Structuring a Whole Life Cost model for the automotive sector

Master thesis G.R. van Aalst

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Abstract

The goal of this research is to formulate a Whole Life Cost (WLC) model for the automotive sector in order to support in the sales conversation with customers. It helps the customer to make a more informed decision when buying a vehicle. Customers tend to look solely at the purchase price while other cost factors are also significant when looking at the whole life cost.

Multiple models are already being used internally; this thesis unifies them in a global format that can be specified to each market. The first part of the thesis consists of a literature review and collection of current models in order to identify the relevant cost factors and variables. The second part formulates the WLC model based on the data retrieved in part one, and assesses the model's sensitivity to alterations of the variables.

Appendix A states a clear structure of the model formulated. The model is divided up into three different sections namely financing costs, operating costs, and automotive taxes. Within these three sections relating cost factors are included. The sensitivity analysis shows financing costs, taxes, and fuel costs to be the most significant factors in the WLC. Most relevant variables for these factors are residual value, term, mileage, customer type, and tax incentives.

The result of this research is a globally formatted WLC model where a The company vehicle can be compared to a competitor vehicle. Variables can be altered so that the calculations are specified to the customer and provides a representable review of the costs involved. This model is to be used by both Sales and Corporate Sales departments in the conversation with potential customers, and incorporated into the website so customers can get insight directly. Validation of the assumptions is difficult and as such the author suggests to use external databases the acquire values for the cost factors. Another solution would be to incorporate disclaimers into the model relieving The company from possible claims. With regards to the roll-out strategy the author suggests a try-out per country to specify the global format to be applicable to the selected country, including possible tax incentives.

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1. Introduction

The aim of this thesis is to create a formal framework for the company. This can be used to assist the departments Sales, Corporate Sales and Financial Services (FS) and regards a universal Whole Life Cost (WLC) model that is to be implemented on a global scale. All was done within the context of completing the master Financial Engineering and Management at the University of Twente. This thesis describes the process and results coming forth out of the conducted research, starting with this chapter that gives a detailed introduction. Section 1.1 contains a general description regarding the company, its history, and the context of the problem. The motivation that led to the applied research is described in section 1.2. In section 1.3 the focus is on the goal of this thesis, stating a clear final product. Subsequently, section 1.4 states the research questions that served as the base of this research and section 1.5 discusses the scope and limitations. This chapter concludes with an overall design of the research.

1.1 Company background and research context

This section describes the general company information together with the overall context wherein the research is conducted.

The company is an American automotive and energy storage company, producing and selling luxurious electric vehicles and battery products. Within twelve years it has set up over 250 stores in the US, Canada, Europe, Asia, and Australia and is currently employing more than 10,000 persons. Also it has opened over 400 Supercharger stations all over the world. Still rapidly expanding into new markets The company Motors Inc. is taking the model X into production this year, following the release of the The company Roadster (2008), the Model S (2012), and the Powerwall (2015). Its market capitalization is nearly 28 billion dollars at the moment, selling over 50.000 vehicles in 2015.(Forbes, 2016) This research was conducted at The company's European headquarters that is based in the Netherlands, Amsterdam.

Founded in July 2003 The company's goal was to show the world that electric-powered driven cars could compete (and win) from traditional internal combustion engine (ICE) vehicles. This translated into the mission "to accelerate the world's transition to sustainable transport".(Tesla, 2016) Starting with the production of the The company Roadster in 2008 a new standard was set in the electric vehicle (EV) branch. Every following model would be increasingly affordable to make the transition go faster. Financing the venture has been challenging all the years; several financing rounds from Elon Musk (current CEO), a partnership with Daimler AG, and even lending from the US government was needed to avoid the company going bankrupt. A loan of $426 million was granted to The company by the US Department of Energy. On June 29, 2010, it became the first American car company to go public in the United States since Ford in 1956, attracting more capital necessary for investments. These investments of currently around $400 million include the development costs for the model 3, expected to be in production over two years, and the building of the The company Gigafactory. This battery-producing factory will be the second-largest building in the world when completed, and The company expects its economies of scale will reduce the production costs of batteries by 30 percent. All investments empower The company's mission and the strategy is working; doubling the number of deliveries of the model S in the past year.

The company follows the new-market, high-end marketing strategy, meaning, they created a new product and are marketing to those on the high end (wealthy) of the consumer spectrum.(van der Rhee, Schmidt, & Van Orden, 2012) Another aspect of its marketing strategy is cutting out the middleman; traditionally dealerships are used. By cutting out the dealerships and not spending money on excessive marketing costs are kept down. The company's current target markets are

homogeneous, enabling the use of standard advertising and us the same or similar market schemes across the globe.(Mangram, 2012) All these aspects allow more money to go into development of the vehicles and/or results into a lower purchase price since the overhead costs are kept low. Main focus is the customer experience, ensuring customers will conform to the vision of The company. Online and in stores, customers can specify the car to their preferences and order it immediately through the website. The customer should really 'love' its experience with the car and thus services as the customization option and customer support are offered and continuously improved. All serve the purpose of achieving a big customer satisfactory rate, resulting in customers promoting the car for The company so there is no need for advertising. Currently produced The company models are high-value premium cars and are not affordable to everyone. To make the car a more affordable option solutions are offered so that customers can choose between the options of requiring the car via cash, a lease or loan. This is where within The company the need for the department Financial Services (FS) arises.

Started in 2008, in the United States, the FS department expanded into Europe in 2013. Its goal is to improve the customer experience by introducing financial solutions. Financing, leasing and insurance are all offered to the customer while in the process of buying the vehicle so that the customer does not need to look for possible offers themselves. This is convenient, saves time and makes it easier for a customer to drive a The company because the customer gets financial solutions quote with competitive low monthly payments directly in the store. One of the solutions for the customers is by The company offering a unique product called the Resale Value Guarantee (RVG) to give the lessees or lenders a peace of mind regarding the future value of their The company. This guarantee gives customers the possibility to return the car after 3 years, continue the lease or loan and keep driving the car, or sell the car on the market. This product will be discussed into more detail in chapter three.

Another solution is the savings calculator on the website. This shows possible savings when buying a The company and also shows costs when buying privately or business, cash or via leasing/financing. Since electric vehicles enjoy both fuel savings and tax incentives, depending on the country, it motivates customers to see how much a The company can save them. The savings calculator is presented next to the design studio where the customer configures his vehicle.
The first tab, the cash tab, shows the cash price resulting from the configuration page and possible savings. Another value is also stated, the price after incentives & gas savings, and here is where an error occurs; the possible gas savings and incentives are subtracted from the cash price, giving a new cash price. On the lease tab the customer can choose its miles/year and this gives an estimated lease payment as calculated using calculators obtained from the partners. It also gives an estimate with subtracted savings. This is incorrect since most part of these "savings" are a cost avoidance instead of cost savings and this cannot be subtracted from the cash price. The savings are based on a constant mileage and fuel price, along with assumptions for both a The company and a fictional ICE vehicle regarding the consumption.

1.2 Research motivation

The motivation for this research has come forth out of daily operations and touches upon the improving the savings calculator to a Whole Life Cost (WLC) calculator. The company wants to be able to give customers a clear insight in the costs of owning a vehicle so that it can differentiate itself from a normal ICE vehicle. (Deloitte, 2014) has shown customers tend to look mostly or even solely at the purchase price, while when looking at all the additional costs a The company could be the preferred choice.

At the present time there is an online savings calculator, as stated in previous section. On the website customers can choose their vehicle and possible options and a calculator on the side shows the amount to be paid, fuel and tax savings, and how much a monthly lease or loan payment would be if chosen. The lease or loan payments are determined according to prices stated by third parties, or The company leasing if applicable in a country. The calculator is very basic; parameters are set and the customer cannot alter these, no difference is made whether the customer will drive the car private or for business, and the customer cannot compare its The company with other cars. The calculator does give some insight to customers, but it can function as a much better selling tool when more of the cost factors are addressed on which the customer bases his choice to buy a vehicle.

Several versions based on this calculator are used in the stores. Interviews show that sales personnel judge the online calculator to be too basic and in most country they have taken initiative to formulate their own. Although these might serve as a good base for a WLC calculator, not all relevant parameters might be included and since the calculator differentiate from each other it creates a lack of uniformity throughout The company. The current calculators do not fully utilize their potential. By standardizing the TCO models and creating uniformity The company is firstly capable of operating in a more efficient way and secondly in a more effective way towards customers.

The WLC also provides The company with useful insights identifying the relevant parameters and how these compare to competitors. The sensitivity analysis depicts which parameter alterations could result in a lower WLC, serving as a possible base for strategic decision-making.

1.3 Research goal

The previous section describes challenges arising from the fast expansion of operations currently happening, the goal is to formulate a clear framework to tackle this challenge.

The goal is to design a WLC calculator and comparator that is to be used on a global scale. This program will include all expenditures and/or benefits related to buying and maintaining a car. Both the Sales and Corporate Sales departments are to be able to work with the model; implementation in the different operating countries should be easy and go smoothly without too many alterations in the model. Parameters should be adjustable to the situation of the customer, without having to fill in too much data.

In conclusion the WLC model is to fulfill three parameters; it should be Simple, Speedy, and Scalable. The sales department is to be able to give an estimation of the several financial solutions to the customer almost instantly, using it as a persuasion tool while informing the customer correctly.

1.4 Research questions

As derived from the previous paragraph the following main research question is defined as:

"How to formulate a universal Whole Life Cost model."

For a sound and structured answer, the main research question is divided into two sub-questions and multiple subsidiary questions. By answering these questions, the answer to the main research question is defined.

- Which models are currently used in the automotive industry, what parameters are important to the customer?
    - Which parameters are commonly used and relevant?
    - What is the influence of the RVG program and partners?

- How to make a Whole Life Cost calculator?
    - Of the relevant parameters identified which should be included in the WLC?
    - Which parameters should be able to be altered?
    - What are the key parameters, having the biggest influence on the WLC model?

Existing literature and both external as in-house research will provide the information needed to answer these questions. Literature provides the how-to of building a WLC model and external research indicates which parameters are commonly used and are relevant to the customer. In-house research will reveal the importance of the RVG program and partners, and also provides currently used calculators which can serve as a base for further establishment of the WLC model. Simulations performed with the created WLC model will identify the influence of the different parameters, and the key influencers of the WLC. Feedback after implementation on the model will show whether the model is too extensive or not.

1.5 Research scope/limitations

This paragraph focuses on the scope and limitations of this research, pointing them out and discussing them in detail. During the execution of the research project the scope of the research has been altered because of time constraints, this has been done in consultation and with approval of both the supervisors from the University of Twente and The company Motors, Inc.

The research looks at the WLC model as from the customer's perspective, so no insight is given into the costs involved in the production of a The company. However, the model does give a good insight in the distribution of costs in the WLC of a vehicle after purchase and thus can serve as a base for a pricing strategy in the future. It also shows potential financial opportunities and risks; chapter six elaborates on these implications.

In the research intangible values, such as emotional value for choosing an EV, are not taken into account. Some of the value is directly incorporated via Governmental actions by subsidies, showing indirectly the willingness of a market to adopt this kind of innovations. These values vary too much for each customer to be explicitly included in the calculation of the total cost of ownership. However, it can be used in the decision-making process as an argument in non-favorable situations for The company on a financial aspect. Also, in the WLC calculator/comparator to be used by customers, discount rates are not used. This is done in order to simplify the conversation between the customer and Sales personnel to justify the value of expenditures. Although the selection of a discount rate is a significant factor in life cost models, these are hard to validate because it includes assumptions about the consumer value of future money, which can differ substantially. The significance of this factor is assessed in the sensitivity analysis.

The approach to determine residual values is not altered in this research. Due to the time constraint this aspect will have to be touched upon in further research. Another limitation resulting from the timeframe is with regard to the scope of possible parameters used in the WLC calculator/comparator; these are depicted from case studies solely in the EU. The assumption is made that results coming forth out of this EU research can be applied to countries across the world.

1.6 Research structure

As already described in previous paragraphs the research resolves around the formulation of a global WLC model for The company. The first step determines all the parameters currently used in TCO and WLC models within The company. Important factors in this research are the RVG program and also the finance partners, they can be accountable for a big part of the WLC when the customers choose them. The next step is to take out the relevant factors and implementing them in such a way that an optimal WLC tool is created for customers and The company to be used globally. A sensitivity analysis reveals the fluctuations where the model is subject to, and the significance of these fluctuations to the WLC analysis. A clear overview of this research design can be found in Figure 2.

