing incentives to the electricity supply side will harm the customers at the other side while incentives to customers, such as lower price per km, may decrease revenues for the electricity company. BP therefore has to create a balance between the interests of both sides and above all the interests of the platform. The common goal is to increase the number of users, which is crucial in the early stages of the project.

Summary platform management

BP and the rest of the EV industry face a challenge to shift values and norms that where shaped by socio-political factors and create a hurdle for faster standard change. BP succeeded however in gaining support from investors, governments and some parts of the automotive industry. The swapping-stations platform is currently lacking diversity in relation to complementary products. BP has only one car manufacture, Renault-Nissan that builds on this platform. In addition, BP's platform is modular and this factor therefore increases the dependency on complementary products.

The platform leadership strategy that BP chose is to keep intellectual property inside the company and create great interdependency and high switching costs without positive incentives. According to Christian

Egenfeld, negative incentives such as market loss, will force companies to cooperate with BP. When looking at the other side of the platform, electricity producers and providers, we see an financial incentives and great will to cooperate and invest in BP.

BP has developed a vision that seems to appeal to many governments, and that was an important factor when establishing the company. This vision seems to drive the whole industry and is giving EVs a great push forward. The challenge, however, is to drive the whole ecosystem in one direction while holding on to their platform leadership position. For now the challenge seems great and it will probably be greater in the future.

A serious risk that BP faces is the total dependency on one complementary company. Every delay in delivering components to BP will have repercussions, due to low diversity of companies in the ecosystem. In addition, a slow adoption rate in the ecosystem enhances the risk of slow ecosystem development.

4.5 Sustainable Advantage

First Mover Advantage

The scope for development in the area of plug-in cars is dependant upon technological advancements regarding major components such as batteries and charging stations. Some developments have already been discussed before in different contexts, but will be combined here with the rate of market development and adoption, in order to look at a possible first mover advantage.

Battery and charging development

There have recently been major improvements within battery technology, in terms of energy density, price, charge time and safety. This is because of the increased commercialization of hybrid vehicles that has given incentives to carmakers and battery suppliers to invest in developing EV-batteries.

In the last 5 years research and development projects have resulted in great breakthrough innovations within the battery technology field. For example, a new technique for charging batteries was announced in March 2009. The new technology gives lithium-ion batteries a 100-fold increase in power density. A Chains company, BYD, started out producing Li-Ion batteries for mobile phones and computers. The company claims to have developed a battery for EVs with a driving range of 300 km and a fast charging capability (BYD, URL).

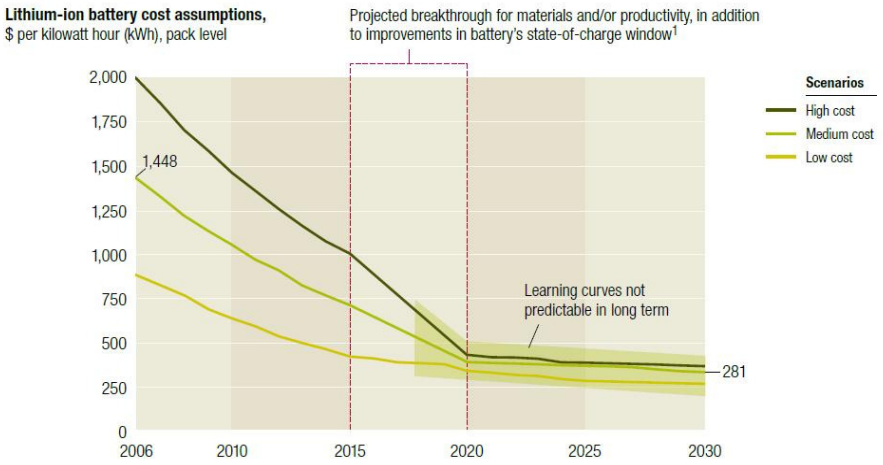


Figure 28: Battery future cost, McKinsey 2009

Charging batteries can be done in two main ways, regular charging and fast charging. The regular charging method can be achieved in a home with a basic electricity capacity. It is done by connecting the car to an electricity outlet and takes 6-8 hours. The second way is the fast-charging method that only takes up to half an hour but requires a high voltage that is not available in all homes. Recent MIT research points to a great breakthrough that may lead to major development in the field of fast charging (Thomson, 2009).

