



A COMPREHENSIVE CORPORATE SUSTAINABILITY MODEL

A Literature Study



Ivo van Gerwen
BSc. Student

Student:

Name: Ivo van Gerwen
Student number: 970406259030
Thesis code: YSS-81812 BSc Thesis Business Studies
Bachelor: Business- and Consumer Studies
Specialization: Sustainable Innovation
Contact: ivo.vangerwen@wur.nl

Supervisors:

1st supervisor: dr. Vincent Blok
Contact: vincent.blok@wur.nl
2nd supervisor: dr. Emiel Wubben

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0. Executive Summary

Several models are designed to enable a useful comparison between companies concerning the commitment to and practices of sustainability. However, current corporate sustainability (CS) models, such as the CS of Dunphy et al (2007), fail to enable a comprehensive comparison. For instance, car companies providing an electric car are currently labelled similar even though the practices behind the end-product – the electric car – could differ. So, it could be argued the current CS model are too much focussed on the end-product instead of commitment to and practices of sustainability behind the end-product. Therefore, a comprehensive corporate sustainability model (CCSM) should be created to enable a useful comparison between companies concerning the commitment to and practices of sustainability.

The Value Hill is proposed as an addition to the current CS model of Dunphy et al (2007) resulting in a CCSM. This CCSM makes it attainable to evaluate the implementation of CS throughout each phase of the end-product separately. From the extraction of raw materials till the recycling, each phase could be evaluated according the criteria of this model. Accordingly, criteria are formulated upon companies could be evaluated and compared.

The application of the CCSM was explored on the car industry since the car companies could not be distinguished given the previously used CS criteria. Namely, providing an electric car could be labelled as 'strategic proactivity' or even as 'the sustaining corporation' in accordance to the CS criteria. However, several sustainability challenges arise in the practices behind the electric car such as the extraction of lithium. For that reason, the application of the CCSM was explored on the car industry in order to enable a comparison between companies Audi, BMW and Chevrolet concerning the commitment to and practices of sustainability.

As a result, a clear overview of the outcome of the application of the CCSM on the car industry was shown in the created corporate sustainability hill (CSH). This is a created tool to visualise the allocated scores in accordance to the CCSM criteria. As a consequence, each company has their own CSH, which gives them the possibility to evaluate their commitment to and practices of sustainability in each phase separately. In addition, they could compare their performance against other companies (in the same industry) to see where they are good at and what they need to improve.

So, the created CCSM is an improvement to the current CS model of Dunphy et al (2007) wherefore a comprehensive comparison could be made. The example of the car industry analysis showed that this CCSM enables a comparison between companies concerning the commitment to and practices of sustainability behind the end-product. However, it is not perfected since e.g. the application of the CCSM on the car industry showed some commitment to and practices of sustainability are still not incorporated. Thus, the CCSM is a point of departure by which a model should be designed which enables a comparison between companies concerning every commitment to and practices of sustainability.

1 Introduction

This chapter contains the problem definition & research objective (see section 1.1), the research questions (see section 1.2), a representation of the steps that need to be taken to achieve the research objective via a research framework (see section 1.4) and the used methodology (see section 1.4).

1.1 Problem Definition & Research Objective

To enable a useful comparison between companies concerning their current commitment to and practices of sustainability, analysts designed several models, such as the corporate sustainability (CS) model by Dunphy et al (Benn, Dunphy, and Griffiths 2007). This model illustrates a stepwise process to two kinds of sustainability: human and ecological sustainability. The six phases in the process are 'rejection', 'non-responsiveness', 'compliance', 'efficiency', 'strategic pro-activity' and 'the sustaining cooperation'. CS is a related construct to corporate social responsibility (CSR). The CSR concept served as the building block, or point-of-departure for other themes and related concept, such as CS (Carroll 2015). The most sustainable global companies use 12 different concepts to report social performance including CSR and sustainability. This explains why Waddock and Graves (1997) used the concepts 'reactive', 'defensive', 'accommodative' and 'proactive' to describe the different commitment to and practices of sustainability. These kinds of models are used to label a company's commitment to and practices of sustainability. However, these models fail to distinguish the practices behind a so called 'sustainable' end-product. As an illustration of this failure, companies providing a sustainable end-product (e.g. the electric car) are currently labelled as 'strategic pro-activity' or as 'the sustaining corporation' by the CS model of Dunphy et al (2007). Namely, the fifth stage 'strategic pro-activity' is characterised by companies who see innovation as their main focus, in which a company uses sustainability to gain a potential competitive advantage. Therefore, a company delivering a sustainable end product – e.g. the electric car - could be labelled as 'strategic pro-active' or even as 'the sustaining corporation'. The practices behind the sustainable end-product e.g. extracting raw materials, manufacturing and recycling, are not taken into account by the current CS model of Dunphy et al (2007). So, the current CS or other related concept models are not applicable to enable a comprehensive comparison between companies concerning their current commitment to and practices of sustainability. For that reason, it is important a comprehensive corporate sustainability model (CCSM) is used to enable a useful comparison between the companies concerning their current commitment to and practices of sustainability. For instance, sustainability challenges come along with the practices around a sustainable end-product for which the commitment to and practices of sustainability for which the company should be labelled. For example, the sustainability challenges behind the practices of the electric car are the higher CO₂ emission exhausting during the production phase, the lack of knowledge on giving batteries a second life and the shortage of using green energy in the Use Phase (Verbeek et al (2015)). A clear comparison should be made which companies are delivering a sustainable end-product (e.g. car companies delivering the electric car) and which companies are incorporating sustainability in their current commitment to and practices behind the end-product. Thus, comparing companies should be compared beyond their end-product, such that the incorporation of sustainability behind the end-product is compared. Therefore, a comprehensive corporate sustainability model (CCSM) designed and used instead of the current CS model to enable a useful comparison between companies concerning their current commitment to and practices of sustainability.

1.2 Research Questions

The General Research Question (GRQ) of this research is:

GRQ 1: Which comprehensive corporate sustainability model could be used to enable a useful comparison between companies concerning their current commitment to and practices of sustainability?

Specific Research Questions (SRQ) is used to answer the GRQ. The SRQ's of this research are:

SRQ 1: What are the characteristics to define corporate sustainability according to literature? (see section 2.1)

SRQ 2: Which aspects do need to be included in a comprehensive corporate sustainability model? (see sections 2.2 & 2.3 for the analysis of the aspects and see chapter 3 for the design and the operationalization of the model)

SRQ 3: What kind of sustainability challenges arise for companies in the car industry concerning the commitment to and practices of sustainability regarding the end-product – the electric car - according a comprehensive corporate sustainability model? (see section 2.4)

SRQ 4: Which strategies/solutions do companies in the car industry have for the sustainability challenges for the current commitment to and practices of sustainability according a comprehensive corporate sustainability model? (see sections 4.1- 4.3 'extraction' till 'recycle')

SRQ 5: How are the different commitment to and practices of sustainability labelled according a comprehensive corporate sustainability model? (see sections 4.1-4.3 'results' and section 4.4 for an overview)

1.3 Research Framework

The research framework is a schematic and highly visualised representation of the steps that need to be taken to achieve the research objective (Verschuren and Doorewaard, 2010). The steps that are going to be taken in this thesis are illustrated in the research framework below (see figure 1.1):

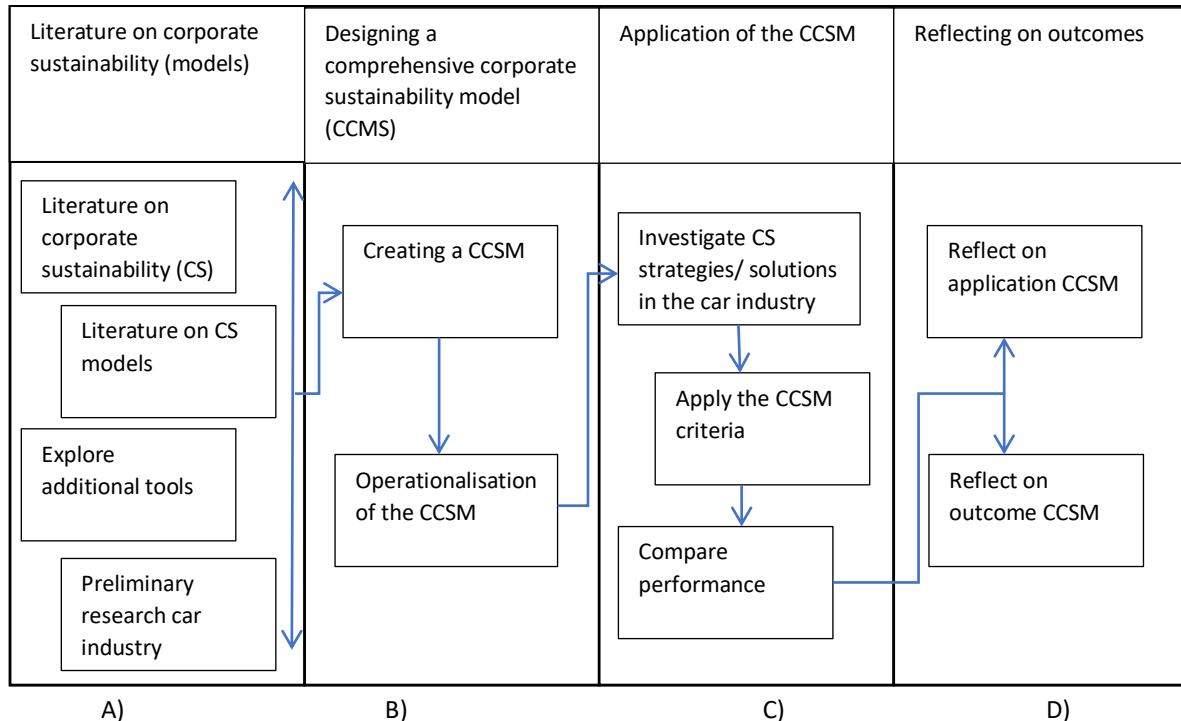


Figure 1.1: 'Research framework comprehensive corporate sustainability model'