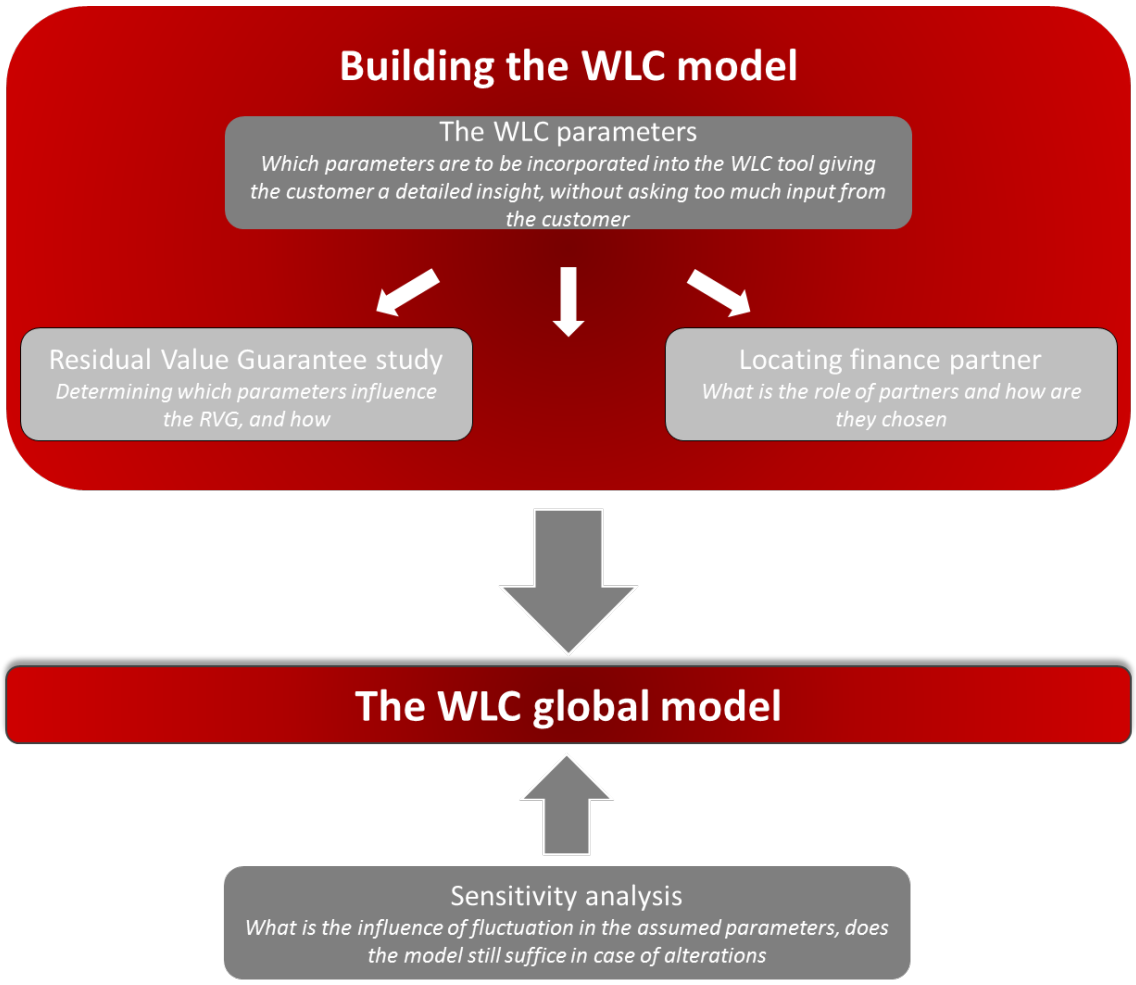


Figure 1 The Research design

Structure of the thesis

Having clearly defined the research, its goals and approach, the following chapters will elaborate on the stages within the research. The literature review in chapter 2 provides knowledge on the scientific topics used. Chapter 3 describes the collection of data on the RVG program, the currently used calculators, and automotive taxes applicable in Europe. This data is assessed in chapter 4 and

results in the formulation of the WLC model described in chapter 5. Chapter 6 consists of a sensitivity analysis of the presented model, showing key influencers on the WLC. The discussion in chapter 7 reflects on the implications of the model and opportunities arising from it. This thesis concludes with chapter 8, consisting of conclusions based on the research and recommendations coming forth from it.

2. Literature review

This chapter discusses literature related to the research, in corresponding order of the research design. It elaborates on TCO, WLC and Lifecycle Cost (LCC) analysis; describing definitions, relevant research, and frameworks incorporated in studies. The first section regards the meaning and importance of TCO and LCC models, the second section links these to the automotive branch. The third and final section elaborates on the WLC, and literature relating to the research.

2.1 TCO and LCC

The term Total Cost of Ownership was introduced and popularized by the Gartner Group in 1987, describing an industry-standard method for the financial analysis of IT and other enterprise costs. “It is the holistic view of costs across enterprise boundaries over time.” (Mieritz & Kirwin, 2005) The “holistic view across enterprise boundaries” reflects a view that also includes indirect costs not contained within a budget. “Over time” refers to the life cycle perspective of TCO, because the cost of factors changes over time. The normal evolution of a TCO is described into three phases: Discovery, Tactical, and Strategic level. Management assesses the current situation using the TCO, a benchmark is conducted to compare costs with competitors, and a strategy is developed accordingly. There are two general approaches that firms use in performing TCO analysis; a one-time analysis, or ongoing. It primarily supports in decision-making situations.(Lisa, 1995)

Life Cycle Cost (LCC), also called a Life Cycle Cost Analysis (LLCA), is a technique for evaluating the TCO between mutually exclusive alternatives.(Ellis, 2007) It provides a framework for specifying the estimated total incremental cost of developing, producing, using, and retiring a particular item.(Asiedu & Gu, 1998) This analysis is used within this research in order to formulate and assess the LCC of vehicles. The total cost of a product throughout its life cycle comprises not only of acquisition costs, but also other cost factors, including “ownership costs” such as operations costs and maintenance costs. Ownership costs might even be higher than the acquisition costs.

In order to assess a LCC of a capital investment project (Fuller & Petersen, 1996) provides 10 key steps. The LCC analysis has little value for the customer on itself since he or she has no real, if any, knowledge what a reasonable LCC is for a vehicle. It is most useful when it can be compared to the WLC of other design alternatives, in this case buying another vehicle. These alternatives are mutually exclusive because only one alternative can be selected for implementation. The ten steps for the analysis are stated as:

1. Define problem and state objective
2. Identify feasible alternatives
3. Establish common assumptions and parameters
4. Estimate costs and times of occurrence for each alternative
5. Discount future costs to present value
6. Compute and compare LCC for each alternative
7. Compute supplementary measures if required for project
8. Assess uncertainty of input data
9. Take into account effects for which costs or benefits cannot be estimated
10. Advise on the decision

2.2 TCO in the automotive sector

A quote from the “Electrification Roadmap” by the Electrification Coalition, in cooperation with Securing America’s Future Energy (SAFE) and PRTM Management Consultants, shows the importance of a representable TCO in the automotive sector.

"When asked, fleet managers rank total cost of vehicle ownership as the most significant factor driving acquisition decisions. Consumers, on the other hand, may purchase for a variety of reasons, including aesthetics and style, in addition to cost. If electric drive technologies can be proven to reduce total vehicle ownership costs while also allowing vehicle drivers to successfully accomplish their primary objectives, consumers may be willing to adopt electric drive vehicles sooner." (Coalition, 2010)

Several Life Cost Analyses (LCA) have been done regarding electric vehicles, the costs of a battery (Delucchi & Lipman, 2001), their material composition (Egede, Dettmer, Herrmann, & Kara, 2015), and even the resale values(Propfe, 2012). The main perspective has mostly been that of the manufacturer while this thesis considers that party to be secondary to the customer. Other research has focused on only parts of the WLC. The main focus is to make a selling tool for the customer. Customers are found to perceive electric vehicles are more expensive than conventional vehicles. The capital costs are being easier for the consumer to evaluate than the operating costs and other secondary costs.(Offer, Howey, Contestabile, Clague, & Brandon, 2010) However, looking at other relevant factors such as the fuel costs (Lipman & Delucchi, 2006) and residual values (Raustad & Fairey, 2014) is shows that electric vehicles are becoming more competitive. This thesis elaborates on the factors applicable to the customer primarily, showing a full spectrum WLC. Its secondary goal is to provide The company with insight regarding its position compared to competitor cars and implications resulting from fluctuations within the WLC.

Several TCO already have been formulated in previous studies, but no paper has treated all the factors with the same level of detail. Research assesses the TCO from the manufacturer point-of-view with a techno-economic model type, showing that electric vehicles perform better than conventional vehicles. (Wu, Inderbitzin, & Bening, 2015)Recent studies have evaluated the TCO for consumers as well. However, they do not capture the full spectrum of cost factors. (Contestabile, Offer, Slade, Jaeger, & Thoennes, 2011) for instance provides a techno-economic analysis for vehicles however does not treat all parameters related explicitly. However, looking from the customer perspective these are extremely. These parameters are shown in dashed boxes and include maintenance costs, taxes, and salvage value.

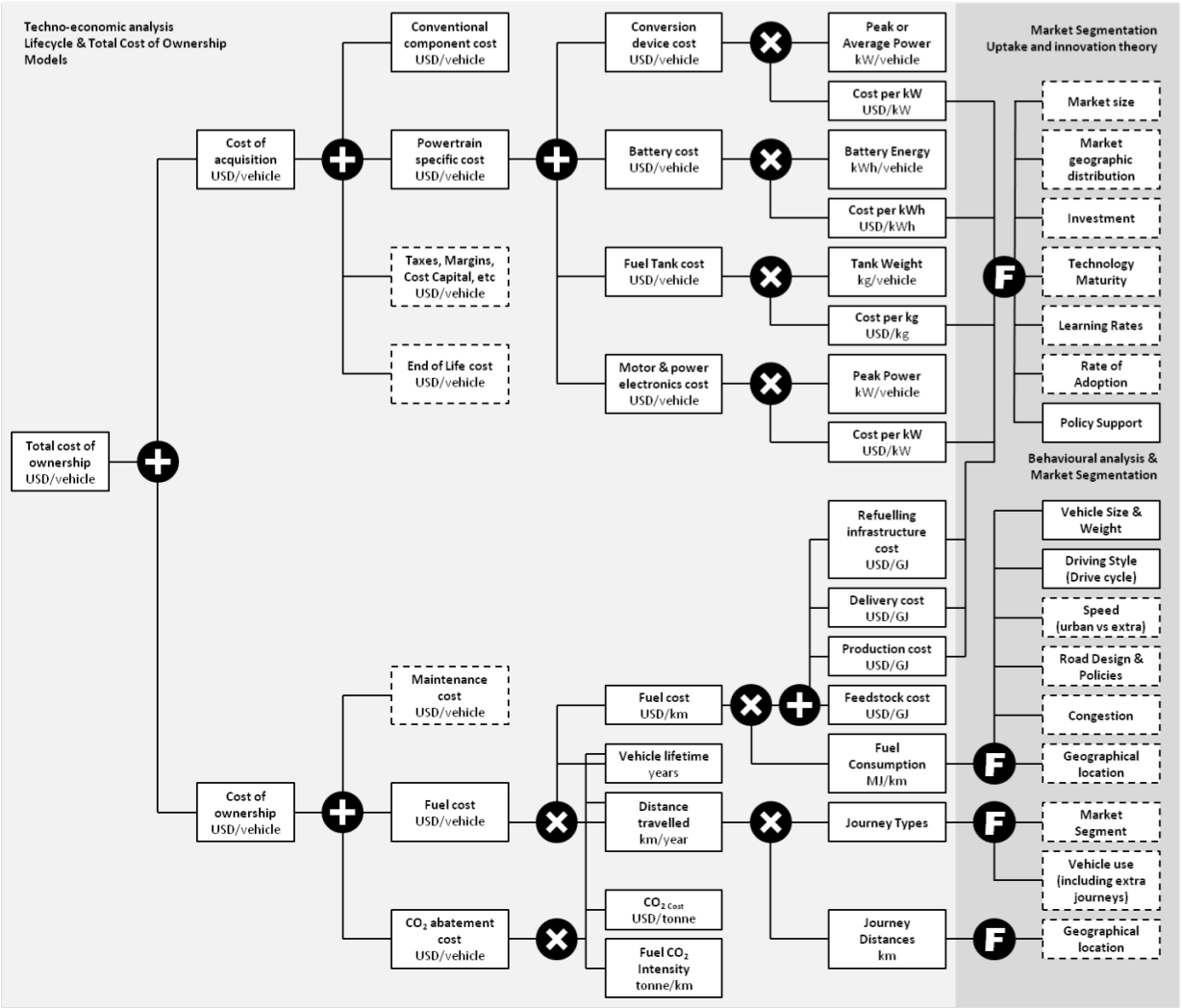


Figure 2 techno-economic analysis framework

The TCO makes a clear distinction between the cost of acquisition and the cost of ownership. The cost of acquisition includes retail price, taxes, and salvage value. Maintenance and fuel costs are part of the cost of ownership. Another study by (Al-Alawi & Bradley, 2013) describes a TCO model including the retail price, salvage value, fuel costs, maintenance costs, Sales Tax, License and Loan, Registration costs, and Insurance costs.

2.3 The WLC and value of time

As previous section has shown TCOs and LCC are already familiar within the automotive branch. Both are not fully correct and as such the model is described as a Whole Life Cost model. Total Cost of Ownership defines the product or service to be owned, however when a customer (lessor) is leasing he or she does not own the vehicle but pays the lessee a monthly fee to be able to use the asset, in this case the vehicle. When talking about Lifecycle Cost it could imply a cyclic process or product that could be used several cycles. For convenience and clear definition the term WLC is introduced, stating the whole life of the product is assessed and the ownership is not defined but subject to the situation, in this case the choice of the customer.

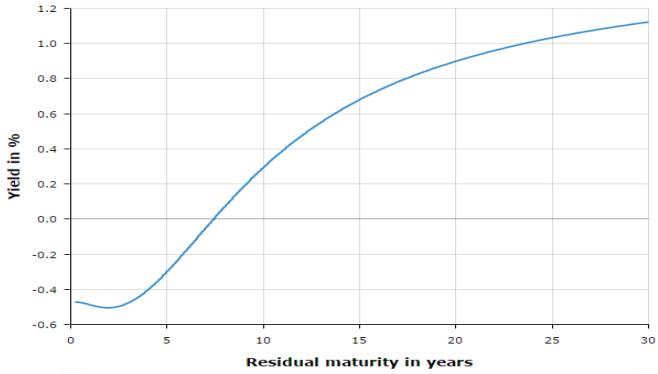


Figure 3 Euro area yield curve

An important aspect of the models is the discount rate, commonly described as the value of capital over time. (Al-Alawi & Bradley, 2013) gives a comparison of study scopes and assumptions, showing that discount rates used in studies (if used at all) range between the 5-10%. When looking at the current yield curve in the Euro area from the ECB it shows that these rates are not in compliance with the market. The yield is very low, even negative in the first years, making the discount factor almost negligible. For the sake of sensitivity the factor is incorporated into the analyses in chapter 6 but not in the creation of the operational WLC model.