The negative aspects of the fast charging method are high battery wear and higher electricity demand, which increases inefficiency and instability of the grid. Professor Mats Alakula and BP claim that the need for fast charging on a daily basis can be relatively small due to most users only driving short distances.

Market Development

According to the Israeli green taxation committee, the percentage of EVs as part of all new cars that are purchased every year in Israel will raise gradually from 4% in 2011 to 15% in 2015. According to this adoption rate, EVs will account for 8.5% of the total passenger cars in Israel in 2020. A common assumption, with consideration to the known characteristics of EVs and the reasonable price range, is that EVs will have penetration range of 5% to 15%, in Israel. Penetration of 8.5% of total passenger cars and 19.5% of new cars in 2020 will bring the number of EVs to 275 000 cars in 2020 (Chief of scientists, 2008).

The chief of science officer report concerning EVs adoption rates in Israel does not refer however to the plug-in hybrids and range extender hybrids that relay on the same charging spot infrastructure that BP intend to build. According to Johan Tollin from Vattenfall, in five years time there will be a greater demand for electricity-based cars. According to his estimation the plug-in cars will make up 30% of the car fleet in the years 2025-2030. The slow change is due to the long life cycle of cars that currently stands at 20 years.

Even according to Boston Consulting Group, EVs adaption rate will be steady. The adoption rate will be affected by the price of the EVs, oil prices and battery prices or per km price, and even by the service and availability of the infrastructure. Boston Consulting Group has made assumptions on the adoption rates according to three different scenarios:

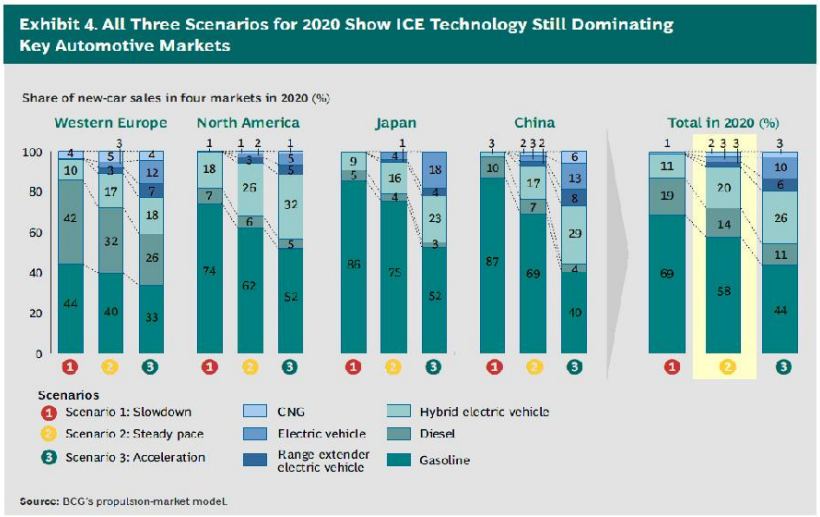


Figure 29: Future market share, BCG 2009

Scenario 1: The price of oil has fallen to $60 per barrel, energy security worries have decreased and public concern about climate change has diminished.

Scenario 2: The price of oil has raised to around $150 and concern over energy security increases. Worries about climate change have intensified and people are concerned about their contribution to $C0^2$ emissions. Governments impose laws and regulations to reduce emissions and increase incentives for low-emission cars.

Scenario 3: All stakeholders including governments, international and national organisations, the private sector and the public feel an increasing need to reduce emissions. Tax subsidies will be introduced to people who drive low-emission vehicles. Oil prices dramatically climb to $300 and create strong incentives to change to other fuel-efficient cars.