The SRQ 1, 2 and 3 will be answered in step A: 'literature on CS (models)'. Thus, it will create an understanding of CS (SRQ1) and the corresponding models to grasp which aspects need to be included in a CCSM (SRQ 2). Hereby, plausible additional tools will be explored. In order to test the additional value of the tool, a preliminary research of the car industry will be executed to examine what kind of sustainability challenges arise for companies in the car industry concerning the commitment to and practices of sustainability regarding the electric car (SRQ 3).

This information is needed in order to design a comprehensive corporate sustainability model, which will be subsequently operationalised in step B: 'designing a comprehensive corporate sustainability model'.

The SRQ 4 and 5 will be answered in step C: 'the application of the CCSM'. First, an analysis will be done to find which strategies/solutions car companies have for the sustainability challenges concerning the current commitment to and practices of sustainability. These strategies/solutions will be analysed in accordance to every phase of the CCSM (SRQ 4). Then, the different commitment to and practices of sustainability will be labelled according the CCSM (SRQ5). These labels will be compared between the car companies.

The final step D: 'reflecting on outcomes' will be executed in order to answer which model could be used to enable a useful comparison between companies concerning the current commitment to and practices of sustainability (GRQ). Therefore, a reflection will be executed on the application of the CCSM on the car industry to see whether the CCSM is comprehensive.

1.4 Methods

This section will explain that executing a literature study is the main type of research methodology for this research. Additionally, there will be made use of a brief data case study in order to explore the implementation of the gained knowledge from the literature study. Thereby, there will be made use of secondary data. The research of Verschuren and Doorewaard (2005) is used as a fundamental guideline.

The literature study will be executed in order to provide answers to SRQ 1, 2 and 3. Literature will be used as a knowledge source, which contains e.g. theoretical insights. Also, the literature will be used as a data source in which elements in the descriptions are considered and could be combined with other data to produce new insights. The following data bases will be used to answer the formulated SRQ's: Google Scholar and Scopus. There will be made use of monographs, bulky books that are focussed on one subject, editorial volumes, in which various chapters have their own view on the subject and scientific papers. The scientific papers will be used as a main source of information. The combination of databases and types of literature enhances the creditability of the research. First, these sources will be used for gathering information about the definitions and synonyms of CS to gain an apparent consensus about this term (SRQ 1). Then, information will be gathered about models to compare companies concerning the commitment to and practices of sustainability. Current models and tools will be analysed in order to find which aspects do need to be included in a CCSM (SRQ 2). This will result in the creation of a CCSM.

Consequently, a **brief case study** will be executed in order to analyse which strategies/solutions car companies have concerning the commitment to and practices of sustainability for every phase of the CCSM. Case-based research is a scientific approach that attempts to ground theoretical concepts with reality (Yin, 2001). Thereby, there will be made use of secondary data, namely the CS reports of car companies BMW, AUDI and Chevrolet. These reports provide information concerning the current commitment to and practices of sustainability throughout the different phases of the end-product, namely the electric car. This information will be analysed in accordance to the CCSM, whereby an attempt will be done to enable a comprehensive comparison between these companies concerning their current commitment to and practices of sustainability. According to Yin (2001) a case study design should be considered when e.g. (a) the focus is to answer 'how' and 'why' questions, (b) you cannot manipulate the behaviour of those involved in the study, (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study, or (d) the boundaries are not clear between the phenomenon and the context. So, this type of research will be additionally to the literature study. A multiple case study will be executed in order to examine similarities and differences to the cases. The evidence conducted from this type of study is seen as trustworthy and vigorous. However, it could be a very time consuming and costly way to conduct information (Baxter and Jack, 2008). Note that the literature study is the main type of research methodology for this research. Since, a multiple case study will be very time consuming, it will be executed briefly by making use of the sustainability reports of a few car companies, namely Chevrolet, Audi and BMW.

Thus, literature study is the main type of research methodology for this research whereby a brief multiple case study will be executed as an addition. There will be made use of data bases Google Scholar & Scopus, scientific papers, and bulky books. Next to that, secondary data will be used, namely the sustainability reports car companies.

2 Corporate Sustainability

Frist, this chapter is going create a general consensus about the concept corporate sustainability (CS) and other related concepts (see section 2.1). Second, a CS model will be studied to examine whether it is able to enable a comparison between companies concerning the current commitment to and practices of sustainability. Also, an own interpretation of the concept sustainability will be pointed out (see section 2.2). Third, the Value Hill will be clarified and explored as a possible addition to CS model in order to make a comprehensive corporate sustainability model CCSM, see section 2.3). At last, the possible addition of the Value Hill resulting in a CCSM will be briefly be demonstrated on the car industry to examine whether sustainability aspects arise which the CS model failed to take into account (see section 2.4).

2.1 Understanding Corporate Sustainability (CS)

CS is a related construct to corporate social responsibility (CSR). The CSR concept served as the building block, or point-of-departure for other themes and related concept, such as CS (Carroll 2015). Often these concepts share a common end, but there is an increasing difficulty in understanding these concepts and relate them to each other (Schwartz, and Carroll 2008). Due to high attention from both academia and industry, miscommunication of these concepts should be avoided. CS was introduced by the World Commission on Environment and Development (WCED) who derived CS from sustainable development (SD). SD is defined as 'development which met needs of the present without compromising the ability of future generations to meet their own needs (Commission 1987). The application of SD at the corporate level is referred to as corporate sustainability (Dentchev 2004).

Since the 1990s studies about CS are usually focused on how to protect the natural environment while making business decisions and implementing business operations (Sarvaiya and Wu 2014). Next to the environmental aspect, the social aspect was also included to the aspect CS by researchers. Social issues should be priority in sustainability thinking because human beings are at the centre of concerns for sustainable development (Doyle 1998). So, the social aspect was included to CS and got a prominent status since the triple bottom line concept of sustainability (Elkington 1998). Thus, CS is based on three core principles: social equity, economic integrity and environmental integrity (Bansal 2005). Porter stated that sustainability refers to actually meeting social and environmental needs in addition to firm profitability, and therefore represents the implementation and outcomes of companies' CSR voluntary intentions (Porter 2008). This implies that the concept CS is not only about managing environmental responsibility, but also managing social responsibility along with economic prosperity.

The most sustainable global companies use 12 different concepts to report social performance including CSR and sustainability. Due to the growing importance of environmental concerns, more companies are using the concept sustainability for their social performance (Paul 2008). The difference between CSR and CS is that they theoretically have common aspect of balancing social, environmental and economic issues, but CSR is the process of managing social issues with stakeholders and CS is the method for achieving ecological Balance (Kleine and von Hauuff 2009). Another distinction is that CSR is more seen to have a short-term view to deal with needs of present stakeholders, while CS has a more long-term view to deal with the needs of future stakeholders. The 'main' difference is that the CSR is focussed on social issues whereas CS is more focussed on environmental issues (Steurer et al. 2005). A suggestion is to use CS-R that stands for corporate sustainability and responsibility (Van Den Brink and Van Der Woerd 2004). This concept expresses

that a sustainable corporation has a broad responsibility to the future and current stakeholders and the society as a whole (Sarvaiya and Wu 2014).

2.2 A Corporate Sustainability Model

To enable a useful comparison between companies concerning their current commitment to and practices of sustainability, a CS model was designed (Benn, Dunphy, and Griffiths 2007). This CS model illustrates a stepwise process to two kinds of sustainability: human and ecological sustainability. These six phases are shown below (see figure 2.1).

The first phase is the 'rejection phase', which is described by the theme 'exploit resources for maintaining financial gain' (Benn, Dunphy, and Griffiths 2007). It is a commitment that all resources of the company – ecological environment, employees and the community infrastructure – are exploited by the company for immediate economic gain. The managers expect the community to pay costs for environmental impacts of the company. Also, the firm disregards the harmful environmental impacts of the company's activities and actively fight any attempts by social advocates, governments and 'green' activists to put constraints on those activities.