Having gotten a clear description of the necessary analysis, combined with insights provided by previous studies, the next step is to establish common assumptions and parameters. Subsequently the costs and times of occurrence of each cost factor is to be determined, all in accordance to the 10 steps described by (Fuller & Petersen, 1996). The following chapters use this framework to provide a full WLC analysis of a The company in comparison to a competitor car. Chapter one has already defined step 1 and 2 in the process. Chapter three establishes the common assumptions and parameters, according to step 3, and also incorporates step 4 by identifying the times of occurrence for each parameter. Chapter four shows the WLC analysis and any supplementary measures, being step 6 and 7. This chapter concludes with the discounting of the future costs to present value. Finally chapter 5 assesses the uncertainty of the input data and takes into accounts possible effects that influence the outcome of the WLC analysis, step 8 and 9. Step 10, regarding the advice on the decision, is already defined as being able to persuade the customer for a The company being the better alternative against a competitor car.

3. Data collection

In previous chapter of this thesis relevant literature regarding TCO/WLC models is discussed. This chapter describes how the necessary data has been acquired on which the new WLC model will be based. The data is separated into two main components; the first being a more detailed description of the RVG/GG program. The second section evaluates the current TCO models, including models used within The company and used by competitors, and country-specific taxes. These define the relevant parameters to be incorporated in the WLC model. The methods used for data collection are described and deeper insight on the data is provided.

3.1 The RVG/BBG program

In 2013 the Residual Value Guarantee (RVG) was designed by the department Financial Services in order to give the customer both flexibility and a peace of mind. Up until then The company only offered a loan product to customers but for the financial/operational leasing customer there were no possibilities, and leasing companies would not offer a The company as an option since they could not get a good indication what the future value of a The company would be. The solution came with the RVG, ensuring a future residual value for a The company after three years. For example, if the customer took on a lease of five years he or she got the possibility to hand the vehicle back in after three years for the pre-determined value. The residual values are set in the range of the best performing vehicles when looking at their residual value and it gave both customers and leasing companies some necessary confidence, resulting in the situation that financial lease contracts were now an option. The RVG behaves like a put option, giving a customer the right to sell his vehicle for a specific amount in the 37th month. It also lets the customer lose constraints in a lease, and changes a loan into some sort of lease, by enabling the customer to pay it off prematurely.
The introduction of the RVG 2.0 is an evolution of the RVG 1.0, as described previously. In the RVG 2.0 the RVG 1.0 is transformed into a pricing mechanism, giving the customer even more flexibility, implementing the 3-year value in a matrix which sets off the period versus the mileage. Lease companies are capable of setting lower monthly payments having the RVG 2.0. The RVG 2.0 is only implemented in a select number of countries, where leasing companies do not want to take the risk of the future value of the vehicle. The final product, the Buyback Guarantee (BBG), is an equivalent of the RVG 2.0 but applies to customers who would like an operational lease.

3.2 TCO models

Several car companies are already incorporating TCO models on their websites. This paragraph describes models currently used both within The company as by competitor car companies. Two car companies are found to be using a TCO model, these are briefly described, and research is done within The company to acquire used TCO models. It shows that car companies are seeing the importance of informing customers about all the costs attributing to the purchase and operating of a vehicle.

BMW is promoting its i3 model using a very basic fuel savings model, stating only the possible fuel savings by being able to compare a customer's current fuel costs with that of an i3. Input parameters are the daily mileage and the average consumption of a compared vehicle. The output shows savings in both fuel costs and CO_2 emission as values, this can be stated per year or per month.

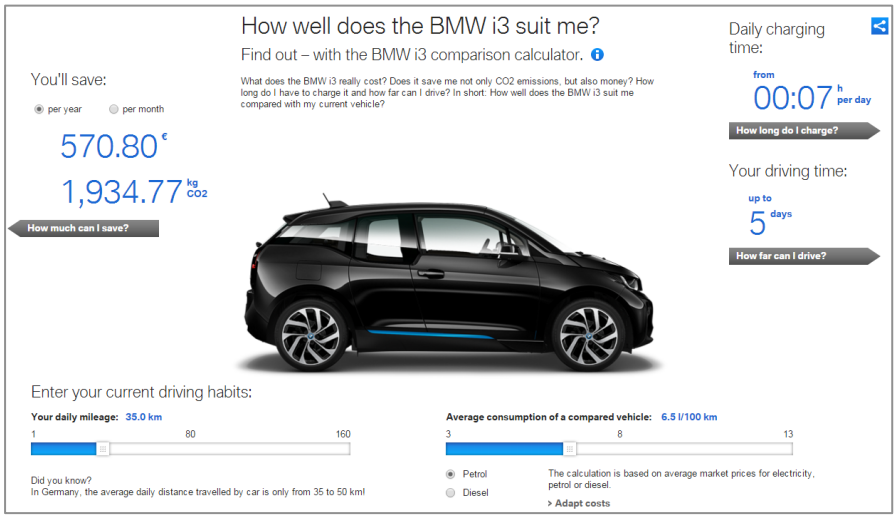


Figure 4 BMW i3 fuel savings calculator

Nissan uses a more extensive TCO calculator on its UK website, allowing the customer to choose a certain model and create a basket of comparable cars using data retrieved from an external database. The data for this calculator is provided by CAP Automotive Ltd. It focusses on the business driver since the TCO is only occurring on the webpage of fleet car. Input parameters are the following: vehicle ownership term, whether free fuel is provided for private use, the average annual mileage, fuel prices, the interest rate for financing, and how many days a month the customer enters the London Congestion charge zone. The screenshot underneath shows the Nissan TCO calculator, stating a Nissan Pulsar compared to a BMW 5 series. The company is not included into the basket since this is not a possibility of choice.

Manufacturer	**NISSAN**	**BMW**
Model	**PULSAR HATCHBACK**	**5 SERIES DIESEL SALOON**
Grade and version	1.2 DiG-T Visia 5dr Xtronic	525d M Sport 4dr
Costs (total period)		
Transaction price	£17,745.00	£40,060.00
Fuel cost	£3,224.93	£3,531.11
Servicing and maintenance	£830.35	£1,412.64
Government Vehicle Tax	£60.00	£260.00
Cost of finance	£2,129.40	£4,807.20
Class 1A National Insurance	£0.00	£0.00
Insurance	Excluded	Excluded
Residual Value	-£5,850.00	-£17,700.00
London Congestion Charge	£4,914.00	£4,914.00
Total Cost of Ownership	£23,053.68	£37,284.95

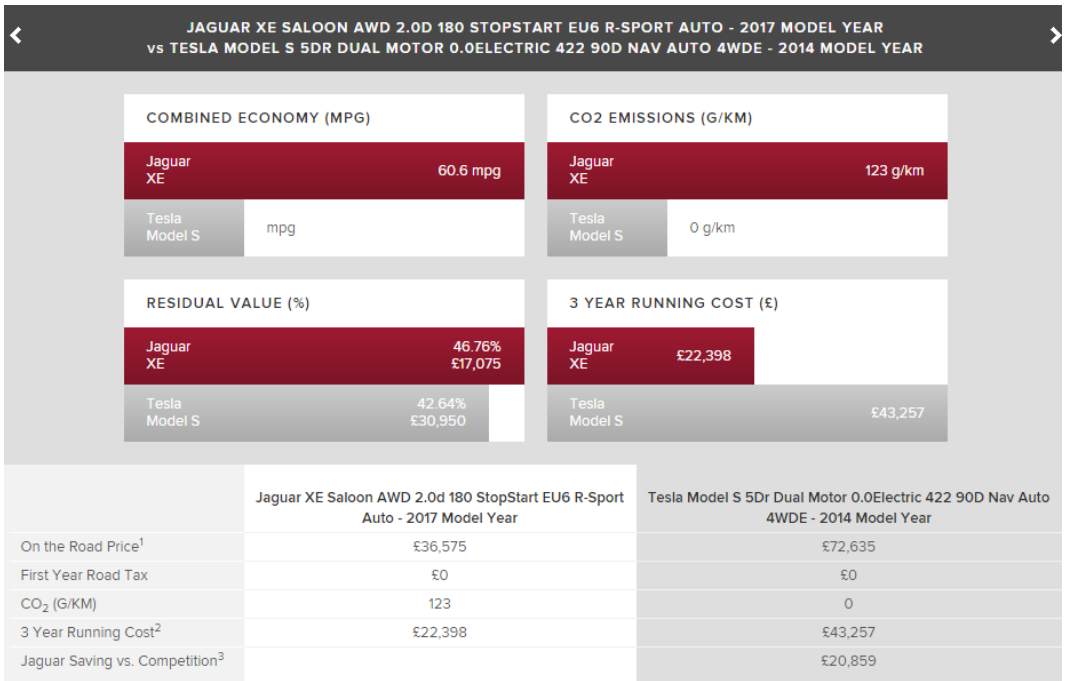
Figure 5 UK Nissan TCO Calculator (source: www.nissan.co.uk/fleet-cars/tools/tco/)

The calculator highlights in red which car is preferred for the specified parameter. Each parameter is listed and briefly described underneath, making clear which considerations are taking into account and what the parameters include.

- The transaction price consist of the total price that is paid for the vehicle including delivery costs, first year vehicle road tax, and first registration fee.
- The fuel cost is the total mileage driven by the vehicle divided by the official fuel economy figure, this result is being multiplied by the fuel price.
- Servicing and maintenance is a forecast value based on the term and mileage parameters set.
- The governmental tax includes the Vehicle Excise Duty (VED), also called Road Tax. This is based on the CO_2 emissions of the vehicle.
- The cost of finance is calculated by multiplying the transaction price of the vehicle by the flat interest rate set earlier, the result of which is multiplied by the term of ownership.
- The residual value is again a forecast value based on the term and mileage parameters set.
- The London Congestion Charge is depicted by multiplying the current charge of £10.50 for entry by the number of visits, which results from the parameter set in the previous page.

All these parameters are summed up to come to the Total Cost of Ownership according to Nissan. Insurance is excluded from the equation because the cost is heavily dependent upon the nature of the business and the profile of the driver. Any figure used is unlikely to represent the true cost. Also BIK is excluded from the TCO, no explanation is given why this is so. However, this is probably because of the lack of relevance for a fleet manager since the costs attribute to the driver. The BIK rate is given when the customer scrolls down, but no value is given. In conclusion, the Nissan TCO calculator shows many parameters attributing to the TCO of a vehicle but still excludes some essential parameters, naming the BIK in particular. Furthermore the model lacks a clear visual representation for the customer to compare vehicles.

The UK website of Jaguar also incorporates a comparing tool into its website, allowing the customer to compare a Jaguar model with a competitor car. The database used is KeeResourcers' KWIKcarcost and is updated on a monthly basis. The first step in the model is the type of customer; private customer, company car driver, or fleet manager. After selecting a Jaguar model and comparison vehicle the tool shows three cost factors, being "on the road price", "3 year running cost", and "Jaguar saving vs. competition". On the road price is the total price of the vehicle including delivery charge, VAT, road tax, and Government First Registration Fee. The running costs are the sum of Depreciation, Road tax over 3 years and Fuel Cost of 36,000 miles. The last cost factor identifies the money saved when choosing for a Jaguar. Following pages on the website gives the customer insight in the specificities of the vehicles.



	Jaguar XE Saloon AWD 2.0d 180 StopStart EU6 R-Sport Auto - 2017 Model Year	Tesla Model S 5Dr Dual Motor 0.0Electric 422 90D Nav Auto 4WDE - 2014 Model Year
On the Road Price[1]	£36,575	£72,635
First Year Road Tax	£0	£0
CO_2 (G/KM)	123	0
3 Year Running Cost[2]	£22,398	£43,257
Jaguar Saving vs. Competition[3]		£20,859

Figure 6 Jaguar comparison tool (source: http://comparison.jaguar.co.uk/)

This example shows the calculation for a private customer. When choosing for company car driver the costs are stated as monthly liabilities and include the BIK.

The TCO models show many similarities and incorporate at least the following parameters; the purchase price, fuel costs, maintenance/repair, and insurance costs. Country-specific tax incentives are also incorporated in some of the TCO models, these differ significantly from each other and thus there is no clear structure to present them. The models from the Netherlands, United Kingdom, and Switzerland show a periodical difference in expenditures while the other models show a true TCO by stating the total of costs over a determined period.

3.3 TCO Country-specific taxes

To get a clear insight in which taxes are applicable the previously mentioned subject where also asked to define the taxes applicable for their country. All respondents described several taxes and incentives, if applicable, and stated the variables determining them. Exact calculations were not attached in those mailings.

Most of the currently used models do not incorporate taxes because of the reason that employees have no knowledge of the calculations behind the determination of the tax expenses. Taxes, if applicable, are causing the TCO models to differ significantly and thus is an important factor affecting customers in their choice of purchasing a The company. The country-specific taxes are discussed in more detail in the next chapter

4. Model designs

Having discussed existing literature regarding WLC models and analyzed models already incorporated by the automotive industry, enough information has been gathered to create a WLC model for The company. This chapter describes the different sections of the collected models and additional information provided by the respondents touching upon every relevant aspect, in order to create a full Whole Life Cost model. There are four paragraphs describing the different sections of the Whole Life Cost model. For this research the WLC model is divided up into three sections namely holding costs, operating costs, and automotive taxes. Within these three sections relevant factors are described and their calculations stated. The last paragraph states the times of occurrences of all the parameters included.