Exhibit 5. Markets in 2020 May See Sales of Some 11 Million Hybrids and 3 Million Electric Vehicles and Range Extenders

Estimated passenger-car sales in 2020 under the steady-pace scenario (millions of units)

	Western Europe	North America	Japan	China	Total
CNG	0.8	0.2	0	0.3	1.3
Electric	0.6	0.4	0.2	0.3	1.5
Range extender	0.5	0.6	0.1	0.3	1.5
Hybrid	2.9	5.4	0.7	2.0	11.0
Diesel	5.5	1.2	0.2	0.9	7.8
Gasoline	6.7	12.9	3.4	8.4	31.4
Total	**17.0**	**20.7**	**4.6**	**12.2**	**54.5**

Source: BCG's propulsion-market model.

Figure 30: Car sales by technology 2020, BSG 2009

Research from Berkeley University, Figure 30, shows even more optimistic figures when combining BP approach to separate the battery ownership from car ownership. The separation helps to accelerate the adoption rate of EVs in the United States. According to the three sources mentioned above, the adaption rate of EVs will be slow but steady. The change will not occur in one day, but the next century will be a milestone and will mark the beginning of full transformation from petroleum to electric miles. The exact adoption rate depends on many factors including oil prices and technological development.

The MIT Joint Program, "The Science and Policy of Global Change" shows the great impact that different policy can have on the adoption of EVs in the United States and Japan. The assumption may therefore have to be modified in cases of policy change and governmental incentives (MIT 2009). The adaption rate in Israel for instance may be faster due to governmental policies and tax incentives. It is, therefore, essential to look at each country as separate cluster with different growth potential. In addition, different priority levels will also affect geographical locations within each country. Thus, it is possible to see even higher adoption rates in big cities and metropolitan areas.

On the other hand, technology seems to change as fast as market evolution. The battery capacity and price will improve, which may aid adoption acceleration, but which can also bring challenges. Even range extender hybrids and plug-in hybrids seem to take a large share of the market. BP may face new actors with more efficient technology and better access to capital. Short-life strategy is unthinkable for BP due to the massive investment and commitment to partners and costumers. When separating BP's offer into two parts, namely swapping stations and plug-in stations, we see two different risk levels.

The first offer, switching the battery, requires massive investment and low flexibility in changing the installed base when the technology develops. Based on McKinsey rapport from 2009, see Figure 28, the

battery capacity and price will change dramatically, which will negatively affect the battery swapping idea in the future. Already today BYD, a Chains Li-Ion battery manufacturer that has moved into the automotive industry, offer a driving range of 300 km without charging. The fast charging alternative can also bring challenges to the swapping stations and minimize the need to extend driving range by replacing the battery. There is however disadvantages with the fast charging method such as negative effect on the grid when increasing demand and breaking the equilibrium of supply vs. demand.

BP is getting into the *Technology Lead* market with its swapping station solution. Other actors that try to exploit the existing technology by improving the driving range of EVs will therefore challenge the market leadership. In order to maximize gains, a quick-in quick-out strategy and short life is likely to be implemented in this category. There is a little chance for a long and durable life. On the other hand, the charging stations that BP intend to build all over Israel, Denmark and other countries, can be categorized under *Market Lead* where the first mover have great advantage. When the market adoption rate is fast, future technological development has a relatively small impact on basic product features. For this offering, BP needs a great resource base in order to satisfy the growing market and new segments. Profitability is very likely but depends on BP possibility to address different market segments. Key success factors are large marketing capability and scale capacity.

Resource based View VRIO

Shai Agassi

Shai Agassi's competency and reputation support the credibility of BP and have helped gain trust and resources from stakeholders. Another potential resource is the cultural bonding to the Israeli President, Shimon Peres, who has agreed for Israel to take part in the project. Intangible resources such as reputation, skill, and knowledge are harder to imitate according to VRIO. Shai Agassi's knowledge and reputation as an entrepreneur has been acquired through socially complex processes, which are hard for other companies to imitate. However, these capabilities are harder to control since they most likely leave an organization along with individuals that possess them.