Figure 2.1: 'Six phases of sustainability (Agents 2007)

The second phase 'non-responsiveness' is described by the theme 'business as usual'. This is characterized by a lack of awareness or ignorance rather than actively putting the financial gain first and opposes the corporate ethics. Many of these companies do not incorporate sustainability issues when making decisions. If human resource strategies exist, they are focused on maintaining an obedient employee. The society's issues occurred by the activities of these companies are ignored and the environmental consequences are taken for granted.

The third phase 'compliance' is labelled as 'avoid risk', which is identified by companies who focus on reducing the risk of sanction for failing to meet minimum standards as an employer or producer. So, they accept the demand of the environment to move toward more sustainable activities, but limit their effort to the minimum requirements. Frequently, these companies are primarily reactive to the expanding legal requirements and community's expectations for more sustainable activities. These companies ensure a healthy workplace and avoid environmental abuses that could lead to a strong community reaction or lawsuit toward the firm.

The fourth phase 'efficiency' is classified as 'do more with less'. Companies in this phase have a growing awareness that there are real advantages to be gained by proactively incorporating sustainability into their activities. Human resource and environmental policies and practices are a stimulus for increasing efficiency and reducing costs. Especially by recognizing that what was previously seen as waste could be valuable to other companies, such as heat and materials. Also, these companies make maximum use of scarce and costly resources.

The fifth phase 'strategic proactivity' is marked as 'lead in value adding and innovation'. These companies have made sustainability an important part of the company's business strategy.

Climate change and a carbon-neutral economy are seen as business opportunities instead of threats. Innovation is the main focus in which a company uses sustainability to gain a potential competitive advantage. These companies try to position themselves as leader in sustainable business practices with advanced human resource strategies, a commitment to sustainability motivated by self-interest. The concept waste is significantly enlarged and redefined, whereby missed opportunities are more clearly defined and recognized such as lost revenue and market share through lack of innovation.

The sixth and final phase ‘the sustaining corporation’ is defined as ‘transform ourselves: lead in creating a sustainable world’. For these companies it is not only important to have an ongoing transformation to align with the requirements of a more sustainable world, but they actively involve the economy and society to do the same. The fundamental commitment is to facilitate the society that supports ecological viability. The company’s key members of the supply chain are involved in sustainability activities and focused effort takes place to improve sustainability behaviour of customers and consumers. Also, sustainability performance is a continuity in which effective change management is an ongoing and ‘built-in’ capability of the company. Waste is interpreted as any operation that deflects the company from sustainability goals for the company as well as the society.

The before mentioned descriptions of the phases are simplified and illustrated below (see figure 2.2).



Figure 2.2: ‘The waves of sustainability’ (Kemp, Stark, and Tantrum 2004)

The above figure (see figure 2.2) gives an overview of the human and ecological sustainability characteristics for every phase. CS has different interpretations and related concepts such as CSR and SD which is mentioned before (see chapter 2.1). Therefore, CS will be examined according to the ecological sustainability characteristics of the CS model of Dunphy et al (2007). This research will be focussed on ecological sustainability, wherefore the below table is designed to define the ecological sustainability characteristics of the different phases (see table 2.1).

Phase	Prevailing Theme	Reference	Ecological Sustainability
1. Rejection	‘Exploit resources for short-term financial gain’	‘Stealthy saboteurs and freeloaders’	The environment is there to be exploited for economic gain. The community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies’ activities

2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	Environmental consequences of activities are not taken into account in decision making. The environmental consequences are taken for granted.
3. Compliance	'Avoid risk'	'Reactive minimalists'	Accept the demand of the environment to move toward more sustainable activities, but limit their effort to the minimum requirements
4. Efficiency	'Doing more with less'	'Industrious stewards'	Environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Pro-activity	'Lead in value adding and innovation'	'Proactive strategists'	Sustainability is seen as important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and transition towards carbon neutral economy as seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	An integrated approach is used to fulfil three main streams of sustainability: economic, social and ecological. All key members of the supply chain are influenced in sustainability practices, including improving sustainable behaviour of customers and consumers.

Table 2.1: 'Ecological and human sustainability characteristics of the different phases'

The above table (see 2.1) fails to enable a comparison between the current commitment to and practices of sustainability between companies. As mentioned before, a company delivering a sustainable end-product could be labelled as 'strategic pro-activity' or 'the sustaining corporation' when the company uses sustainability as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. So, it could be argued that this table is focussed too much on the end-product. Therefore, a comprehensive corporate sustainability model (CCSM) should be designed to enable a useful comparison between companies concerning their current commitment to and practices of sustainability. This comparison should include all the different phases of a product instead of evaluating the end-product which is done by the CS of Dunphy et al (2007). Thus, a CS model should enable a comprehensive comparison between companies concerning their commitment to and practices of sustainability by comparing all the phases separately.

2.3 The Value Hill

To explore options to design comprehensive corporate sustainability model, the Value Hill will be analysed as an addition. The Value Hill in a linear world demonstrates how products are designed, produced, distributed and sold. By extracting resources from the earth, refining them for manufacturing, assembling them into products and distributed them to consumers, value is added at every phase (see figure 2.3). After the consumer uses the product, value is destroyed. The Value Hill in a circular world is a strategy to keep the product at its highest value (top of the hill) for as long as possible (see figure 2.4). Products are designed to be long lasting, and are suitable for maintenance and repair thus slowing resource loops (Bocken et al. 2016). Thus, by feeding the complete product or its components back into a previous phase value is retained.



Figure 2.3: 'The Value Hill in a Linear World'



Figure 2.4: 'The Value hill in a Circular World.'
(Achterberg and Van Tilburg 2016)

Uphill the Value Hill (see figure 2.4) four phases are investigated, namely: 1) extraction 2) manufacturing 3) assembly and 4) retail. Thus, this corresponds to the business activities which take place in the extraction of materials, the design, production and distribution phase of a product. These activities are aimed at prolonging the Use Phase, reduce resource use and consider end-of-life suitability (e.g. modularity).

On top of the Value Hill (see figure 2.4) the Use Phase is characterized by optimizing the use phase of the product. Business models could consist of by providing add-ons or repair/maintenance services to extend the lifetime of the product.

Downward the Value Hill (see figure 2.4) the Post-Use Phase is analysed on the basis of the following four steps: 1) reuse/redistribute, 2) refurbish, 3) remanufacture and 4) recycle. Business activities are focused on capturing value from used products which involves for example providing products from recaptured materials and/or components, having a recycling facility and providing used products.

Since the entire resource loop is mapped in the Value Hill (see figure 2.4), it could provide an overview of the current commitment to and the practices of sustainability in the Pre-Use, Use and Post-Use Phase. Therefore, the Value Hill could be an addition to the CS model of Dunphy et al (2007). The CS model of Dunphy et al (2007) could be used to classify companies to one of the six phases wherefore points 1-6 will be allocated. If a company's characteristics are labelled as 'rejection', one point will be allocated, if a company's characteristics are labelled as 'the sustaining organisation' six points will be allocated. Six points will be allocated if a company incorporating sustainability superbly, wherefore the maximum points will be allocated. Note that in the CS of Dunphy et al (2007) points allocated for the phases are allocated the other way around. Namely, 'rejection' is indicated by the number six and 'the sustaining organisation' is indicated by the number one. Thus, the Value Hill provides the possibility to compare companies concerning the current commitment to and practices of sustainability throughout the different phases separately. Every phase could be compared wherefore a comprehensive comparison could be made. Thereby, the Value Hill is known to be easily enhanced with additional business models or ones which are going to be invented (Achterberg, Hinfelaar, and Bocken 2016).

2.4 Exploration of the addition of the Value Hill

In the next section a brief exploration Value Hill will be demonstrated to explore the current commitment to and the practices of sustainability throughout the different phases. Therefore, a sustainable end-product – the electric car- will be used as an example to explore the possible additional value of the use of the Value Hill compared to the CS model of Dunphy et al (2007) by itself. The sustainability challenges concerning the electric car will be examined in accordance to the different phases of the Value Hill.

2.4.1 Pre-Use Phase

In the Pre-Use Phase, the before mentioned steps should be examined. For instance, in the extraction phase of the materials for the electric car, sustainability problems occur. The materials such as dysprosium, neodymium, samarium, lanthan and lithium are extracted from the earth for the purpose of the electric car. These materials are especially needed for the use of the electric engines and batteries. As a result, raw materials will be exhausted in the long term. These materials could no longer be available in the future, and it costs energy to gain these raw materials (Verbeek et al. 2015). Next to that, retrieving the raw materials is burdensome, as there are predominantly coming from China, South America and Australia. The extraction overseas occurs due the fact Europe does not have a source to extract Lithium from. Thus, the CS of Dunphy et al (2007) fails to enable a useful comparison of the current commitment to and practices of sustainability in the Pre-Use Phase.

2.4.2 Use Phase

In the Use Phase, the before mentioned steps should be examined. As an illustration, electric cars are often marketed as zero-emission cars because they do not exhaust CO₂ emission while driving. However, this depends where the electricity comes from. 82 Percent of the electricity in the Netherlands is generated by fossil energy in 2013. Renewable energy sources account for 12 percent of the total generation of electricity (TNO 2015). Results of a comparison between the CO₂-emissions of conventional cars and electric cars based on 220.000 kilometres are shown below (see figure 3.5).