Customer types

Not every customer is the same; there are two questions to be asked defining what type of customer is applicable. These two questions are; “How is the customer paying for the car?” and “How will the customer drive the car?” A visual representation is given underneath, stating the questions and possible answers.

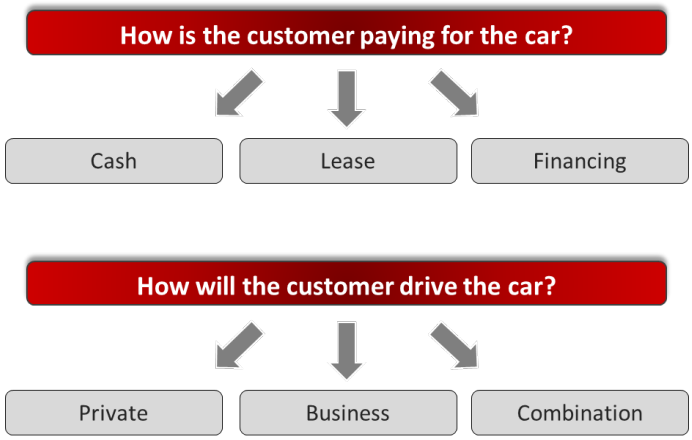


Figure 7 Different customer types

In total there are nine different types of customers that can be defined, resulting in different whole life cost calculations. The customer is capable of paying the vehicle full-cash or choose for a lease/financing option. The lease or financing option might still include a down payment this is subject to the parameters set in the contract of the customer. The customer can drive his for private purposes, business purposes, or a combination of both purposes. There are several factors depending on the type of customer for instance interest payments, fuel costs, and taxes applicable. The dependency of these factors on the WLC calculation is described within the following sections.

4.1 Financing costs

This section describes all the costs involved during the acquisition and selling of the vehicle. These are inevitable cash flows and are independent on the kilometers driven by the customer, if any. The purchase costs and the RV, including the RVG/BBG, are described and discussed respectively.

Purchase costs

The purchase costs as described in this paragraph is defined as being the amount that is stated on the final invoice. The final invoice shows the car model, the options taken by the customer, extra fees and the VAT. The total price of the car is calculated by taking a basic model of the car (75, 85, or 90) and adding the price of the possible options that the customer has chosen. Additional fees are added such as maintenance plans and/or charging stations, other fees are standard. Standard included are documentation, delivery, and/or coordination fees. This gives a subtotal of which the VAT is applied, giving the total costs of the vehicle. There are three factors which could alter the total costs of the vehicle for the customer. These are discounts, VAT reclaiming, or incentives.

When traditionally buying a car the customer always has the possibility of negotiating about the price. Free or discounted accessories or savings on the delivery fee are a genuine part of purchasing a car. The company Motors, Inc. has a clear no-discount policy; customers cannot negotiate about the purchase price given. There are only referral discounts and discounts resulting from the fact that the car has previously been used as a demo car, these are depicted by The company itself.

The other factor is with respect to the possibility of reclaiming the VAT on your purchase. When the customer buys the vehicle to drive for business purposes, he or she is able to reclaim the VAT. If the vehicle is also used for private occasions some of the VAT has to be paid.

RV & RVG scheme

The residual value is introduced in the financing costs because of its influence in both the cash purpose as in the monthly payments when the customer chooses for a financial solution. Literature showed the residual value to be subtracted from the financing costs when the customer is paying cash, and in the case of a financial solution it is incorporated in the monthly payment. A major variable in the calculation of monthly payments is the balloon payment; as described in chapter three a higher balloon payment directly leads to lower monthly payments. Thus by increasing the residual value of a vehicle The company is directly capable to influence the amount of monthly payment.

The company's approach to calculating the residual value of the model S is described extensively in paragraph 3.1, this section shows a brief summary with the numbers relevant for the WLC model. The residual value is determined as a percentage of the purchase price and depends on the age of the vehicle and the distance driven. The value for the model S is chosen to be equal to the RVG or BBG matrix, depending on the type of customer, for the comparable ICE car the residual value is found on the internet or estimated.

Interest is the fourth and final factor in the equation for the holding costs, this is depending on the customer whether he or she is paying the whole car with cash or chooses to finance/lease. In case the customer does not choose to pay with cash an interest has to be paid to the loaner or lessor. A down payment will lower the total of the lease/loan, as such lowering the monthly payment. The leasing/financing company pays the remaining costs and the customer pays a monthly payment, acting as an annuity. If the customer is choosing for such a solution, the monthly payment is calculated using the standard annuity formula:

$$Monthly\ payment = \frac{r * PV}{1-(1+r)^{-n}}$$

PV = *the amount financed*
r = *the monthly interest rate of the loan*
n = *the number of periods*

The interest rate is set by the leasing/financing partners and is commonly stated as a yearly rate. The company has negotiations in order to lower the rate from partners but cannot have a direct influence on it since this rate embodies the third party company profit and risk coverage. The rate is divided by 12 to get to the monthly interest rate.

Taking into account all the previous mentioned factors the overall financing costs can be depicted. The following equation stands for customers with regards to the acquisition of a vehicle:

$$\begin{aligned} Total\ Financing\ costs = {} & Purchase\ Price - Discount\ (not\ applicable\ for\ Tesla) \\ & -Residual\ value - VAT(if\ applicable) \\ & +Interest\ (if\ applicable) \end{aligned}$$

4.2 Operating costs

This section describes all the costs resulting from the customer using the vehicle; it elaborates on SMR, tires, fuel consumption, and insurance. The costs depend on the intensity by which the vehicle is used by the customer, not just on the mileage but also the quality of the ways it drives on or the manner in which it is driven.

Service, Maintenance, Repair (SMR), and Tires

The SMR is described as being the expenditures resulting from regular wear and tear of the vehicle. It considers the prices of services and that of the parts, and also the frequency in which the repairs are occurring. Both producers and databases, such as KeeResources in the UK, have done research in these expenditures and set up estimates. Research consists of looking at historical data of a vehicle. For a The company customer the SMR can be set by taking the 4-year maintenance package when buying the vehicle. The customer pays a yearly fee and covers all scheduled servicing including parts and labor, occurring in the next four year.
Tires are also a relevant cost when looking over multiple years, The company assumes the tires have to be replaced approximately every 40.000 kilometers. This expenditure is calculated by taking the price of the set of tires as stated on the producer's website.

An important occurrence with regards to tires is the changing of them during the seasons. In the Netherlands there is a clear distinction between winter and summer tires, and drivers are legally obliged to have winter tires under their vehicle in the winter. These yearly replacements are done for free at The company when the tires are bought from The company, in the other case there is a fee involved. The costs of such replacements have no clear guideline and therefore are not incorporated into the equation. Another reason is the customer to be able to have all-season tires, making replacements unnecessary unless there is wear and tear damage.

Insurance

As is required by law, vehicles have to be insured in case of any incidents. The company is currently also engaged in setting up partnerships with insurance companies and getting them to know all the technical aspects. This way insurers get a more representable picture of possible damage and

repair costs, thus possibly lowering the yearly rate. The insurers have to fulfill the same criteria as financing and leasing companies with regard to the customer experience and competitive pricing.

Fuel

Fuel consumption is parameter where The company can differentiate itself from the ICE vehicles. Instead of running on petrol or diesel, a The company is powered by a battery and thus uses solely electrical power. So while normal fuel consumption as liters per hundred kilometers, or miles per gallon, the calculation is slightly different for a The company. The fuel consumption calculation for a standard car is as follows;

$$Fuel\ Consumption = \frac{kilometers\ (miles) driven}{Fuel\ efficiency} * Fuel\ price$$

In the calculators only petrol or diesel vehicles are considered, gas-driven vehicles are not considered to give a relative comparison looking at the quality/price of a The company. The units in which the fuel efficiency is given depends on the country, but a simple recalculation gives the fuel efficiency in the right units. The price of the fuel is established by taking the average over the last quarter and this is updated twice a year. In case of any excessive fluctuation additional adjustments are made in the price. The same approach is used for establishing the price of electricity. Electricity costs are given in a price per kWh, and a The company consumes an estimated 0.2 kWh per kilometer. This estimate is based on the assumption that a customer is capable of driving 560 kilometers on a 90 kWh battery as is in accordance to the specifications on the website. This gives a consumption of 0.16 kWh per kilometer and this rounded up to 0.2 as a conservative measure.
There is another factor to be taken into account when calculating the fuel costs for a The company, which is the use of Superchargers. The company customers can charge their The company at a Supercharger station without additional costs. In the models provided it is assumed that a normal customers charge their The company at a Supercharger 10% of the time, meaning the customer only pays for 90% of the electricity costs coming forth out of charging.

Taking into account the previous mentioned factors the overall operating costs are summarized in the following equation for the determination of the operating costs;

$$Total\ Operating\ costs = SMR\ costs + Tires + Fuel\ costs + Insurance\ costs$$

4.3 Automotive taxes

Having described all the holding and operating costs in the previous two sections, this section will elaborate on all the different kinds of automotive taxes. It has been separated into three parts namely acquisition tax, operating tax, and business tax. Before discussing the different taxes an overview of all the variables being used in the tax calculations is given, defined per country.

European country	Purchase Price	Fuel type	CO2 – emission	Weight	Fuel consumption	Cylinder capacity	Kilowatt
Austria	✓	✓	✓				✓
Belgium	✓	✓	✓	✓			
Germany	✓	✓	✓	✓	✓	✓	✓
Finland	✓	✓	✓	✓			
France	✓	✓	✓		✓		
Italy	✓	✓	✓				✓
Netherlands	✓	✓	✓	✓			
Sweden	✓	✓	✓	✓			
Switzerland	✓	✓	✓	✓	✓		
United Kingdom	✓	✓	✓	✓	✓		

Table 1 Variables relevant to automotive taxes in Europe, per country

This table is the result of the emails from the respondents and serves as the base for further establishment of the WLC model. As can be seen there are three variables obligatory for each country; the purchase price, the fuel type, and CO_2-emission. The weight of the car and the fuel consumptions are also taken into account in the majority of the countries.

The next step is to define and categorize every tax applicable. As described previously these are categorized into three categories; acquisition tax, operating tax, and business tax. Each category will briefly be elaborated on and several examples are mentioned.

Acquisition tax

Acquisition taxes are directly applied at the moment of the purchase of a vehicle. It can take the form of a cash incentive such as is applicable in the UK, or secondly on a tax on top of the normal VAT. A third factor is the registration tax which can differ from being a single value or dependent on variables such as the CO_2-emission.

Operating tax

The most prominent tax in this section is the road tax, which is a tax levied on the driver for the use of a vehicle on roads within a country. Another kind of taxes depends on the location where the car is driven. Examples are the London Congestion Charge in the UK, which is a fee charged on vehicles operating in Central London, or the toll pricing in Austria that implies that all vehicles with a gross weight up to 3.5 tons have to carry a toll label for circulation on all Austrian highways and expressways.

Business tax

For this kind of taxes the type of customer is a very important aspect regarding the valuation. As a business customer there might be several depreciation incentives in place, and in many countries there is a Benefit In Kind (BIK) in place. BIK is a tax applicable to customers driving their vehicle both for business and private purposes. It applies to benefits other than money received by an employee on top of his or her salary. These benefits, in this case the vehicle, are subject to tax.

The second type of tax relates to several accounting incentives in place, such as the 120% deductibility of company car expenses in Belgium or the 100% writing down allowances (FYA) in the United Kingdom. These brings down the taxable income/profit over which tax has to be paid, resulting in an indirect benefit.

Country	Applicable taxes
AT	Government grant (only business)
	Toll
	Fringe benefit
	Motorbezogene Versicherungssteuer
	KPC Unternehmerförderung
BE	BIK
	Road tax
	Registration tax
	120% Deduction
DE	Road tax (Kfz-Steuer)
	BIK
FI	Registration / automobile tax
	Vehicle tax/ Power tax
	BIK
FR	Bonus Ecologique Grant
	Malus ecologique
	VAT reclaim for business
	Taxe sur les véhicules des sociétés (TVS)
	Battery Amortization
NL	BIK
	Road tax (MRB)
	Registration tax (BPM)
SE	Road tax
	BIK
CH	Registration tax (canton specific)
	Road tax (canton specific)
UK	Government grant
	BIK
	Road tax
	Registration tax
	London Congestion Charge exemption
	100% First year write-down (FYA)

Table 2 Taxes applicable per country

4.4 Times of occurrences of parameters

This paragraph looks at the times at which certain expenditures occur. This is relevant for calculating the present values from the corresponding future cash flows. Paragraphs 2 to 4 have described the different parameters contributing to the WLC calculations and the next table shows their times of occurrences.

Parameters	Times of occurrences
Financing costs	
Purchase costs[1]	Start of the time-period
Cash grant	Start of the time-period

Residual value	End of the time-period
Operating costs	
SMR[2]	Yearly
Insurance	Monthly
Fuel[3]	Weekly
Automotive taxes[4]	
Acquisition	Start of the time-period
Operating	Monthly & daily
Business	Monthly

Table 3 Times of occurrences of parameters

(1) Purchase costs may differ depending on the customer type. If the customer chooses for a leasing or financing solution interest has to be included into the calculation, and the costs will be paid monthly throughout the time-period instead of all at once.