Partnerships

Industries involved in electric vehicle production and infrastructure lack legitimacy among stakeholders. They find the project too risky to invest in when EV-technology is in such an early stage of development. The ability to align with crucial partners is considered to be valuable. BP deploys the first scale infrastructure for EVs and gains the advantages of economy of scale both on the supply and demand side. On the supply side the project enables carmakers and battery manufacturers to lower the high production costs, especially regarding the manufacture of lithium-ion batteries. On the demand side, the massive battery service networks will be competitive with the existing gasoline fueling infrastructure in terms of price, range, and reliability.

Business Model and Technology

The concept of switchable batteries eliminates the limitations fixed battery EVs. It also enables the firm to meet the customers' responsiveness by enabling the feeling of long-range driving. Consequently, no efforts were made to enhance the current science of the EVs. Instead the offering was based on the boundaries of today's technology sphere. Shai Agassi has said that the disruption already occurred technology-wise. Furthermore, BP does not hold any patents or copyrights that constrain other firms from imitating the concept and deploying it in other geographical markets. However, BP controls which drivers can make use of the network, by using proprietary technology in the physical equipment. This means that carmakers have to make agreements with BP and build their interfaces in accordance with the technology architecture of BP.

Capital

The BP project is considered to be of a high risk since the EV industry is still at an early stage. Furthermore the funding is unrecoverable. However, the VRIO values of capital must be considered low since capital can be accessible on the factor market.

Resource	**Value**	**Rarity**	**Imitable**	**Organized**
Shai Agassi	Gives credibility to stakeholders.	Individual.	Acquired through socially complex processes.	No, the individual may leave the organization.
Technology (Offering)	Eliminates technology constraints, enabling customer responsiveness.	Yes, the concept of a switchable-battery is unique.	Yes, no copyright or patent hinders other firms from copying the offering in other markets.	No, controls through proprietary technology on the interfaces.
Partnerships	Yes, enable scale markets and ecosystems.	Yes	Yes	-
Capital	No	Available on the factor market	Available on the factor market	Yes

Figure 31: The competiveness of BP´s resources according to VRIO, Arif & Hakim 2009

Summary sustainable advantage

Technology development due to increasing commercialisation of EVs is likely to accelerate in the future. The two main technological developments that will have the greatest impact on EVs future adoption are; battery capacity and fast charging technologies. Battery capacity seems already today to reach 300 km. Fast charging seems to be developing quickly as well, and together these factors will go a long way toward solving the major problem of EVs being limited in range. Fast charging however involves great overload on the grid and may lead to inefficiency. Fast charging will help to accelerate EVs adoption but may have negative consequences for BP's battery swapping idea. Increasing battery capacity and lowering battery prices will also have a positive effect on EVs adoption rate.

Different market adoption scenarios are also been affected by external factors, not just by technological development of EVs. Oil prices are correlated to adoption rates of EVs so when oil prices increase the profitability of switching to a different standard is higher. Governmental incentives also affect the adoption rates at local levels. Like oil prices, governmental incentives differ from country to country and therefore have different effects on the local markets.

Adoption rate also has a great impact on the profitability of EVs due to economics of scale. Fast adoption will enable lower prices for infrastructure and faster technology development. According to research from Berkeley University, a faster adoption rate is possible when separating the car and battery ownership. This will lead to faster price reduction and higher profitability. It seems however that this method that may not be so relevant in the future when technology has further developed.

BP offers two different solutions to this problem. The first is swapping stations and the separation of car and battery ownership. The second solution is charging points. The two offerings have to be separate due to differences in technology, strategy and risk. BP's swapping station solution is in a market where technology changes faster than market evolution. There is high risk for flat sales and competition from new actors with greater financial capabilities that hope to take market share with different technologies. This is however, offset by steady market growth. Short-life strategy is unlikely due to BP's commitments to some segments. Durable profits are therefore at risk from late movers. On the other hand, future technological development will have a relatively small impact on charging stations while the market growth is steady.

5 Results

5.1 Results of Analysis

External business environment:

Economic cycles: Macro economic cycles are a good basis for the evolution of new industries. According to Schön there is a clear course of events in periods of structural crisis, economic crisis and emerging industries. The present structural crisis in the mature automotive industry increases the necessity for changes through technological growth and thereby supports the emerging EVs industries.