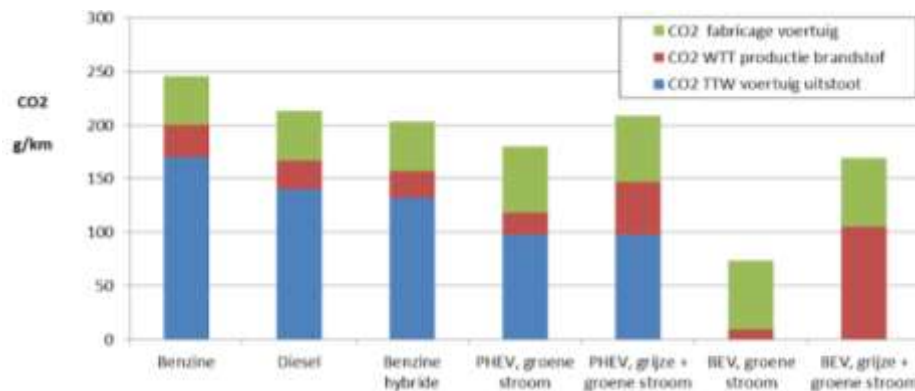


Figure 3.5: 'The CO₂-emissions of conventional and electric cars based on 220.000 km.' (TNO 2015)

The blue boxes above in figure 3.5 show the exhausting of CO₂-emissions while driving. The full battery electric car is indicated at the right side of the graph. So, the fully electric vehicles do not produce CO₂-emissions while driving. Comparing the different sources of energy for electric cars, it can be stated that with the use of grey energy the CO₂ emissions from energy production increase from around 10g/km to around 100g/km. The emissions are also significantly higher compared to benzene and diesel cars with 30g/km and 25g/km respectively. Thus, the electric car could only be seen as CO₂-emission saving, when green energy sources are used. Otherwise, the impact of having an electric car is strongly reduced.

The immature battery technology and the limited self-service possibilities are a few sustainability challenges which occur in the Use Phase. Thus, the CS of Dunphy et al (2007) fails to enable a useful comparison concerning the current commitment to and practices of sustainability in the Use Phase.

2.4.3 Post-Use Phase

In the Post-Use Phase, the before mentioned steps should be examined. The extraction of Lithium exhausts many CO₂ emissions (Verbeek et al, 2015). Therefore, Europe has said that the Lithium battery should be recycled for 50 percent minimum. Currently, two recycle companies are

technically capable of recycling these batteries. The importance of knowing what to do at the end of the vehicle application of the Lithium batteries is discovered by Neubauer and Persaran (2011). The vehicle application of these batteries is estimated to last 8 to 10 years. However, the batteries may hold a significant charge level which could be used to gain additional economic value. Three examples are remanufacturing for intended reuse in vehicles, repurposing the battery for stationary storage application or recycling to extract the valuable metals and other bi-products (Foster et al. 2014). So, the focus on remanufacturing, repurposing and recycling has economic and environmental potential. Again, the CS model of Dunphy et al (2007) fails to enable a useful comparison concerning the current commitment to and practices of sustainability in the Post-Use Phase.

Thus, the CS model of Dunphy et al (2007) fails to enable a useful comparison between companies concerning their current commitment to and practices of sustainability. The addition of the Value Hill could result in a CCSM which is able to make a comprehensive comparison by evaluating all the different phases. The main addition of the Value Hill is the possibility to enable a comparison which exceeds the end-product, by comparing the different phases behind the sustainable end-product.

3 A Comprehensive Corporate Sustainability Model

This chapter will attempt to design a comprehensive corporate sustainability model (CCSM) to enable a useful comparison between companies concerning the current commitment to and the practices of sustainability. The corporate sustainability (CS) model of Dunphy fails to enable that comparison (see section 2.2), which is demonstrated by the Value Hill (see section 2.3) to expose sustainability challenges behind the sustainable end-product (see section 2.4). Therefore, a CCSM will be designed (see chapter 3.1) together with the corresponding criteria (see section 3.2) to enable a useful comparison between companies concerning their commitment to and practices of sustainability.

3.1 Designing a Comprehensive Corporate Sustainability Model

The merge of the Value Hill and the CS model of Dunphy et al (2007) should enable a useful comparison between companies concerning the current commitment to and the practices sustainability. A company should not be labelled by the end-product that is delivered, because commitment to and the practices of sustainability throughout the phases of the Value Hill should be taken into account. A company providing a sustainable end product – the electric car – could be labelled by the CS model of Dunphy et al (2007) as ‘strategic pro-activity’, since the fifth stage ‘strategic pro-activity’ is characterised by companies who see innovation as the main focus in which a company uses sustainability to gain a potential competitive advantage. The demonstration of the Value Hill shows it could be an addition to make a comprehensive comparison of a sustainable end-product. The merge between the Value Hill and the CS of Dunphy et al (2007) results in a CCSM below (see table 3.1)

CCSM	Pre-Use				Use	After-Use			
	Extraction	Manufacturing	Assembly	Retail		Reuse/ Redistribute	Refurbish	Remanufacture	Recycle
6. Sustaining									
5. Pro-Active									
4. Efficiency									
3. Compliance									
2. Non-Responsiveness									
1. Rejection									

Table 3.1: ‘The merge between the Value Hill and the CS model of Dunphy et al (2007) resulting in the CCSM’

The prime advantage of the CCSM (see table 3.1) to the original CS model of Dunphy et al (2007) is to enable a comparison between companies concerning their commitment to and practices of sustainability beyond a sustainable end-product. Instead of the end-product being labelled, each phase from the extraction phase till the recycling phase could be labelled separately. In the case of a sustainable end-product – e.g. the electric car –, the business practices of the extraction phase and the recycling phase are not considered in the CS model of Dunphy et al (2007). The addition of the Value Hill enables a useful comparison between companies concerning the current commitment to and the practices of sustainability. Each phase of the Value Hill could be allocated a score on a 1-6

scale of the CS model of Dunphy et al (2007). A maximum of six points per phase could be allocated for the practices of a company if that phase is labelled as 'the sustaining corporation', five points will be allocated when a phase is labelled as 'strategic proactivity', etcetera. Note that in the CS of Dunphy et al (2007) points allocated for the phases are allocated the other way around. Namely, 'rejection' is indicated by the number six and 'the sustaining organisation' is indicated by the number one. Thus, the CCSM enables a useful comparison between companies concerning the current commitment to and practices of sustainability. In order to visualize the allocated scores, the corporate sustainability hill (CSH) is used. The CSH is a created tool in which the allocated scores are illustrated separately for every phase of the CCSM. In that way, the performance of a company's commitment to and practices of sustainability is presented visibly and comprehensively (see figure 3.1).

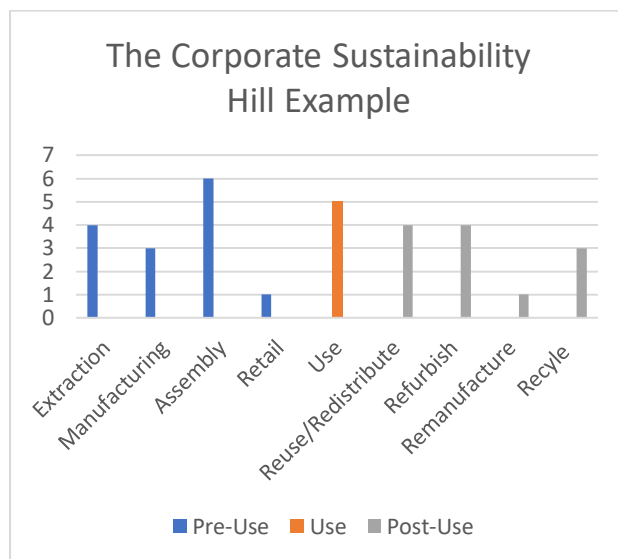


Figure 3.1: 'The Corporate Sustainability Hill Example'

The above figure (see figure 3.1) illustrates a possible visualisation of the application of the CCSM on a sustainable end-product. Hereby, a clear distinction is made between the different phases of the Value Hill. Each phase of the Value Hill is evaluated and stated separately. The blue boxes indicate the phases during the Pre-Use Phase, the orange box indicates the Use Phase and the grey boxes indicate the phases of the Post-Use Phase. The CSH enables a useful visualization of the companies concerning the current commitment to and practices of sustainability. Besides, the CSH could help companies to identify new opportunities, because every step is analysed separately whereby challenges and/or opportunities could be identified more easily. Thus, the CCSM enables a useful comparison between companies concerning their current commitment to and practices of sustainability. Subsequently, the CSH could be used to visualize the outcome of that comparison.