(2) SMR are to be including tires and is taken to occur on a yearly basis. The yearly occurrence is assumed because of the yearly inspection which is done by The company, and often by other car companies, when choosing for a service maintenance package. This package can be bought when purchasing the car, making the cost occur at the start of the time-period. However, even when this package is included the repair and tires expenditures are non-determinable. These are to be occurring at the same time of the services, thus every year.

(3) Fuel costs are assumed to be occurring on a weekly base meaning that the car is re-fueled every week or more, depending on the mileage set per year. The costs are the result of dividing the yearly fuel costs divided by 52.

(4) Automotive taxes are country-specific and follow their own regulation, the times of occurrences stated here resembles the situation as it is in the United Kingdom. The Road Tax for example is paid monthly while the London Congestion can be chosen to be paid up front, up to a maximum of 90 days.

5. Result

Having described all the parameters, factors and variables applicable to a WLC model, this chapter shows the result from the conducted research. A global format is presented and all aspects are described, including their calculation. The first section shows a visual representation of the WLC model format, the second section elaborates on the factors, their calculations, and the choice of setting values. The last section consists of an analysis of the WLC model. The United Kingdom is taken to serve as a case study throughout the WLC model, a clear distinction is made between the globally applicable calculations and the country-specific variables.

5.1 Visual representation of the WLC model

This section describes the parts of the WLC model as designed according to the information provided in the previous chapters. The model consists of three parts, the input tables, the output table, and the graph depicted from the output table. This is the format to be used globally, it can still be subject to design alterations, and a picture is stated underneath. Discounting is not included in this model because of simplicity purposes for both the customer and Sales personnel, section 5.3 does elaborate on the discounted cash flows and chapter six elaborates on its significance.
Part one presents all the different variables incorporated within the WLC model. Customers and/or

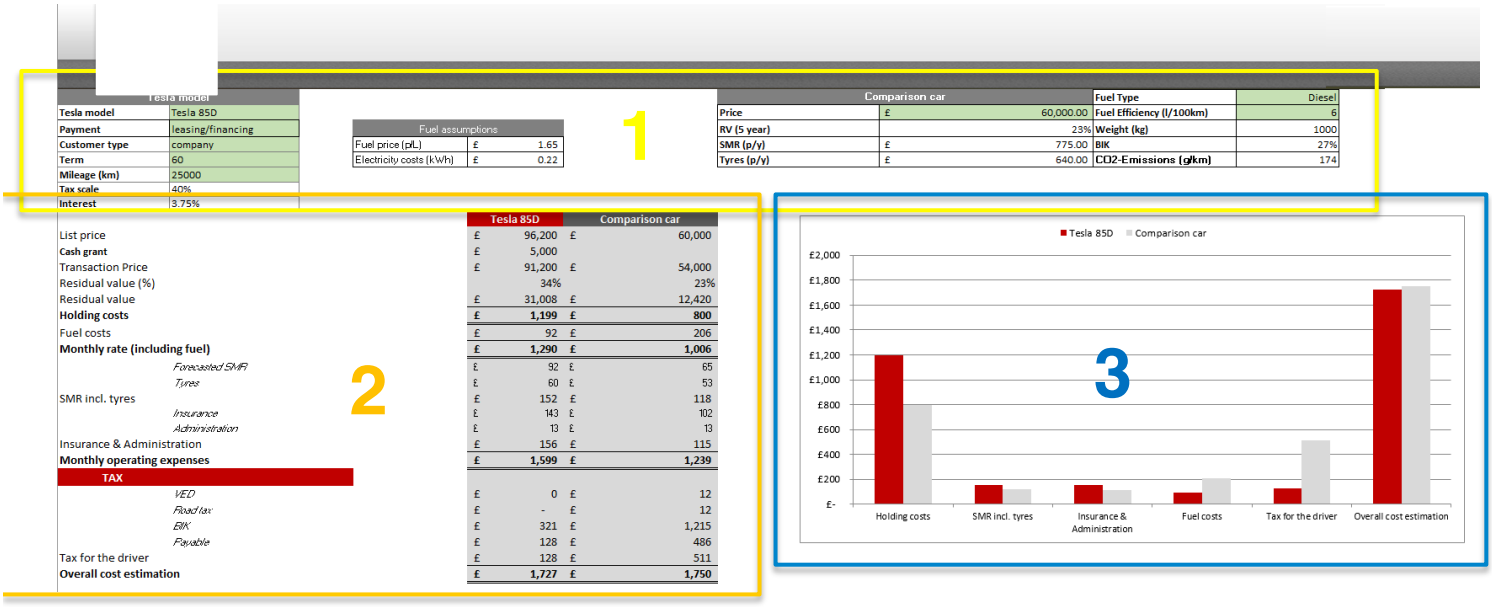


Figure 8 global WLC model, UK case study

employees are able to alter them to specify the specific needs. The technical specifications are known so the customer just has to choose between the several models and the necessary data is used. For the comparison car the customer can customize the vehicle using the right table. This table states the relevant variables for the WLC calculation, the format comes forth out of the results from paragraph four in chapter four. Default values are given according to a competitive car in the market, for most cases this comes down to the values of a BMW 535d

As soon as all the variables are specified to the user's needs an automatic dropdown (part two) gives all the relevant costs of the vehicle, the left column shows the The company model and the right column that of the comparison car. The costs are divided into three components, the first component being the depiction of the holding cost. The second component involves all costs regarding operations such as SMR, tires, and insurance. The third and final component describes all the taxes relevant to the vehicle. The bottom line summarizes these three components, resulting in a total cost estimation for the user.

Part three summarizes the costs from the dropdown menu in part two and gives a visual display how the two vehicles compare to each other in the whole life cost estimation. Cost components are stated separately to show the difference between a The company and the comparison car, giving the customer clear insight, and the most right column shows a summation of all the costs.

5.2 Calculations and underlying assumptions

This section elaborates on the choices made in the calculation of the WLC regarding the alteration of variables, and the calculations incorporated. Part one and two from the WLC model include all the calculations, the depiction from part three of part two is presumed to be known.

The following figure shows enlargements of the three tables within part one of the WLC model, all the variables within the three tables are briefly explained and validated. Assumptions are made clear and usage of external data is also elaborated on.

Tesla model	
Tesla model	Tesla 85D
Payment	leasing/financing
Customer type	company
Term	60
Mileage (km)	25000
Tax scale	40%
Interest	3.75%

Fuel assumptions		
Fuel price (p/L)	£	1.65
Electricity costs (kWh)	£	0.22

Comparison car			Fuel Type	Diesel
Price	£	60,000.00	Fuel Efficiency (l/100km)	6
RV (5 year)		23%	Weight (kg)	1000
SMR (p/y)	£	775.00	BIK	27%
Tyres (p/y)	£	640.00	CO2-Emissions (g/km)	174

Figure 9 part one of the WLC model

The starting point of the model is for the customer to choose a The company model, without options. This cell serves as a reference point for the costs associated with that specific model; the most recent book prices are used. The cells “payment” and “customer type” determine the way the customer is going to finance the vehicle and how it will be driven. The cells “term” and “mileage” determine over which time period the calculations are to be done and serve as reference cells for the determination of the residual value and fuel costs. The cell “tax scale” is only relevant for the business driver since, for instance, the BIK only applies for that sort of customers. Because a The company is counted as a premium car it is assumed that a customer is subject to the largest tax scale, in the UK this is 40%. The last cell, “interest”, relates to the interest taken on the loan or lease. The interest on a lease or loan is assumed to be the same for a The company as for the comparison car.

The table on the right states the assumed prices of the fuel types. As stated earlier in chapter three the price of the fuel is established by taking the average over the last quarter and this is updated twice a year. In case of big fluctuation in prices does is corrected more often. The values serve as default values, the customer is still given the liberty to alter these. Past fuel prices are obtained using validated resources, namely governmental corporations. The prices for European countries are depicted from reports by the European Commission. Statistics Norway and Swiss statistics are used for the prices of Norway and Switzerland respectively. No differentiation is made between house-hold electricity prices and commercial prices. The last table shows the possible configurations of the comparison car. The default values are set to that of the most competing vehicle (BMW 535d), depending on the country, and the values are all adjustable for the user. The variables are depicted from the results in section 4.4 and the obtained old TCO models.

Part two of the WLC models shows a dropdown of all the different costs, an example is given underneath. The costs are stated as a monthly expenditure or as a total over the entire time period, depending on the customer type applicable.

	Tesla 70RWD	BMW 330i
Prijs (ex BTW)	€ 50,323	€ 36,000
Transactieprijs	€ 50,323	€ 36,000
Restwaarde (%)	34%	23%
Restwaarde	€ 17,110	€ 8,280
Financieringskosten (ex BTW)	**€ 661**	**€ 533**
Brandstofkosten	€ 92	€ 210
Maandelijkse betaling (inc. brandstof)	**€ 753**	**€ 743**
Voorspelde SMR	€ 92	€ 64
Banden	€ 59	€ 53
SMR incl. banden	€ 151	€ 117
Verzekering	€ 125	€ 116
~~Administratie~~	€ 13	€ 13
Verzekering & Administratie	€ 138	€ 129
Maandelijkse gebruikskosten	**€ 1,042**	**€ 990**
BELASTING		
BPM	€ -	€ 115
Motorrijtuigenbelasting	€ -	€ 63
Belasting voor het bedrijf	€ -	€ 179
Algehele kostenschatting	**€ 1,042**	**€ 1,168**
Bijtelling	€ 223	€ 660
Belasting voor de rijder	€ 89	€ 264

Figure 10 part two of the WLC model

The dropdown starts with stating the Purchase price, the cash grant, and the residual value. The residual values are depicting from the BBG matrices using the set parameters of time-period and mileage. Both the cash grant and residual value are subtracted from the purchase price, leading to the financing costs. In case the customer has chosen to lease or finance the car interest is included in the financing costs according to the calculation described in chapter four, with the interest rate set in part one of the WLC model. Subsequently the dropdown adds fuel costs, SMR & tires, insurance, and administration costs to the monthly payments. Finally the country-specific taxes are added, distinguishing which costs apply to the company and which to the driver. The tax amounts are depicted by the parameters set by the customer; the costs for the driver is the BIK times the tax scale in which the customer is presumed to be.

All the several costs are visually represented in the graph in part three of the WLC model. In this example the customer has chosen for a leasing solution and is driving the vehicle both for business as private purposes.

5.3 Cash Flow Diagrams

This paragraph analyses all the different cash flows resulting from the factors within the WLC model. Previous chapter already defined the times of occurrences of the costs and as such the cash flow diagrams can be depicted accordingly. One uniform discount factor is used throughout the calculations, the specific times of occurrences and the corresponding cash flows are stated separately. The paragraph concludes with an all-including formula for calculating the present value of the WLC for a vehicle.

The re-occurring cost factors are accounted as a cash flow stream; series of equal payments at regular intervals. As such the following formula is used in order to discount the future payments.

$$PV = \sum_{k=0}^{n} \frac{x_k}{(1+\frac{r}{m})^k}$$

PV =*present value of the cost(s)*
n =*number of periods*
x =*the amount paid in that period*
r =*the yearly discount rate*
m =*dependents on time of occurrence*

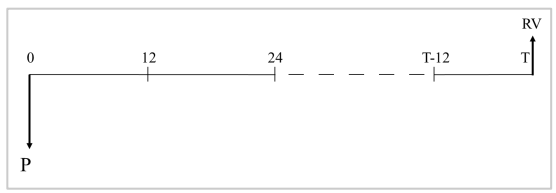
The following cash flows and their relating formulas to calculate the present value are depicted according to the times of occurrences in previous chapter. The horizontal interval is given in months.

Cost **Cash Flow Diagram**

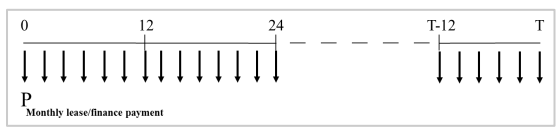
Financing costs

Two scenarios are stated; scenario 1 where the customers choses to pay cash and scenario 2 where the customer choses for a financing or leasing solution in order to pay for the vehicle. In case the customer pays cash there is no case of a periodical cash flow stream. The present value in that case is the price paid for the vehicle minus the discounted residual value of the vehicle after the term-period. The residual value being the purchase price multiplied by the residual value percentage.