This transformation phase accelerated after the financial crisis in the global economy due to investors seeking new opportunities. Indeed, investments from governments and private sectors are accelerating the new standard development towards energy efficiency and new energy sources. These investments are also stimulating the energy industry, which has also suffered as a result of the structural crisis. This transformation phase is stimulated by world conflicts but can also be seen as a reason for future conflicts between countries with contrasting interests.

Security of Supply: The automotive industry and the transportation sector are greatly dependant on fossil fuels. This dependency leads to suffering in times of scarce supply, which can in turn lead to high alternative costs. In addition, the oil market is monopolistic and controlled by only a few countries and big corporations, which further exacerbates the problem. There is therefore enormous interdependency between oil producing countries and companies, and oil consuming countries and industries.

This interdependency enhances strategic challenges and requires therefore improvements in security of supply and energy diversification sources. Governments intend to reduce this dependency and strengthen their strategic position by influencing the dominant strategic behaviour of OPEC countries. They intend to achieve this by improving and developing new energy sources and alternatives to oil. In addition to the need for improving strategic position by increasing diversification of energy sources, oil consuming will gain great financial benefits from domestically production of energy for the transportation sector. Electricity is accessible resource that can meet this great demand for energy independency by domestic production and is therefore a very good substitute for fossil fuels.

Externalities: Taxation should in an efficient market economy, cover the negative effects being created by the use of products and services with negative social external effects. Thus, there is an economical justification to higher taxation when there are negative effects or to lower taxation when there are positive effects. External negative effects like pollution, noise and global warming due to transportation, create great costs for society. In order to minimize these costs, there is a need to internalize negative effects created through pollution by increasing the cost of fossil fuel vehicles and reducing the relative price of low emission vehicles.

Taken into consideration, these negative social effects enhance a breakthrough for the EV industry. Denmark and Israel has very low purchasing tax on EVs, which is due to the positive effects on society, and which increases the profitability of using the new electric standard. Other programs like the European Union clean air program and lower emission strategy will also support the sustainability of zero emission cars. Subventions are greatly important to the development of this industry and are a crucial component in speeding up the process of a standard race. On the other hand there are some difficulties that may risk the support to EVs through internalization of external costs. The European Union is supporting lower emission vehicles by giving subventions to the supply side of the automotive industry, and not the demand side. Subventions to the supply side may decrease the development of EVs and future adoption rates. In addition, internalization of all the external costs from transportation, like parking, density, usage of ground, may promote car sharing and thus harm the EV industry. Furthermore the cost of internalization of other means of transport, such as trucks, buses etc, may create financial difficulties and economic burdens for governments and thereby risk future internalization process. Adoption rates may decrease in the future when governmental incentives stop.

Industry Analysis

Each force is given a value between 0 and 5, were 0 is no significant powers and 5 is highly influential force to BP's profitability.

Figure 32: Result of the Infrastructure industry analysis, Arif & Hakim 2009

Strong entry barriers characterize the industry. A nationwide project of this type requires a great amount of capital as well as a third party, in the form of the granting of governmental permissions. Smaller scale investments are characterized by less capital requirements and involvement of only local actors. Electricity

suppliers, buyers, manufacturers of complementary products and carmakers exercise great bargaining power. The rivalry in the industry is currently high, characterized by a standard race between different emerging technologies as well counter-moves from the conventional industries.

BP has two components that it intends on using in order to dilute the negative power balance; by engaging in *scale operations* and deploying a *proprietary technology* on its network. Scale operations are crucial for the EV-industry at the moment since they offer an opportunity to press down the extremely high manufacturing costs for both automakers and battery suppliers. In addition, a large-scale operation strengthens the firms bargaining power as they consume significantly less electricity. Porter (1995) argues that the interest of established actors is to raise the entry barriers. BP's intention with a large-scale investment consequently results in high entry barriers for other potential competitors. The high investment results in a high switching cost, which will force the company to minimize future technological change. This is unlike smaller projects, which can abound if the technology is perceived inefficient. The second factor, a proprietary technology, will result in greater control of the system, hence increasing the switching costs for car manufacturers who choose to build around their platform.