3.2 Operationalization of a comprehensive corporate sustainability model

Firstly, the variables should be operationalized of the CCSM to enable a useful comparison between companies concerning their current commitment to and practices of sustainability. Therefore, different criteria should be formulated upon which companies could be compared. For example, the material usage should be analysed whether the company exploits resources for immediate financial gain and expects the community to pay for the costs ('rejection') or the company utilises input materials such as renewable energy, fully recyclable materials and/or bio-based materials ('strategic proactivity'). Thus, every phase of the Value hill will be operationalised according to the CS model of Dunphy et al (2007). The summarized ecological sustainability criteria of the CS

model of Dunphy et al (2007), which are formulated in section 2.2 (see table 2.1), are implemented subsequently on every stage of the Value Hill. As a result, the CCSM is operationalised in accordance to the summarized ecological sustainability for every phase separately. Thus, the CCSM is a merge between the Value Hill and the CS model of Dunphy et al (2008). The phases of the Value enable a useful comparison between companies concerning their current commitment to and practices of sustainability throughout the different phases. The characteristics of the CS model of Dunphy et al (2007) mentioned in section 2.2 (see table 2.1) are used to compare the phases separately instead of the end-product. Therefore, on table will be designed for each phase of the CCSM to enable a useful comparison between companies concerning their current commitment to and practices of sustainability.

First, the extraction phase – extracting resources - will be operationalised according to the summarised ecological sustainability criteria of the CS model of Dunphy et al (2007). The new criteria will be named: ‘the CCSM1 Criteria’, since these are the criteria of the first stage of the CCSM (see table 3.2).

1. Extraction Phase	Prevailing Theme	Reference	CCSM1 Criteria
1. Rejection	‘Exploit resources for short-term financial gain’	‘Stealthy saboteurs and freeloaders’	Resources are extracted from the earth, because they are there for exploiting economic gain. Parties who try to put constraints on the companies’ activities during the extraction phase are actively fought.
2. Non-Responsiveness	‘Business as usual’	‘Bunker wombats’	Resources are extracted from the earth, without taking the environmental consequences of the activities during the extraction phase into account in decision making. These environmental consequences are taken for granted.
3. Compliance	‘Avoid Risk’	‘Reactive minimalists’	Resources are extracted from the earth, while accepting a demand to move toward more sustainable activities during the extraction phase. But the company limits the effort to the minimum requirements.
4. Efficiency	‘Doing more with less’	‘Industrious stewards’	Resources are extracted from the earth, while environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Also, waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	‘Lead in value adding and innovation’	‘Proactive strategists’	Resources are extracted from the earth, whereby sustainability is seen as important part of the firm’s strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral extraction phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	‘Transform ourselves: lead in creating a sustainable world’	‘Transforming futurists’	Resources are extracted from the earth, whereby all key members of the supply chain are influenced to improve sustainability in the extraction phase.

Table 3.2: ‘Ecological sustainability characteristics of the extraction phase of the CCSM’

The above table (see table 3.2) is an operationalisation of the summarised ecological sustainability criteria of the CS model of Dunphy et al (2007). The tables of the other phases are shown in the appendix (see chapter 8 ‘appendix’) for the reason that they are operationalised in accordance to the same method wherefore the other tables will be repetitious. Thus, criteria of the manufacturing phase – manufacturing resources - will be named: ‘the CCSM2 criteria’, since these are the criteria of the second stage of the CCSM (see table 3.4 in the appendix).

The criteria of the assembling phase – assembling resources - will be named: ‘the CCSM3 criteria, since these are the criteria of the third stage of the CCSM (see table 3.5 in the appendix). The criteria of the retail phase – retailing/redistributing the product – will be named: ‘the CCSM4 criteria’, since these are the criteria of the fourth stage of the CCSM (see table 3.6 in the appendix). The criteria of the use phase – repairing/maintaining the product – will be named: ‘the CCSM5 criteria’, since these are the criteria of the fifth stage of the CCSM (see table 3.7 in the appendix). The criteria of the reuse/redistribute phase – capturing value by providing re-used products- will be named: ‘the CCSM 6 criteria’, since these are the criteria of the sixth stage of the CCSM (see table 3.8 in the appendix). The criteria of the refurbish phase – refurbishing the product - will be named: ‘the CCSM7 criteria’, since these are the criteria of the seventh stage of the CCSM (see table 3.9 in the appendix). The criteria of remanufacture phase – remanufacturing the product - will be named: ‘the CCSM8 criteria’, since these are the criteria of the eighth stage of the CCSM (see table 3.10 in the appendix). The criteria of the recycle phase – recycling the product - will be named: ‘CCSM9 criteria’, since these are the criteria of the ninth stage of the CCSM (see table 3.11 in the appendix).

The operationalised CCSM criteria of all the phases are summarised in the table on the next page (see table 3.12). Thereby, the CCSM criteria are indicated by keywords. So, the phases of the CCSM are operationalised to enable a useful comparison between companies concerning their current commitment to and practices of sustainability. The CCSM could be used to allocate scores to each phase separately and the CSH could be used to visualize the outcome.

the criteria of the use phase – repairing/maintaining the product - be named: ‘the CCSM5 criteria’, since these are the criteria of the fifth stage of the CCSM (see table 3.7 in the appendix).

	Pre-Use				Use	Post-Use			
	<u>Extraction</u>	<u>Manufacturing</u>	<u>Assembly</u>	<u>Retail</u>		<u>Reuse/Redistribute</u>	<u>Refurbish</u>	<u>Remanufacture</u>	<u>Recycle</u>
<u>Value Hill</u> <u>CS</u> <u>Dunphy</u>					<u>Use</u>				
<u>6. The Sustaining Corporation</u>	Influence Key Members	Influence Key Members	Influence Key Members	Influence Key Members	Influence Key Members	Influence Key Members	Influence Key Members	Influence Key Members	Influence Key Members
<u>5. Strategic Proactivity</u>	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity	Carbon neutral is an opportunity
<u>4. Efficiency</u>	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction	Stimulus for efficiency and cost reduction
<u>3. Compliance</u>	Limited effort	Limited effort	Limited effort	Limited effort	Limited effort	Limited effort	Limited effort	Limited effort	Limited effort
<u>2. Non-Responsiveness</u>	Taken for granted	Taken for granted	Taken for granted	Taken for granted	Taken for granted	Taken for granted	Taken for granted	Taken for granted	Taken for granted
<u>1. Relection</u>	Activists fought	Activists fought	Activists fought	Activists fought	Activists fought	Activists fought	Activists fought	Activists fought	Activists fought

Table 3.12: 'The summarized operationalization of the CCSM'

4 The Application Of A Comprehensive Corporate Sustainability Model

This chapter will explore the application of the created comprehensive corporate sustainability model (CCSM, see table 3.10) to the car industry. This is done in order to illustrate a useful comparison between companies concerning their current commitment to and practices of sustainability throughout the different phases. Therefore, the car industry will be analysed in order to explore which strategies/solutions the companies in the car industry have concerning the current commitment to and the practices of sustainability according to the CCSM (SRQ 5). Note that the car industry is used as an example, since the CCSM enables a useful comparison between in general concerning their current commitment to and practices of sustainability. The car companies Audi (see section 4.1), BMW (see section 4.2) and Chevrolet (see section 4.3) will be analysed by making use of their published sustainability reports. This is a brief analysis in order to illustrate application of the CCSM, resulting in how those strategies/solutions are labelled. Information about the different phases of CCSM will be analysed separately. The information retrieved from the sustainability reports will be taken over literally in order to prevent a bias in the framing of the actions. Thus, information of each phase will be analysed in the sustainability reports and directly taken over. Then, points will be allocated to each phase of the CCSM in accordance with the corresponding CCSM criteria. Note that a score of zero implies no emphasis was mentioned of incorporating sustainability on that respective phase in the sustainability report. It does not mean that the company is doing worse than the rejection phase. Besides, information concerning the current commitment to and practices of sustainability which could not be assigned to one specific phase will be mentioned in a 'general' part. In the end, the CSH will be used to visualize the comparison between the car companies concerning their current commitment to and practices of sustainability (see section 4.4).

4.1 Audi

In this section the application of the CCSM will be illustrated to the car company Audi. The information will be retrieved from the Audi Sustainability Report of 2017 (Audi, 2018).

Extraction

Due to lack of information about the implementation of sustainability in the extraction phase, zero points will be allocated to the extraction phase according to the CCSM1 criteria.

Manufacturing

- Audi produces their first fully electric model in a carbon-neutral factory. Therefore, they want to reduce the CO₂ emissions from approximately 22,000 metric tons to zero. All the energy they use by the plant is generated from renewable sources, such as hydroelectric power and solar panels. Besides, biogas certificates are bought from green waste recycling centres. The remaining emissions will be balanced out by compensation projects at other locations.
- Within the scope of the Exchange 2.0 reconditioning project, Audi teamed up with the Volkswagen plant in Kassel in the year under review to create reconditioning concepts for mechatronic parts and transmissions.

According to the CCSM2 criteria, the above-mentioned actions could be labelled as 'the sustaining corporation'. The actions taken by Audi are focussed on 'lead in creating a sustainable world'. The product is manufactured, whereby sustainability is seen as an important part of the firm's strategy. The transition towards a carbon neutral manufacturing phase is seen as a business opportunity. Also, they teamed up with important players in the supply chain. Thus, six points will be allocated to the manufacturing phase.