Cash:

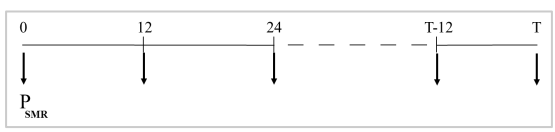


Leasing/Financing: $m = 12$

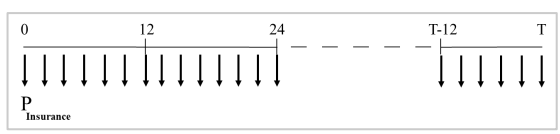


Operating costs

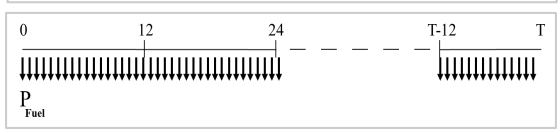
SMR $m = 1$



Insurance $m = 12$

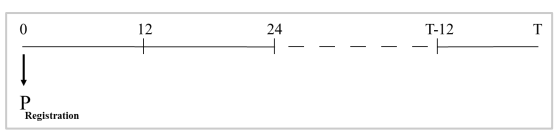


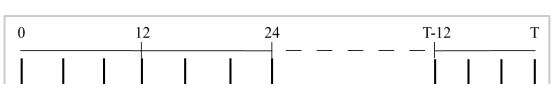
Fuel $m = 52$



Automotive taxes

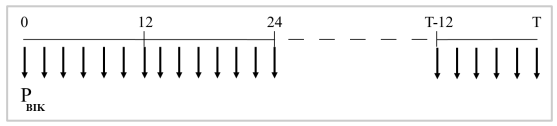
Registration *No discounting*





Road tax $m = 4$

BIK $m = 12$



Having established the formulas for each cost factor the WLC can be determined by the summation of all of them. Underneath shows the simplified calculations for the WLC; scenario 1 describes a cash customer driving the car for strictly private purposes, while scenario 2 describes a customer with a leasing/financing solution and driving the car both for private and business purposes. A term-period of three years is assumed.

$$x_{yearly} = SMR$$
$$x_{monthly} = insurance + (BIK\ and\ leasing\ if\ applicable)$$
$$x_{quaterly} = Road\ tax$$
$$x_{weekly} = fuel$$

Scenario 1:

$$(1) PV = \sum_{k=0}^{t/12} \frac{x_{yearly}}{(1+r)^k} + \sum_{l=0}^{t} \frac{x_{monthly}}{(1+\frac{r}{12})^l} + \sum_{m=0}^{4t} \frac{x_{quaterly}}{(1+\frac{r}{4})^m} + \sum_{n=0}^{52t} \frac{x_{weekly}}{(1+\frac{r}{52})^n}$$

Scenario 2:

$$(2) PV = P_{purchase} - \frac{RV_{vehicle}}{(1+r)^{t/12}} + P_{registration} + \sum_{k=0}^{t/12} \frac{x_{yearly}}{(1+r)^k} + \sum_{l=0}^{t} \frac{x_{monthly}}{(1+\frac{r}{12})^l} + \sum_{m=0}^{4t} \frac{x_{quaterly}}{(1+\frac{r}{4})^m} + \sum_{n=0}^{52t} \frac{x_{weekly}}{(1+\frac{r}{52})^n}$$

6. Sensitivity analysis

This chapter evaluates the variance of all the parameters and their influence on the WLC model. Two sections can be distinguished within the chapter. The first section describes the overall contribution of the different parameters in the WLC model and a benchmark analysis is performed, showing the influence of the general parameters and results in the defining of The company's key performance indicators. The second section elaborates on the individual parameters and their influence onto the total WLC of the vehicle.

All the simulations are based upon the Dutch variant of the WLC model previously depicted; it also incorporates discount factors which are disregarded in the standard WLC model. These have been determined in the previous chapter and are incorporated as such. Values for the parameters of the benchmark vehicles are depicted from the website www.autoweek.nl. Two benchmark models are used within the simulations, the BMW 535i and the Audi A6 3.0. The values for The company are generally from internal data, except for the SMR which is also depicted from the used website. The green cells can be altered and the WLC dropdown is automatically created, only including relevant cost factors. Two situations are stated, differentiating two different customer types and their relevant cost factors. The upper WLC resembles a customer paying cash and the WLC below resembles a leasing customer who drives the vehicle both for private as for business purposes. Leasing regards financial leasing; operational lease is touched upon separately.

Discount rate	
Yearly	5.00%
Monthly	0.42%
Weekly	0.10%

General input	
Payment	Cash
Driving type	Privat
Term	36
Mileage (km)	25000
Tax scale	52%
Interest	3.75%

Options	
Maintenance package	No

Model input	Tesla 90D	BMW 535i	AudiA6 3.0
Price	€ 99,600	€ 67,452	€ 71,370
Delivery costs	€ 440	€ 1,215	€ 1,190
Residual value (%)	41%	41%	41%
Residual value	€ 40,836	€ 27,655	€ 29,262
Down payment	10%	10%	10%
Fuel price kWh or Gallon	€ 0.20	€ 1.50	€ 1.50
Fuel consumption (kWh/km) or (l/100 km)	0.3	7.2	7.4
SMR (p/y)	€ 912	€ 768	€ 876
Tyres (set)	€ 438	€ 640	€ 640
Insurance (p/y)	€ 2,000	€ 2,000	€ 2,000
Taxes applicable			
MRB	€ -	€ 81	€ 81
Bijtelling	4%	25%	25%

Figure 11 Input parameters discounted WLC model

	Cost factor	Occurrence	CF Tesla 90D	Present value	CF BMW 535i	Present value	CF Audi A6	Present value
	Acquisition	Once	€ 100,040	€ (99,600)	€ 68,667	€ (67,452)	€ 72,560	€ (71,370)
	Down payment		€ -	€ -	€ -	€ -	€ -	€ -
	Residual value		€ 40,836	€ 35,276	€ 27,655	€ 23,890	€ 29,262	€ 25,277
Financing				€ (64,324)		€ (43,562)		€ (46,093)
	Fuel	Weekly	€ 78	€ (11,278)	€ 156	€ (22,555)	€ 160	€ (23,182)
	SMR	Yearly	€ 912	€ (2,484)	€ 768	€ (2,091)	€ 876	€ (2,386)
	Tyres	Yearly	€ 730	€ (1,988)	€ 1,067	€ (2,905)	€ 1,066.67	€ (2,905)
	Insurance	Monthly	€ 166.67	€ (2,758)	€ 166.67	€ (2,758)	€ 166.67	€ (2,758)
Operating				€ (18,507)		€ (30,309)		€ (31,230)
Taxes								
	MRB	Monthly	€ -	€ -	€ 81	€ (2,703)	€ 81	€ (2,703)
	Bijtelling	Monthly	€ -	€ -	€ -	€ -	€ -	€ -
Taxes				€ -		€ (2,703)		€ (2,703)
WLC				€ (82,831)		€ (76,574)		€ (80,025)

Figure 12 WLC dropdown Cash customer, discounted WLC model

	Cost factor	Occurrence	CF Tesla 90D	Present value	CF BMW 535i	Present value	CF Audi A6	Present value
	Acquisition	Monthly	€ 1,573	€ (52,468)	€ 1,092	€ (36,432)	€ 1,153	€ (38,454)
	Down payment		€ 9,960	€ (9,960)	€ 6,745	€ (6,745)	€ 7,137	€ (7,137)
	Residual value		€ -	€ -	€ -	€ -	€ -	€ -
Financing				€ (62,428)		€ (43,177)		€ (45,591)
	Fuel	Weekly	€ 78	€ (11,278)	€ 156	€ (22,555)	€ 160	€ (23,182)
	SMR	Yearly	€ 912	€ (2,484)	€ 768	€ (2,091)	€ 876	€ (2,386)
	Tyres	Yearly	€ 730	€ (1,988)	€ 1,067	€ (2,905)	€ 1,066.67	€ (2,905)
	Insurance	Monthly	€ 166.67	€ (2,758)	€ 166.67	€ (2,758)	€ 166.67	€ (2,758)
Operating				€ (18,507)		€ (30,309)		€ (31,230)
Taxes								
	MRB	Monthly	€ -	€ -	€ 81	€ (2,703)	€ 81	€ (2,703)
	Bijtelling	Monthly	€ 173	€ (5,760)	€ 731	€ (24,381)	€ 773	€ (25,798)
Taxes				€ (5,760)		€ (27,084)		€ (28,500)
WLC				€ (86,695)		€ (100,570)		€ (105,321)

Figure 13 WLC dropdown Leasing customer driving business/private, discounted WLC model

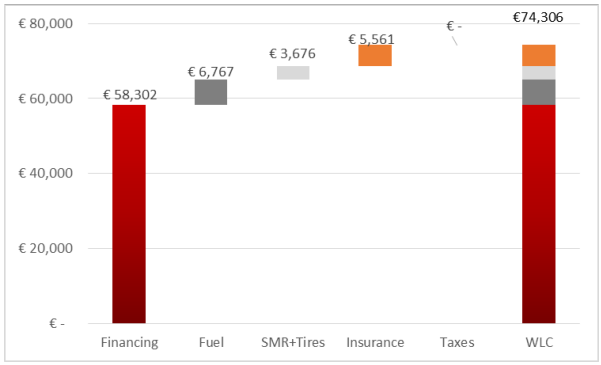
The percentage of the residual value for the cash customer is based on the matrix from appendix B, the BBG matrix. This value is not shown in the WLC for the leasing/financing customer since it is incorporated into the monthly payments to the leasing or financing company. For the following assessment a default parameter setup is established, this is presumed to be in effect if not stated otherwise. The discount rate is set at 5%, the interest rate at 3.75%. Furthermore the period is set at 36 months, with a mileage of 15.000 kilometers per year. Finally the type of customer is assumed to be a cash paying customer, driving the car just for private purposes.

6.1 Overall discounted WLC model assessment

This first section consists of an evaluation of the contributions of the individual parameters to the total WLC value, an assessment of influence of the mileage and term parameters, and the influence of the different customer types. These analyses are benchmarked against the previously described two vehicles, being the BMW and the Audi. The result shows the key selling points (KSPs) for a The company and addresses the parameters most influential to the WLC, which is further evaluated in the other sections.

Following table shows the WLC dropdown for both a cash paying customer, driving for solely private purposes, and a leasing customer driving the car both for private as for business purposes. The graph on the right of the dropdown shows the contribution of all the cost factors to the WLC.

	Cost factor	Occurrence		CF Tesla 90D		Present value
	Acquisition	Once	€	100,040	€	(99,600)
	Down payment		€	-	€	-
	Residual value		€	47,808	€	41,298
Financing					€	(58,302)
	Fuel	Weekly	€	47	€	(6,767)
	SMR	Yearly	€	912	€	(2,484)
	Tyres	Yearly	€	438	€	(1,193)
	Insurance	Monthly	€	166.67	€	(5,561)
Operating					€	(16,004)
Taxes						
	MRB	Monthly	€	-	€	-
	Bijtelling	Monthly	€	-	€	-
Taxes					€	-
WLC					€	(74,306)



	Cost factor	Occurrence		CF Tesla 90D		Present value
	Acquisition	Monthly	€	1,389	€	(46,347)
	Down payment		€	9,960	€	(9,960)
	Residual value		€	-	€	-
Financing					€	(56,307)
	Fuel	Weekly	€	47	€	(6,767)
	SMR	Yearly	€	912	€	(2,484)
	Tyres	Yearly	€	438	€	(1,193)
	Insurance	Monthly	€	166.67	€	(5,561)
Operating					€	(16,004)
Taxes						
	MRB	Monthly	€	-	€	-
	Bijtelling	Monthly	€	173	€	(5,760)
Taxes					€	(5,760)
WLC					€	(78,071)

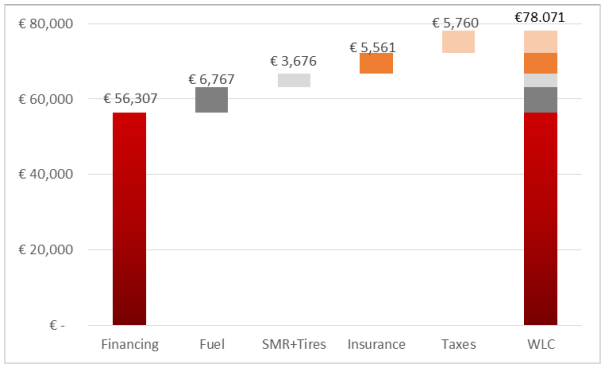
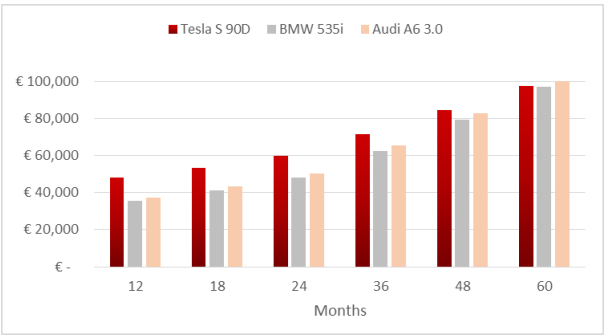


Figure 14 WLC models; cash customer driving for private purpose and leasing customer driving for both private and business purposes

The financing costs are the biggest cost factor within the WLC, attributing 82% to the WLC of the cash customer and 75% to that of the leasing customer. The other big cost factors are the fuel costs, insurance and taxes. Fuel costs are contributing 9% to the WLC, and the BIK 8% for the leasing/financing customer that drives the vehicle both for private and business purposes. The SMR & Tires and Insurance attribute 5% and 7% respectively to the total WLC of the vehicle. These percentages are based upon the default parameters and subject to alterations, which can have significant implications. Following paragraphs discuss alterations in the parameters and their impact on the WLC.

Following two assessments incorporate the two benchmark vehicles to clearly identify The company's key performance indicators. It also reflects on the importance of the customer type in terms of The company's competitive position. Increasing the term and mileage increases the WLC significantly as the following graphs show, improving the position of The company compared to its competitors.