Competitive strategy

Standards: Standardization work in the EV industry has suffered from delays due to the different interests of the numerous actors. There are two approaches when introducing a new standard, sponsored and unsponsored (David 1995). BP uses a cross-industry collaboration of private sponsors and public authorities. Successful standards should incorporate the interests of all stakeholders as well as be in touch with practical requirements (Van der Bossche, 2003). Car manufacturers are very important stakeholders in enabling standard shift since they provide complementary products that enhance the network externalities on the demand-side. Focusing solely on customer responsiveness can lead to unappealing standards for carmakers. BP's platform is based on proprietary technology and can therefore only be used by the custom-built vehicles of Renault-Nissan.

Disruptive innovation: The EV technology of BP is classified as disruptive innovation since it is contrary to the incremental innovations that have been characterising the automotive industry during the last few decades. Better Place offers a product with lower performance (top speed, horsepower, acceleration etc) but also a lower cost.

With there currently being no clear expectations regarding EVs, suppliers do not have to deliver the best performing product at the beginning, this according to the technology push-pull theory. BP's attempt to deliver a product that is as convenient as the conventional vehicles may be a risky act, as push-technologies requires the time to gradually and implicitly evolve through R&D efforts.

Revolutionary innovation: The separation of the battery ownership from the car ownership opens up the possibility of offering drivers the feeling of unlimited driving which minimizes the biggest constraint of

EVs today. On the market level it seems that the battery-leasing option will make plug-in switchable battery models more competitive on the mass market because a low initial price and leasing possibilities. However we found that operational practices and power positions of the automotive industry are threatened if batteries are separated from the vehicle component. We also found that carmakers may resist the concept of switchable batteries since they may lose control over the battery component and the battery manufacturers. Furthermore, we found that the switchable batteries force "overstandardization", whereby costumers have no choice of driving vehicles, brands or performance features.

Path dependence: According to the path-dependence theory, the fittest technology is not necessarily the winner of the standard race. Better Place will gain an advantage by being early in the market, which may increase the possibility of establishing a new standard, that is, EVs and swappable batteries. In addition, BP intends to supply their EVs to large governmental organizations and private companies by leasing the cars. This method, together with mass international marketing, will help BP to reach an initial advantage and enhance the adoption of EVs through signaling effects, learning curves and network externalities which all play a crucial role in the standardization process of EVs.

Platform management

In order to overcome difficulties to allocate resources, BP has chosen a platform strategy involving the development of three main solutions, namely battery swapping stations, plug-in stations and a computing platform. Universal design irrespective geographical location is critical to this emerging standard so that all cars plug into the same technology. Thus this problem will be overcome if there is a worldwide universal standard driving the entire ecosystem. Complementary products in the form of EVs will be accessible in the future when the ecosystem allows mass production to start. The greatest challenge however, is the development of complementary products for the swapping-station platform. The future competitive advantage and sustainability of this platform may face difficulties producing further value for costumers by developing additional differentiated vehicles in all segments. In addition, the dependency on one complementary producer increases the risk for failing to deliver within the timeframe. Furthermore, the adoption process' role in the ecosystem enhances the risk factor and may lead to slow ecosystem development. Thus, even if an automotive manufacturer adopts the swapping station solution now, it will still take up to four years to establish mass production of complementary products to this platform.

The platform leadership strategy that BP chose for the swapping station solution creates a great interdependency and strengthens BP, but seems to harm the development of the ecosystem and complementary products. BP is keeping strong intellectual property inside the company and do not give clear positive incentives to complementary developers, which seems to damage the growth of this ecosystem. The electricity companies on the other side of the platform would appear on the contrary, to have greater incentives to support any kind of solution that would accelerate the adoption of EVs, either by using swapping stations or plug-in stations.

BP's vision seems to drive the automotive industry, governments, and other organizations. This is giving the EV industry a great push forward. The challenge however, is to drive the whole ecosystem in one direction while holding its platform leadership position and still sustaining a durable advantage.