Assembly

- To respond more flexibly and efficiently to growing complexity and the increasing number of variants in production, Audi is developing the principle of modular assembly. The concept has the potential to replace the assembly line approach and deliver a productivity gain of up to 20 percent. Small, separate workstations allow temporally and spatially flexible working processes. The long-term goal is to realize the potential of the technologies in suitable areas of series production.

According to the CCSM3 criteria, the above-mentioned action could be labelled as 'efficiency'. The action taken by Audi is focussed on 'doing more with less'. While assembling the product a stimulus is seen for increasing efficiency and reducing costs. Thus, four points will be allocated to the assembling phase.

Retail

Audi has optimized transport processes in recent years, focusing particularly on environmentally friendly rail transport. Since 2017, rail transport in Germany has been handled entirely CO₂-neutrally: All shipments from and to the German production locations Ingolstadt and Neckarsulm are CO₂-free. This enabled the Company to reduce its CO₂ emissions by over 13,000 metric tons in 2017.

According to the CCSM4 criteria, the above-mentioned action could be labelled as 'strategic pro-activity'. The action is focussed on 'lead in value adding and innovation'. The product is retailed, whereby the transition towards a carbon neutral retail phase is seen as a business opportunity. Thus, five points will be allocated to the retail phase.

Use

- Audi is working on many other types of potentially climate-neutral driving besides electric mobility. For some years now, they have been conducting research into sustainable fuels such as e-gas, e-gasoline and synthetically manufactured e-diesel fuel.

- We will also make key contributions toward the establishment of a network of high-performance charging stations for electric vehicles. As a member of the IONITY joint venture, we are working to expand the network of fast charging stations in Europe.

According to the CCSM5 criteria, the above-mentioned actions could be labelled as 'strategic pro-activity'. The action is focussed on 'lead in value adding and innovation'. Audi does conducts proactive research to potentially climate-neutral driving and wants to facilitate carbon neutral driving. Thus, five points will be allocated to the use phase.

Reuse/redistribute

- Meaningful use of the battery beyond this period is the subject of Audi's "Second Life" project. The aim is reuse batteries that still have good storage capacity at the end of the vehicle's life cycle for stationary industrial applications before ultimately recycling them.

According to the CCSM6 criteria, the above-mentioned action could be labelled as 'efficiency'. The action of Audi is focussed on 'doing more with less'. Audi does reuses batteries and searches for other applications, before ultimately recycling them. Thus, four points will be allocated to the reuse/redistribute phase.

Refurbish

Due to lack of information about the implementation of sustainability in the refurbish phase, zero points will be allocated to the refurbish phase according the CCSM7 criteria.

Remanufacture

- Exchanged parts are being reconditioned at Volkswagen and Audi, and new lines and tools going into operation. Some 4,500 transmissions and 20,000 mechatronic devices a year can be reconditioned as a result
- Audi teamed up with a supplier to set up the Aluminium Closed Loop pilot project. This project focuses on the processing of aluminium materials. The aluminium sheet offcuts that occur in the Audi press shops are sent back to the supplier for reprocessing. This collaborative approach saved 70,038 metric tons of CO₂-equivalent emissions in the year under review. To enhance the entire aluminium value chain further, Audi joined the Aluminium Stewardship Initiative (ASI) in 2013. The ASI, a non-profit initiative bringing together leading manufacturers and customers of the aluminium industry, has developed a global standard for the handling of aluminium, which lays down environment-related and social criteria along the value chain.

According to the CCSM8 criteria, the above-mentioned actions could be labelled as 'the sustaining corporation'. The action of Audi is focussed on 'lead in creating a sustainable world'. Audi reconditions exchanged parts at Volkswagen and Audi partners up with members. Thus, six points will be allocated to the remanufacturing phase.

Recycle

- Audi closes material loops where possible in order to reduce waste. Audi is aware of the various conditions and local statutory requirements concerning the disposal of hazardous waste and complies with them. Audi was able to further increase the proportion of recyclable waste in the year under review, while reducing the proportion of disposable waste. Overall, just under 98 (2016: 97) percent of waste occurring Group-wide is recycled.

According to the CCSM9 criteria, the above-mentioned action could be labelled as 'efficiency'. The action of Audi is focussed on 'doing more with less'. Audi closes loops where possible in order to reduce waste and increased the proportion of recyclable waste while reducing the proportion of disposable waste. Thus, four points will be allocated to the recycle phase.

General:

- Before submitting a bid, suppliers must accept the sustainability requirements that apply to all purchased goods and services. This confirmation must be repeated after a period of twelve months. So that Audi can gain an insight into social, ecological and human-rights-related risks at the various supplier sites ahead of negotiations, it also looks at the sustainability rating, which comprises self-disclosures and an on-site check (currently being piloted).
- Audi has fundamentally set itself the goal of reducing the environmental impact of every new model compared with its predecessor. In order to evaluate this objectively and maintain an overview of the entire value chain for products and processes, Audi prepares a life cycle assessment at the production start of a new product line based on a selected reference model in accordance with the international ISO 14040 ff. series of standards.

Results

The application of the CCSM enables a useful comparison between the car companies concerning the current commitment to and the practices of sustainability. Scores are allocated separately to every phase in accordance to the CCSM criteria. The outcomes will be visualised to illustrate the performance of AUDI concerning their current commitment to and practices of sustainability throughout the different phases. The CSH enables this visualization of Audi's allocated scores in accordance to the CCSM criteria (see figure 4.1).

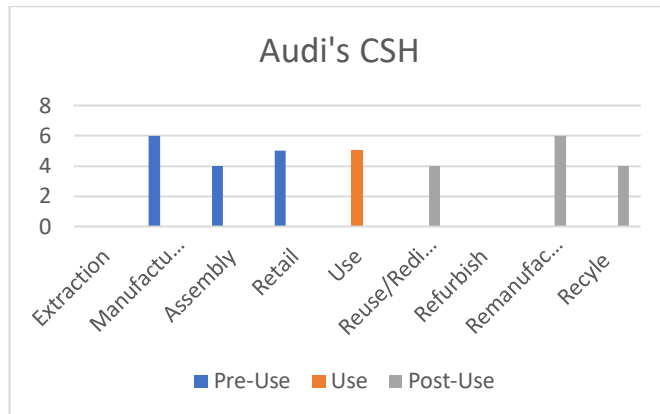


Figure 4.1: 'The outcome of the application of the CCSM on Audi's sustainability report 2017'.

The blue boxes indicate the allocated scores in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Pre-Use Phase of Audi (see table 4.1). Nothing explicit is mentioned in the extraction phase. Therefore, it is not clear whether Audi has no specific strategy on implementing sustainability in the extraction phase, or they just have not mentioned it in the sustainability report. The maximum score of six points is allocated to the manufacture phase. Four points have been allocated to the assembly phase and five points have been allocated to the retail phase.

The orange box indicates the allocated score in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Use Phase of Audi (see figure 4.1). Accordingly, a score of five points is allocated to Audi's Use Phase.

The grey boxes indicate the allocated scores in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Use Phase of Audi (see table 4.1). The reuse/redistribute and the recycle phase have been allocated a score of four points. Again, nothing explicit is mentioned about the refurbish phase thus zero points have been allocated to the refurbish phase. The remanufacture phase is allocated a maximum score of six points.

Thus, the additional value for using the CCSM compared of the CS model of Dunphy et al (2007) for Audi is enabling a useful comparison between companies concerning their current commitment to and practices of sustainability along the different phases. Next to that, opportunities and weaknesses are exposed separately in each phase. Especially the extraction and refurbish phase show a lack of incorporating sustainability.

4.2 BMW

In this section the application of the CCSM will be illustrated to the car company BMW. The information will be retrieved from the BMW Sustainability Report of 2017 (BMW, 2018).

Extraction

- We place particular emphasis on the support of initiatives to ensure that sustainability criteria are met in the mining and processing of critical raw materials. As electro mobility spreads, these measures are becoming increasingly important. In this manner, we want to make a contribution towards solving the challenges faced by society, decrease risks and reduce production costs.
- Increased transparency and resource efficiency in the supply chain
- Water, energy, waste, solvents per vehicle reduced by 45% (base year 2006)

According to the CCSM1 criteria, the above-mentioned actions could be labelled as 'the sustaining corporation'. The actions taken by BMW are focussed on 'lead in creating a sustainable world'. They do not only focus on increasing efficiency and reducing costs. They mention that they support initiatives to ensure sustainability in the extraction phase and want to make a contribution towards solving the challenges faced by society. Because they influence members of the supply chain to improve sustainability in the extraction phase, six points will be allocated to the extraction phase.

Manufacturing

- The BMW value chain stands out for its use of renewable energy sources: from the manufacture of energy-intensive materials such as CFRP (carbon fibre reinforced polymer)
- We create our vehicles in such a way that their components can largely be reused or recycled efficiently throughout their whole life cycle.
- Leader in the use of renewable energy in production and value creation
- We consistently pursue a reduction in emissions of CO₂ and pollutants in the development of our vehicle fleet. In reducing pollutant emissions, we intend to continue to meet the statutory limit worldwide.