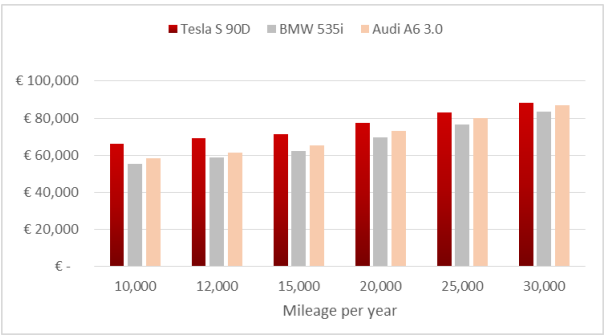


Figure 15 WLC benchmarking with changing terms and mileage

Looking at the left graph, showing the influence of the term-period to the WLC, it can be seen that while a The company is approximately 35% more expensive compared to the benchmark vehicles after 12 months, extending the term sharply decreases this difference between the 0% and 3% after

60 months. The right graph show that the increase in mileage also benefits the WLC of a The company, starting at a difference of approximately 16% at 10,000 kilometers per year, resulting in a WLC difference of 1%- 6% when driving 30,000 kilometers per year. This is calculated setting the other parameters at default, so over a period of 36 months.
Increasing the mileage results in a higher contribution of the fuel costs to the WLC, as expected. Accounting for 9% in the default situation this has risen to 15% in the case of driven 30,000 kilometers per year. In the benchmark vehicles' WLC fuel costs have a much higher share, starting at 21% in the default situation and rising up to 32% in the other case. Because other parameters have been constant during this assessment, fuel costs are considered to be a key performance indicator for a The company.

The competitive position of The company with respect to the two benchmark vehicles is also highly dependent on the customer type, especially when the customer is driving the vehicle for both private as business purposes. The following graph states the WLCs for the different type of customers; "A" standing for a cash customer, "B" for financing/leasing, and "1" & "2" defining whether the customer is driving the car for private/business purposes or both.

Figure 16 WLCs with different customer types & WLC breakdown for a B2 customer

The graphs show that The company gains a very competitive position as soon as the customer decides to drive his vehicle for both private as for business purposes. The benefit in kind creates a competitive advantage for The company since the model S is within the 4% category while the benchmark vehicles are in the 25% category. So while the BIK adds 7% to the WLC of a The company, it adds approximately 25% to the WLCs of the benchmark vehicles. This result in The company having at least a 14% lower WLC, or approximately €14,000 cheaper, when driving the vehicle for three years for 15,000 kilometers per year. Thus, the current BIK regulation can be seen as another key performance indicator.

This section establishes the key performance indicators for the WLC of a The company. It shows fuel cost, customer type, and taxes to be key performance indicators for the WLC of a The company when regarding its competitive position. The assessments assumed no fluctuations in the parameters; they remained set at default values as described earlier. Next section discusses the possible implications in case of fluctuating parameters.

6.2 Parameter specific discounted WLC model assessment

This section focuses on specific parameters within the WLC model in order to assess the implications of any fluctuations in their values. Conclusions from the previous section serve as a base for this further research; default parameters are set if not stated otherwise. The following parameters are considered: discount rate, interest rate, down payment, residual value, fuel prices, SMR, tires, insurance, and taxes.

Discount rate & interest rate

This paragraph discusses both the discount rate and the interest rate. The discount rate defines the discount factor and determines the present value of future cash flows. This rate does not just take into account the time value of money, but also risks regarding the future cash flows. Literature determined the discount factor within the automotive market to be between the 5% and 10%. However, this research from 2013 was conducted in a different economic situation and as such different discount rate may apply. The following graphs show the default WLC set out against different values of discount rates. It considers a leasing customer driving the vehicle both for a combination of purposes. The left graph shows the change in percentage of the WLC when changing the rate by ten basis points. The right graph shows the WLC for different values of the rates.

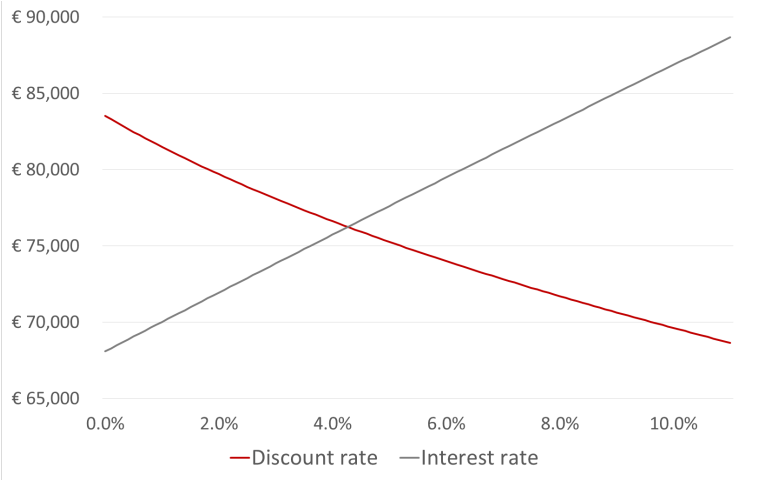


Figure 17 Influence of fluctuation in the discount rate and interest rate on the WLC

Another important rate is the interest rate, the rate at which the customer is capable of lending money or has to pay over its lease payment. Since these solutions are offered by a third party this value is subject to the values they set. The graphs above also show the possible implications of fluctuations in the interest rate.

Small fluctuations of one percentage in any of the rates have significant influence, approximately 2.5% for the discount rate and 2.5% for the interest rate as well. Both are showing a decrease in fluctuation for higher rates, but the discount rates follows a more exponential trend while the interest rate is more linear. This can be explained by the influence of the interest rate on solely the financing costs while the discount rate influences all the cost factors. When looking at a broader range of fluctuations the rates are becoming significant. An increase of 2% on the discount rate results into the WLC lowering with approximately 3.5%, or €2,500. Fluctuations in the interest rate have a higher contribution; a 2% increase of the interest rate results in the WLC rising approximately 5%, or €4,000.

A final remark has to be made regarding the relation between the discount rate and the interest rate. As the discount rate is increasing, meaning the customer is expected to achieve a higher return on his money, a customer might be more attracted to the leasing/financing solution than paying for the vehicle in cash. This is a consideration for the customer to be taken into account.

Residual value

For the calculations in this chapter the residual values are depicted according to the BBG program, which has been presented in chapter 3. The program ensures customers of an operational lease a certain RV under selected parameters in the contract. Having this insurance is highly relevant for both The company and the customer. This section describes two scenarios, namely the impact of fluctuations on the WLC and how differences in residual values with the benchmark vehicles might alter the competitive position of The company. The following graph accounts for fluctuations in the WLC with changing values of the RV.

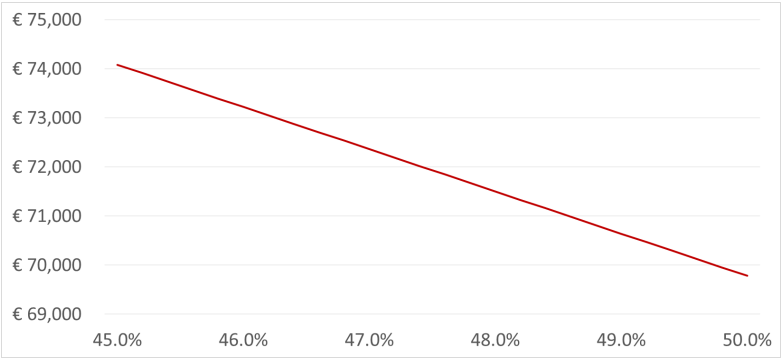


Figure 18 Influence of the RV on the WLC

Alterations in the RV result in a constant value difference for the WLC. Described in percentages a 1% increase of the RV results in a 1.2% decrease of the WLC, a difference of €1,032. This percentage decreases over time because the contribution of the RV to the WLC becomes smaller. Over a period of 60 months the effect has diminished to 0.9%.

Having described the possible implications of altering the RV values in the BBG program, it also changes the competitive position of The company in comparison to the benchmark vehicles. As described in chapter three the BBG program incorporated an aggression factor which let The company maintain a higher RV over longer periods of time, this improves its competitive position for longer term-periods. The benchmark research showed that the RV for an Audi after 48 months, with 60,000 km driven, the RV was set at 38% for instance, not 42%. This has a significant impact on the WLC as shown underneath.

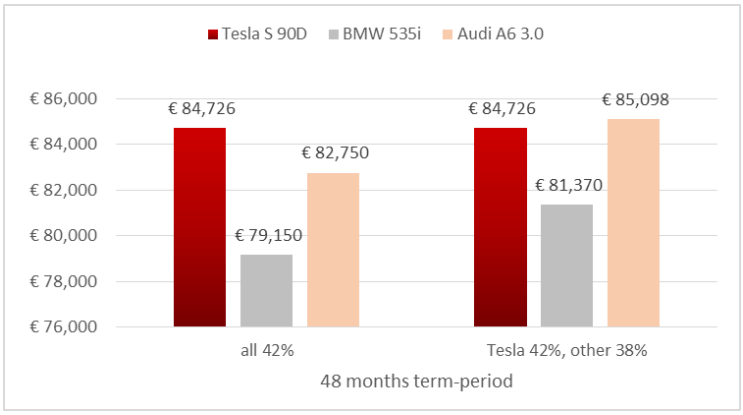


Figure 19 Competitive position The company for different RVs of benchmark vehicles

Decreasing the RV of the benchmark vehicles increases their WLCs by a several thousand euro's, making The company a more attractive option or even a less expensive option for the customer when considering the Audi A6.

Down payment

When a customer is leasing or financing the vehicle he or she is given to make a down payment in order to lower his/her monthly payments. Analysis has shown that the amount of down payment has no significant impact on the WLC; if the customer chooses to increase his down payment by 5% the WLC increases by approximately 0.2%, or €130. Explanation can be found in the offset between lower monthly payments and the future value of the down payment. Although the monthly payments go down, saving interest, this is offset by the possible future value of the extra amount paid immediately at the start of the contract as a down payment. The amount of down payment is thus not directly relevant in order to lower the WLC. However, it is a parameter to be eligible for the RVG/BBG program if applicable, which is a significant cost factor as shown in the previous paragraph.

Fuel prices

The costs resulting from the fuel consumption of a vehicle are described as being the second biggest cost factor within the WLC, describing a customer driving the vehicle for solely private or business purposes and thus excluding BIK. This paragraph addresses the possible fluctuations in the fuel prices, both for electricity as for gasoline, and the implications for the WLC. Besides analyzing the implications of possible fluctuations in the electricity prices, fluctuations in the gasoline prices are also taken into account and the relating competitive position of The company with respect to the benchmark vehicles. The following graph describes three scenarios, the so-called normal-, best-, and worst-case scenario. Fuel prices are assumed to make jumps of 10%, resulting in the following table of prices in the three different scenarios.

Scenario	Price electricity (p/kWh)	Price gasoline (p/L)
Normal	€0.20	€1.50
Worst	€0.22	€1.45
Best	€0.18	€1.65

The results in WLC of these scenarios are stated in the following graph, stating the worst-case, normal-case, and best-case respectively.

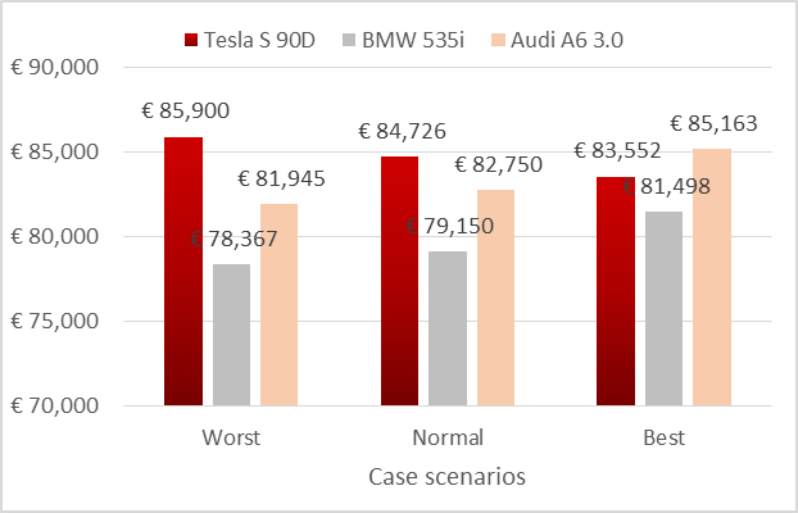


Figure 20 WLC for changing fuel prices

Since fuel costs have a bigger contribution in the WLC of the benchmark vehicles than in that of a The company, a The company shows less correlation to fluctuations in fuel prices. This can be depicted from the graph above, showing the three scenarios earlier described. While a 10% increase in electricity prices raises the WLC of a The company with 1.4%, the WLCs of the benchmark vehicles rise with a percentage of approximately 3.0%. This stronger variance also goes

the other way when the fuel prices would drop; The company would see a decrease in its WLC by 0.9% while the benchmark vehicles would show a 1.6% decline in their WLC.

Another important aspect is the usage of the The company Superchargers. These chargers are currently sponsored by The company and offer the customer free charging. The WLC is calculated under the assumption that a regular customer charges his or her The company approximately 10% of the time with a Supercharger, this assumption is subject to the type of customer; a cab driver uses the Supercharger significantly more frequent than a regular driver. When the usage of Superchargers is taken out of the equation the fuel costs of The company will rise with 10%, resulting in an effective rise of 1% in the WLC.

SMR & tires

Making only a small contribution to the WLC and a low possibility of major fluctuations in price are the tires. A The company customer has the choice between to two types set of tires, the most expensive one being €438, excluding labor costs. The SMR costs are depicted from the website stated earlier, www.autoweek.nl, and is based on historical data. It currently suggests that a The company is more expensive to maintain than one of the benchmark vehicles, prospects are that this will not be the case in the future. An electric vehicle has less moving parts, lowering the change of mechanical failure. If the SMR is lowered by 10%, between the SMR of the benchmark vehicles, this results in a 0.03% decrease in the WLC.