Sustainable Advantage

First Mover: The rate of technological development should be compared with adoption rates and markets evolution in order to look at possible first mover advantage. Thus, increasing development of technology will have a significant effect on battery prices and thereby EVs adoption rate and market evolution. EVs are greatly depended on two technological and economical hurdles, battery capacity (which affects driving range) and battery price. The range problem is likely to be solved by battery efficiency and a fast charging method. According to our findings, technology development is likely to accelerate in the future and have significant impact on these two hurdles.

However when looking at market evolution and adoption rate, it seems that the market will evolve slowly due to low government incentives, technology developments, oil prices and lock-in mechanisms which all affect the paradigm shift of the automotive industry. Future events, like geopolitical conflicts, may push the oil prices up and accelerate the market evolution. Some states nevertheless, such as Israel and Denmark will have faster adoption rates due to greater incentives.

Thus, first movers like BP are operating under both market risk and risk from future technology development. It is important to notice however that the two solutions BP offers, swapping stations and charging points, have different risk levels due to possible future technological developments and adoption rates.

Swapping battery stations are potentially very risky investments due to fast changing technology and a high cost installation base. They will however, help to accelerate market adoption due to the subsequently lower purchase price of EVs. This will lead to relatively steady market growth in some segments. Some locked-in mechanisms will tie the costumer and lower BP's initial risk, thus helping to sustain the competitive advantage of this solution in the near future.

The second offering BP has is the charging stations. Future technological development in this segment will have relative small impact on the offering while the market growth is steady. The risk is therefore lower and profitability is likely but is dependant upon the capability of addressing different segments. Key success factors are marketing capability and scale capacity.

Arguably BP's greatest current resource is CEO Shai Agassi. His personal knowledge and abilities and his rare skill in integrating a full ecosystem are likely to be valuable only at this specific stage. The EV-industry is associated with a significant high risk at the moment and the ability to convince skeptical resource holders is highly valuable. Shai Agassi's reputation, skill, cultural background, and knowledge are hard for

other firms to imitate. However, individually possessed capabilities are harder to control since they may leave the organization along with the individuals that harbor them.

Signing agreements with several governments to build electric recharge grids in Israel, Denmark and Australia, as well as the US states of Hawaii and California, only confirms BP's great network capabilities. In addition, the partnerships with several utility companies across sectors demonstrate BP's capability to move a large ecosystem towards one direction and one standard. The ability to align crucial partners is considered to be valuable and rare at this moment in time.

5.2 Conclusions

We have found that companies need to take into account four challenges in order achieve a standard shift within the EV-industry:

Using the beneficial macro factors in favor for standard shift

Schön's argument regarding the emergence of new industries in times of crises in economy is highly relevant for the automotive industry at this moment. One of the tasks facing the EV industry is making the best use of the current circumstances in order to introduce disruptive technologies and business models. Being able to influence policymakers in its own favorable to the new technology requires less effort in times where governments can be influential by delivering market regulations and control. In addition, governmental requests for the security of a reliable oil supply support the new standard. However, depending upon regulation and internalization programs creates a considerable risk for a sustainable and long-term profitability of the new standard. Thus, if the new standard and technology do not establish a strong position in the market before the governmental subventions run out, we may witness a short life for the EV standard.

Lowering manufacturing costs through economies of scale

Actors within the standard war must find ways to achieve economies of scale. Large-scale infrastructure investments are essential at this particular time when the EV industry is associated with extremely high manufacturing costs. Large-scale projects also give incentives to other companies to join the project and force down the extremely high manufacturing costs. This concerns all physical equipment but especially the manufacturers of batteries where the cost of rechargeable lithium-ion batteries. Car manufacturer also have great need for economies of scale since they have great fixed cost in production plants.

Attracting complementary products through platform strategy

Our analysis shows that carmakers are the key stakeholders in the standard shift. Thus, attracting these as many carmakers to engage in a specific standard is vital in order to achieve a rapid standard shift. One way

of attracting carmakers is to offer economies of scale as discussed in previous line. Carmakers can influence a standard shift by increasing the network externalities on the consumer side. Thus the challenge is to creating positive in order to strengthen the economic benefits of the complementary products and services. In addition, we found that the new industry and growing standard has met resistance from the old industry that relies on oil. A strong platform leader with various complementary products and services can change the competitive strategic landscape and minimize the power of this dominant standard. Thus, the mission of creating strong strategic alliances to meet the different interests of the oil-based industry is a great challenge for the EV industry.