According to the CCSM2 criteria, the above-mentioned actions could be labelled as 'efficiency'. The actions taken by BMW are focussed on 'doing more with less'. Sustainability is seen as a stimulus for increasing efficiency and reducing costs. Since they mention that they comply with the statutory limit worldwide, they cannot be labelled as 'strategic pro-activity'. Therefore, they needed to focus more on the carbon neutral manufacturing instead of increasing efficiency and complying with the statutory limit worldwide. Thus, four points will be allocated to the manufacturing phase.

Assembly

- We require a reliable supply of resources for the production of our vehicles and the energy we consume generates emissions. For this reason, we continuously increase our energy and resource efficiency and minimise CO₂ and pollutant emissions from our production. In addition, these measures help us reduce production costs, meet the needs of our stakeholders and prepare for new legal requirements.
- We have established environmental management systems at all of our existing production plants and plan to install them at all future locations

According to the CCSM3 criteria, the above-mentioned actions could be labelled as 'efficiency'. The actions taken by BMW are focussed on 'doing more with less'. Sustainability is seen as a stimulus for increasing efficiency and reducing costs. They state that they continuously increase

their energy and resource and efficiency, to reduce products costs and meeting the needs of stakeholders and preparing for new legal requirements. Thus, four points will be allocated to the assembly phase.

Retail

- Models with electric drivetrains in the new vehicle fleet of BMW do their part towards lowering CO₂ and pollutant emissions.

According to the CCSM4 criteria, the above-mentioned action could be labelled as 'compliance'. The action taken by BMW is focused on the 'reactive minimalist. The demand of the environment to move toward more sustainable activities is accepted, but the effort is limited. BMW only mentions that their new fleet will be moved on electric drivetrains to lower CO₂ and pollutant emissions. Thus, three points will be allocated to the retail phase.

Use

- Green energy package for our customers in the utilisation phase.
- We aim to help our customers become used to the idea of electro mobility. Therefore, starting in 2015, we expanded our product range step by step with new plug-in hybrid models, reaching nine by the end of 2017. We added the fully electric BMWi3 in 2013, and now have offerings in all vehicle segments. By 2025, we plan to offer 25 electrified models, of which twelve will be purely electric.
- E-vehicles have zero local emissions, along with the potential of significantly reducing the emission of CO₂ and air pollutants over the whole product life cycle, while also markedly reducing traffic noise in cities
- An electric car can only reach its full potential in terms of sustainability when it runs on electricity that is as carbon neutral as possible. The partner companies with which the BMW Group is collaborating in this area include both market-specific providers of green energy and manufacturers of solar energy systems for carports, house and garage roofs. This allows customers to produce carbon free green energy in their own homes to recharge their BMWi3, BMWi8 or BMW iPerformance plug-in hybrid vehicle.
- As part of the BMW 360° ELECTRIC portfolio, we offer private and fleet customers state-of-the-art charging solutions at home and on the road (wall boxes, charging cables, brokering green energy contracts and solar solutions).

According to the CCSM5 criteria, the above-mentioned actions could be labelled as 'the sustaining corporation'. The actions are focussed on 'lead in creating a sustainable world'. When the car is sold by BMW, they acknowledge that selling a sustainable car – the electric car- is not enough. They state that in order to reach the full potential in terms of sustainability the electricity has to be as carbon neutral as possible. Therefore, they teamed up to provide the customers at home and on the road sustainable charging solutions. Thus, members of the supply chain are influenced in sustainability practices to improve a sustainable use phase. Thus, six points will be allocated to the use phase.

Reuse/redistribute

- Other approaches include the recycling and reuse of batteries, for example in large storage units.

- We continued to invest in the reutilisation of used i3 batteries as a storage solution to support our own power supply and the public grid

BMW makes use of Take Back systems.

According to the CCSM6 criteria, the above-mentioned actions could be labelled as 'efficiency'. The actions taken by BMW are focussed on 'doing more with less'. The actions taken by BMW are taken, whereby sustainability is seen as a stimulus for increasing efficiency and reducing costs. Thus, four points will be allocated to the reuse/redistribute phase.

Refurbish

Due to lack of information about the implementation of sustainability in the refurbish phase, zero points will be allocated to the refurbish phase according to the CCSM7 criteria.

Remanufacture

Due to lack of information about the implementation of sustainability in the remanufacture phase, zero points will be allocated to the remanufacture phase according to the CCSM8 criteria.

Recycle

- We improved our expertise in recycling batteries, so a recycling rate of around 75–80% is currently possible.

- In the final project phase starting mid-2018, we want to, if possible, gain recyclates of suitable quality for producing new lithium-ion batteries.

According to the CCSM9 criteria, the above mentioned actions could be labelled as 'efficiency'. The actions taken by BMW are focussed on 'doing more with less'. The product is recycled, whereby sustainability is seen as a stimulus for increasing efficiency and reducing costs. Thus, four points will be allocated to the recycle phase.

General:

- When they sign the contract, the suppliers of BMWs also commit to ensuring that their suppliers in turn comply with these agreements. Accordingly, our suppliers are instructed to ensure that sustainability criteria are also met in the upstream supply chain.

Results

The application of the CCSM enables a useful comparison between the car companies concerning the current commitment to and the practices of sustainability. Scores are allocated separately to every phase in accordance to the CCSM criteria. The outcomes of this application will be visualised to illustrate the performance of BMW concerning their current commitment to and practices of sustainability. The CSH enables this visualization of BMW's allocated scores in accordance to the CCSM criteria (see figure 4.2).

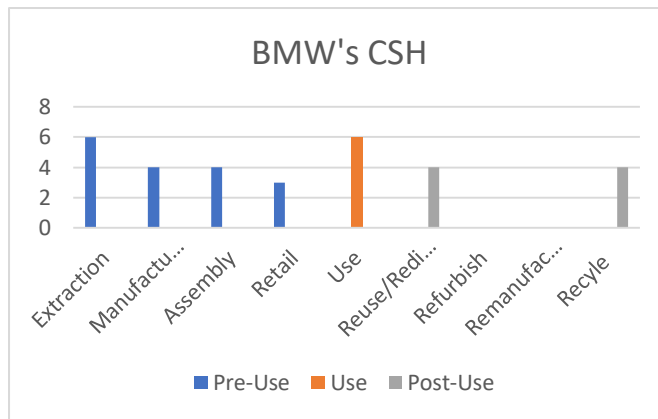


Figure 4.2: 'The outcome of the application of the CCSM on BMW's Sustainability report 2017'.

The blue boxes indicate the allocated scores in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Pre-Use Phase (see figure 4.2). A maximum score of six points is allocated to the extraction phase. The manufacture and assembly phase have a respectively score of four points. A score of three points is allocated to the retail phase.

The orange box indicates the allocated score in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Use Phase. Accordingly, a maximum score of six points is allocated to BMW's use phase.

The grey boxes indicate the allocated scores in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Post-Use Phase. Accordingly, the reuse/redistribute and the recycle phase have been allocated a score of four points. Nothing explicit is mentioned about the refurbish and the remanufacture phase. Thus, zero points have been allocated to these phases.

Thus, the additional value for using the CCSM instead of the CS model of Dunphy et al (2007) for BMW is enabling a useful comparison between companies concerning the current commitment to and practices of sustainability throughout the different phases. Next to that, opportunities are exposed in each phase separately. Especially the refurbish and remanufacture phase show a lack of the incorporation of sustainability.

4.3 Chevrolet

In this section the application of the CCSM will be illustrated to the car company Chevrolet. The information will be retrieved from the General Motors Sustainability Report of 2017. Note that Chevrolet is a part of General Motors (GM), so in their report they talk about Chevrolet specific or GM.

Extraction

- Tire manufacturing consumes three-quarters of the world's rubber. And much of that rubber comes from Southeast Asia, including areas along the Mekong River where unsustainable harvesting practices can lead to deforestation. GM has made an industry-first commitment to sourcing sustainable natural rubber for the tires we buy, sending a strong demand signal and setting an example of leadership for our entire industry. Working with partners including Michelin and the World Wildlife Fund, GM hopes to develop a road map that ensures the rubber we purchase does not contribute to deforestation. We also aspire to support education about sustainable farming and foresting practices in the Mekong region. GM is working with suppliers such as Bridgestone,

Continental, Goodyear and Michelin to develop appropriate transparency into natural rubber and ensure its traceability throughout the supply chain

According to the CCSM1 criteria, the above-mentioned actions could be labelled as 'the sustaining corporation'. The actions taken by Chevrolet are focussed on 'lead in creating a sustainable world'. They state that they made an industry-first commitment to sourcing sustainable natural rubber. Therefore, they try to send a signal to the rest of the industry. Also, they collaborate with several partners to realize their goals. Thus, six points will be allocated to the extraction phase.