Since SMR is a very uncertain expenditure there are several possibilities to lower some of the risk. One possibility is the maintenance package for which the customer pays a pre-determined amount where the vehicle is checked and updated. The full content of such a package, and its cost for the several possibilities, is added in APPENDIX H. It lowers the possible of risk of failures for the car, but it does not include repair costs and costs of parts. When comparing the costs of a 4-year maintenance package (€2.450) to the relative PV of the SMR (€3.234) it might suggest the maintenance package to be the better option. However, the package does not include possible repairs while these are included into the SMR. A personal assessment of the driver should decide if repairs are to be expected and which option is best-suited.

If the customer wants to be excluded from any unfavorable and/or unexpected expenditures, he or she could choose for a full operational lease. This lease combines all possible expenditures during the term-period, such as SMR and insurance, resulting in just one monthly payment for the customer. This brings the WLC for a customer, choosing full operational lease, down to the discounted cash flows of these monthly payments. The great difference between the two forms of leasing is the party that has the ownership. For a financial lease this is the customer, while with a full operational lease the vehicle is owned by the leasing company. Comparing the WLC of a normal customer and that of a full operational, fuel costs are to be excluded and the residual value is to be put back in at the financial lease. The difference in WLC is given in the following graph, showing two WLCs based on partners from The company that are offering full operational leases.

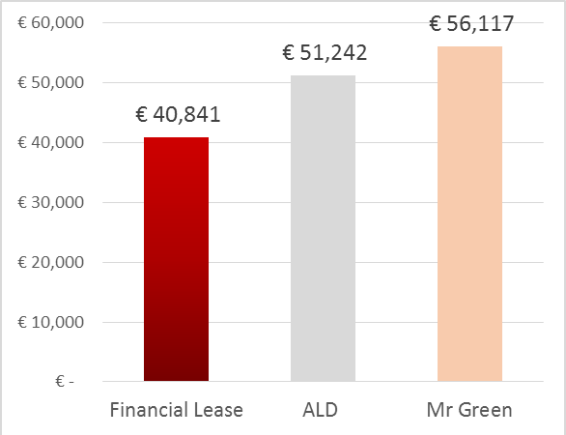


Figure 21 Financial lease vs. Full Operational lease of the companies "ALD" and "MrGreen"

A great difference is to be seen in the graph; at least a difference of €10.000. If the partners expect the same WLC for a The company this is the value of risk to the companies. This value should cover SMR expenditures and unexpected costs resulting from the lease to the customer.

Insurance

The insurance costs are set on equal values in the model because of the different parameters to which this expenditure is subject to. There might be a base tariff but the exact value is depending on the age of the driver, amount of damage-free years, and even place where the driver might life. The external database indicates comparable insurance costs for the benchmark vehicles; these are expected to change in comparison to each other since The company is presumably a safer and lower-cost vehicle than the benchmark vehicles. A 10% lowering of the insurance would result in a decrease of €723 in 48 months on the WLC of a The company, respectively 0.83%, so this could significantly change the WLC due to the insurance costs.

It should be taken into account that the insurer with the lowest premium might also cover fewer damages. The customer should assess whether he/she wants to take on the extra risk of having to pay for uncertain damage to the car or a third party, or just wants the lower insurance costs.

Taxes

The final, but a very significant, cost factor within the WLC is the applicable automotive taxes in the market where the car is to be registered. These differ per country, as the table is showing in chapter three, and can attribute a large cost to the WLC. This example still discusses the situation in the Netherlands, clearly stating the different situations when there is a favorable tax environment or not. The influence of taxes in the WLC was already present when discussing the different kind of customer, to which different kind of taxes apply. Previously used graph, restated on the following page, shows the BIK having a 25% contribution to the WLC when the customer is driving the vehicle for both private and business purposes.

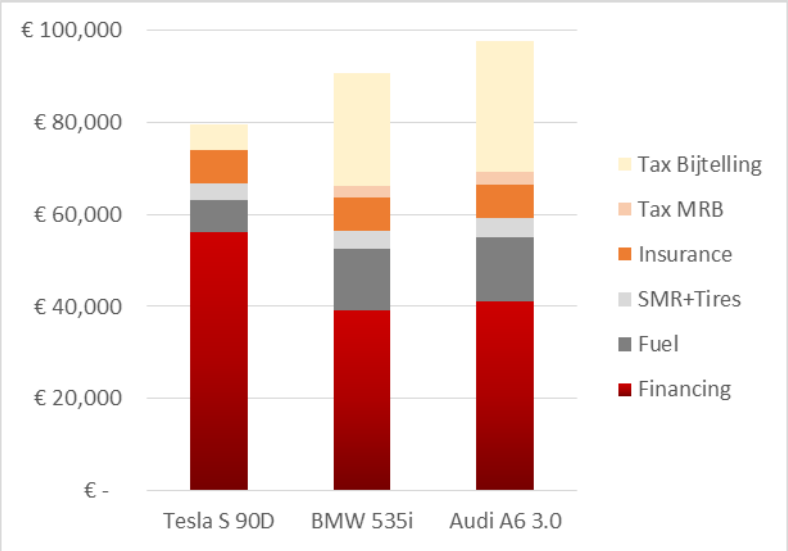


Figure 22 Contribution of applicable taxes for the business & private driver

This graph shows the importance of a favorable tax environment, making The company a much cheaper option to drive. The low BIK percentage is the most important cost factor of the WLC at the moment. This is surely beneficial for the customer, and certainly also for Sales personnel to address as a persuasion reason. However, it is very subjective to possible governmental changes in the future. In the case of the Netherlands a The company Model S enjoys the low BIK percentage up until 2019, after this an extra rule is introduced; the vehicle has to cost less than €50.000. This excludes the Model S from a future low BIK percentage and thus is to be considered as a temporary benefit to the WLC.

Having done several assessments on the WLC model and comparing the Model S WLC to two benchmark vehicles multiply key influencers are identified. The WLC assessment identified term, mileage and the residual value to be the top three influencers within the WLC, resulting in the highest fluctuations when varying the parameter. Tax incentives contribute the biggest costs after the financial costs, depending on the customer type. Since these incentives are country-specific they cannot be identified as general key influencers, but they show the significance of be a favorable tax environment.
The benchmark analyses showed tax and fuel costs to be the two key influencers, resulting in The company to favorably differentiate itself with competitors on financial aspect. Customer type and country's tax incentives determine the contribution of tax costs in the WLC. On the long-term residual value becomes a more dominant cost factor. Insurance, SMR, and tires are at a competitive level and have relatively low influence on the WLC.

7. Discussion & opportunities

This chapter discusses the steps required to implement the created model, the resources possibly needed, and which problems are to be avoided. This chapter also presents and discusses actions future researchers could or should take as a result of this thesis.

The model is created from the customer's perspective; the literature has provided the base of parameters that should be used in the WLC. When looking at the cost factors used in the current WLC models all of them are included; tax expenditures are also included in addition to these frameworks, creating a broader insight for both the customer as for The company. With the theoretical part of the model completed it now comes down to the practical implementation of the WLC model in the operations of The company. Having created a global format a clearly structured implementation strategy is to be formulated. The following paragraph proposes a possible strategy to ensure a structured and correct roll-out throughout The company's operating markets. This is also stated in the figure underneath.

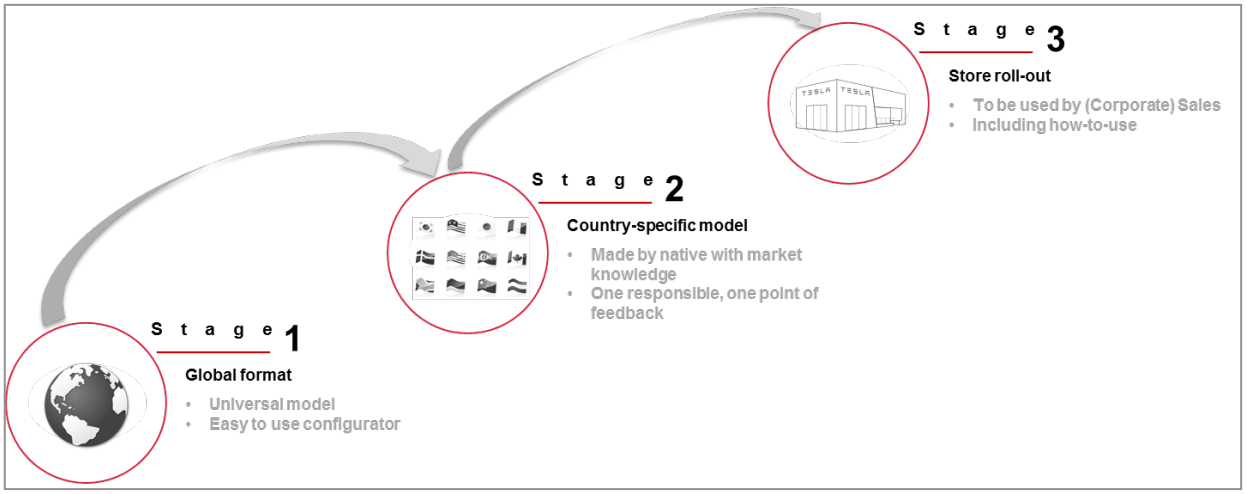


Figure 23 the implementation strategy

A three-stage approach lets the global model format be structured into a country-specific model and function correctly in the country applicable. The first stage has already been completed with this thesis, resulting in a global format WLC model. The second stage is formulating a country-specific model and consists of cooperation with one employee, being up to date with current legislation in the market and speaks the native language. By appointing one responsible employee communications will run smoother, resulting in faster results. For this stage the store manager is chosen to be the best option, assuming to have the best knowledge of the current market. In a combined effort he or she will reform the global model to the country-specific variant, translating the cost factors and ensuring the calculations to the possible tax implications are correct. After this stage the model is rolled out by the manager to Sales and Corporate Sales, with a user policy describing how the model is to be used and what the restrictions to it are. They will also serve as a feedback group for possible improvements.

The model is based upon several assumptions regarding the costs of expenditures, such as SMR and insurance, but also on fuel prices and residual values. Validation of these assumptions is a time-consuming and expensive project if this is to be done for benchmark vehicles thus the suggestion is to employ a third party for this data. Another advantage is that a legal discussion regarding the presented data that is avoided since an independent party provides it. Research done by The company is expected to quickly be regarded as non-objective and could lead to competitor automotive brands to take legal actions. Using data from a third party prevents this, making them

responsible. Eurotaxglass's for example is operating in many of The company's major markets and offers automotive business intelligence services. Their database not only contains RV values but also forecast estimates with regards to the SMR. A subscription to their database would provide The company with the needed information.

The fluctuations of the cost factors over time are also to be taken into account. These are to be checked periodically as well as ensuring no major between the model and the current market. Especially changes in automotive tax regulations are to be addressed as previous chapter has shown them to have a significant impact. Parameters such as the residual values, SMR, insurance, and fuel prices can be extracted from the third party described in the previous paragraph. The amount of periodical updates would depend on the costs associated with the subscription, whether it contains an unlimited use of the database or not. Changes in tax regulation remain a difficult topic, since there is no database available with calculations for country-specific taxes. The European Automobile Manufacturers Association does publish a yearly tax guide with automotive taxes that could serve as a base for the calculations, but additional information would be presented. Another solution would be to have personnel in relevant countries make calculators that are to be incorporated in the global format model. Research also indicated the tax environment to be of importance in determining the WLC. Especially for the markets where The company currently is benefiting from local incentives it is important to be up to date about regulation, and possible alterations therein in the future.

Another important aspect of this research is the fact that previous chapters have all been with the focus on the customer's perspective, showing how the WLC of a The company compared to other competitor vehicles and the possible implications to fluctuations of the parameters. As a selling tool it already serves it function towards customers but it also holds a great beneficial value for The company. Besides knowing the competitive position of The company with its current WLC, The company is able to structure a strategy based on the sensitivity analysis in chapter 6 in order to bring down its WLC.

Already The company is trying to bring down the costs of production and improving the performance of the vehicle. This beneficially influences the purchase price, material costs associated with repair costs, and fuel consumption. Another is finding the right partners, not just for leasing and/or financing but also insurance and operational leases. As partnerships improve premiums are expected to go down. For leasing and financing contracts lower interest rates might become applicable as a result of non-troublesome cash flows from The company owners, insurance premiums could decrease because more and more insight is created in the possible damages and relating repair costs of a The company.

8. Conclusion & recommendations

Research has shown The company to have a very competitive position when looking beyond the purchase price. The created WLC model is capable of validating this argument to customers and should be used accordingly. The model creates a peace of mind to the customer, knowing that he/she has knowledge into future expenditures, while boosting orders through this persuasion tool. The objective is to globally incorporate the model in a structured, fast, and efficient way.

The selling points are defined according to the analyses done in chapter six. It defined the following cost factors to be possible drivers in the decision-making process of a customer. Customer type is the first parameter to be defined, after which other KSP's are to be introduced into the conversation. The customer type defines whether taxes are an important cost factor in the sales conversation. Secondly terms and mileage are two important parameters; longer terms and higher mileage both increase the competitive position of The company in comparison to benchmark vehicles. The RV values, according to the BBG matrix, become significantly more competitive if this parameter increases. The parameters also influence the fuel costs, resulting in a better competitive position when they increase. In conclusion the three most essential parameters are: customer type, terms, and mileage. Other parameters are relevant for the WLC of a vehicle but do not provide a significant contribution to the competitive position of The company, so the focus should be on these three parameters.

The influence of a partner is beneficial to the customer; it contributes to the customer experience in the sense that they easily provide the customer with a financial solution. The RVG/BBG program is highly relevant for the WLC model, causing significant changes in the WLC when fluctuating, and for partners. It allows partners to potentially lower the monthly payments using the residual values in the guarantees. Further research and implementation of the RVG2.0 program will result in lower WLCs, thus are important actions to be taken in the future.

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