Trade-off between proprietary technology and standardization

The standardization work has been delayed for several reasons. We have found that companies should not overlook the danger of "overstandarnization" since the international standardization work is still in an early stage. Thus, EV technologies must incorporate great amount of flexibility which could be achieved through modularity. Overstandarnizations, could be suicidal when the rate of technological change concerning battery and charging technology is high.

5.3 Recommendations for Better Place

We believe that following recommendations are of relevance for BP in order for them to enforce a standard shift:

- BP depends greatly on governmental cuts in taxation rates for EV usage and should therefore work to protect present and future governmental incentives. The greatest risk that BP faces is reduction of the tax incentives in a governmental effort to internalize other negative external costs such as parking problems, density issues, land requirements or the destruction of natural environments. BP should work to eliminate this risk by promoting future solutions that minimize all other negative external costs that result from the use of passenger vehicles.

- We see a potential resistance from the large monopolistic petroleum companies. BP should continue to work closely with governments in order to overcome these difficulties. We also believe that BP should seek to influence public opinion by increasing awareness to the problems that arise due to dwindling supplies of petroleum, likewise the negative effects of pollution.

- BP should put increased effort into shaping the international standardization work in order to promote its technological components as the dominant standard. This is important since standardization of EV technology is at an early and risky stage. Thus interacting with the standardization bodies (International Electro technical Commission and International Organization for Standardization) will be vital for BP in gaining recognition from the rest of the automotive industry.

- BP should deploy its recharging infrastructure as quickly as possible. We think that BP will enjoy great benefits from being the first company to deploy mass national scaled infrastructure. An investment at this early stage will enable BP to benefit from its first mover advantage and from the mechanism of path dependence and lock in the markets. We believe that BP should develop a program to increase network effects and speed up adoption rates. However, any delays in the launch will decrease the probability of achieving success in the standard shift. This is due to hardened competition and increased skepticism over the competency of the technology.

- Although BP has succeeded in attracting complementary products to its platform, there is still a need for further development of complementary products and services. The greatest need is supplementary car brands and models that will enhance BP's concept. More complementary products will speed up deployment of swapping-stations and plug-in stations and will increase confidence among customers and the industry. We believe that incentives, subsidy programs and further development of alliances are vital in achieving fast platform growth and winning the standard war.

- BP's current capabilities of entrepreneurship and marketing are vital now when EV technology is at an early and risky stage. BP and Shai Agassi have successfully managed to coordinate ecosystems and alliances to engage in their project. However, as industry and technology of EVs matures, new capabilities of a scientific and technical character will be required. Thus, BP must also incorporate or further extend these capabilities in order to sustain their advantage in the future.

5.4 Contributions

The research purpose of this thesis is to identify potential strategic challenges that influence standard wars. We have chosen to map these challenges by building an extensive theoretical framework with five research areas; External business environment, scope of the industry, competitive and sustainable advantage and ecosystems. Numerous theories and aspects within each research field have being used in order to develop a deeper and nuanced theoretical framework.

This wide theoretical framework has greatly contributed to a deeper understanding of the mechanisms behind standard wars. We have discovered that standard shift is characterised by high complexity due to multiple elements that affect the dominant and emerging standard.

In addition to our contribution in understanding of major part in standard shifts, we have succeeded to link these parts together and create better perceptive of their interdependency. Thus, we have made one step towards better understanding of how these interconnected parts create a complex system. We believe that our greatest contribution is the development of a holistic approach in order to understand not only

the importance of each research area or aspect and their interdependency, but also the sum of all the aspects together.

Our hope is that further research will be done within this field in order to discover additional factors that affect standard shifts. In addition, we suggest to deepen the understanding of this complex holistic system by exploring the strategic importance of each factor in relation to the sum of all potential factors in standard wars.

6 References and Appendix

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