Manufacturing

- One good thing leads to another. As we develop solutions for sustainable rubber, we also have our eye on other supply chains. The intent is to leverage sustainable rubber to increase the sustainability of supply chains for other raw materials, such as leather used in vehicle interiors. Manufacturers are devising ways to produce leather more sustainably, as well as developing leather alternatives that offer similar levels of luxury and comfort.

- Our zero-emissions vision extends beyond products to our manufacturing operations, where we have committed to use 100 percent renewable energy by 2050.

According to the CCSM2 criteria, the above-mentioned actions could be labelled as 'strategic proactivity'. The actions taken by Chevrolet are focussed on 'lead in value adding and innovation'. Chevrolet states that sustainability goals in the case of rubber, lead to other initiatives in the supply chains such as manufacturers that are devising ways to produce leather more sustainably. Furthermore, they have committed to use 100 percent renewable energy by 2050 in their manufacturing operations. So, the transition towards carbon neutral manufacturing phase is seen as a business opportunity. Thus, five points will be allocated to the manufacturing phase.

Assembly

- FCSM production is based at the same Brownstown, Michigan, facility where GM assembles battery packs for electric vehicles. GM and Honda are pooling their intellectual property, and will each receive their fuel cells from this plant. The venture was recognized by Environmental Leader as a 2017 Project of the Year.

According to the CCSM3 criteria, the above-mentioned action could be labelled as 'the sustaining corporation'. The actions taken by Chevrolet are focussed on 'lead in creating a sustainable world'. That is because their action is focussed on implementing sustainability as an important business opportunity and they are influencing other supply chain members in sustainability practices. Thus, six points will be allocated to the assembly phase.

Retail

Due to lack of information about the implementation of sustainability in the retail phase, zero points will be allocated to the retail phase according the CCSM4 criteria

Use

- Making our vehicles lighter and more powerful benefits our customers: Reducing mass by 10 percent improves fuel efficiency by about 5 percent. Lighter vehicles also eliminate billions of dollars in costs and millions of pounds in materials.

- To accelerate a zero-emissions future, consumer acceptance of electric vehicles must increase faster and be supported by a cleaner electric grid. We support policies and legislation that provide various incentives to help make electric vehicles more desirable and affordable. We also seek partnerships with energy suppliers to build robust charging infrastructure and improve the percentage of renewable power sources in the grid to maximize the value of electric vehicles.

According to the CCSM5 criteria, the above-mentioned actions could be labelled as 'the sustaining corporation'. The actions are focussed on lead in creating a sustainable world. They try to improve fuel efficiency in the use phase. Next to that, they try to accelerate a zero-emissions future by stimulating consumer acceptance and improving renewable power sources. Chevrolet tries to accomplish a zero-emissions future via collaborating with partners in the supply chain. Thus, six points will be allocated to the use phase.

Reuse/redistribute

- When battery components or full battery packs are returned, we perform a root cause analysis, feeding any knowledge we gain back to the design process. After analysis, there are three main paths a material may take: refurbishment, secondary use or efficient recycling. We choose the best path for each battery or component based on what best fits the capabilities of the material and what will bring the most value.
- GM is proactively developing a battery life cycle management strategy that will increase our vehicles' residual value, provide sustainability benefits and, through repurposing batteries for stationary storage, reduce the impact that a proliferation of EVs will have on the electrical grid.
- Additionally, as we explore ways to reuse our EV batteries as energy storage for our operations, we are integrating a more circular economy into our operations
- When a Chevrolet Volt is retired, up to 80 percent of its battery storage capacity remains. The secondary use potential of these batteries is on display at Milford Proving Ground, where five Volt batteries help power a GM data centre.

According to the CCSM6 criteria, the above-mentioned actions could be labelled as 'strategic proactivity'. The actions are focussed on 'lead in value adding and innovation'. Sustainability is seen as an important part of the firm's strategy with a focus on innovation. Therefore, they pro-actively develop battery life cycle management strategies, repurpose batteries for stationary storage and try to keep the value as high as possible. Thus, five points will be allocated to the reuse/redistribute phase.

Refurbish

- When battery components or full battery packs are returned, we perform a root cause analysis, feeding any knowledge we gain back to the design process. After analysis, there are three main paths a material may take: refurbishment, secondary use or efficient recycling. We choose the best path for each battery or component based on what best fits the capabilities of the material and what will bring the most value.

According to the CCSM7 criteria, the above-mentioned action could be labelled as 'efficiency'. The actions are focussed on 'doing more with less'. The product is refurbished, whereby sustainability is seen as a stimulus for increasing efficiency and reducing costs. They refurbish something if it brings them the most value. Thus, four points will be allocated to the refurbish phase.

Remanufacture

Due to lack of information about the implementation of sustainability in the remanufacture phase, zero points will be allocated to the remanufacture phase according the CCSM8 criteria.

Recycle

- The final stage of the battery life cycle is recycling, a process that can be complex and costly. We are engaging with stakeholders on this issue through leadership in the National Alliance for Advanced Transportation Batteries (NAATBatt) and U.S. Advanced Battery Consortium, exploring ways to increase the value of recycled materials, optimize logistics and simplify the recycling process.

According to the CCSM8 criteria, the above-mentioned action could be labelled as 'efficiency'. The actions are focussed on 'doing more with less'. They do team up with partners, but the emphasis is on a stimulus for increasing efficiency and reducing costs. Thus, four points will be allocated to the recycle phase.

General:

- The CO2 emissions of our global vehicle fleet represent 77 percent of our carbon footprint today. We aim to take that percentage to zero so that our children will inherit a healthier planet.
- This presents an opportunity for automakers like GM to make an already environmentally friendly technology even more sustainable: finding ways to maximize batteries' useful life direct them to secondary uses and eventually recycle their component parts. While the hybrids and EVs on the road today may have years of usable life ahead, GM is proactively developing a battery life cycle management strategy that will increase our vehicles' residual value, provide sustainability benefits and, through repurposing batteries for stationary storage, reduce the impact that a proliferation of EVs will have on the electrical grid.
- The most important action our suppliers can take to improve sustainability is to mobilize their own supply bases. Our Tier I suppliers are responsible for only about 19 percent of our GHG emissions, while Tier II suppliers account for 33 percent. This means that we have a huge opportunity to impact the environment, not only through our own actions, but also by communicating our work down multiple tiers. We are becoming more disciplined about the deployment of our sustainability expectations, using self-estimate and self-declaration approaches along with collaboration through industry organizations like AIAG.

Results

The application of the CCSM enables a useful comparison between the car companies concerning the current commitment to and practices of sustainability. Scores are allocated separately to every phase in accordance to the CCSM criteria. The outcomes will be visualised to illustrate the performance of Chevrolet concerning their current commitment to and practices of sustainability throughout the different phases. The CSH enables this visualization of Chevrolet's allocated scores in accordance to the CCSM criteria (see figure 4.3).

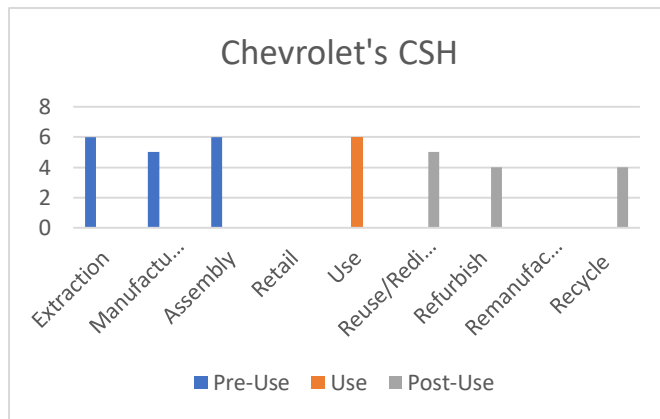


Figure 4.3: 'The results of the CSH implemented on Chevrolet's Sustainability report 2017'.

The blue boxes indicate the allocated scores in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Pre-Use Phase (see figure 4.3) of Chevrolet. The extraction phase and the assembly phase have been allocated the maximum score of six points. The manufacturing phase has been allocated a score of five points. However, nothing explicit is mentioned in the retail phase. Therefore, it is not clear whether Chevrolet has no specific strategy on implementing sustainability in the retail phase, or they just have not mentioned it in the sustainability report. So, zero points have been allocated to the retail phase.

The orange box indicates the allocated score in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Use Phase. Accordingly, the maximum score of six points is allocated. The grey boxes indicate the allocated scores in accordance to the CCSM criteria concerning the commitment to and practices of sustainability during the Post-Use Phase. Chevrolet is allocated a score of five points in the reuse/refurbish phase. In the refurbish and in the recycle phase the score of four points is allocated. Nothing explicit is mentioned about the retail phase and the remanufacture phase, wherefore zero points will be allocated to these phases. However, it is not clear whether Chevrolet has no specific commitment to and practices of sustainability in the remanufacture phase and the retail phase, or they failed to mention it in their sustainability report.

Thus, the additional value for using the CCSM compared to the CS model of Dunphy et al (2007) for Chevrolet is enabling a useful comparison between companies concerning their current commitment to and practices of sustainability along the different phases. Next to that, opportunities are exposed separately in each phase. Especially the retail and remanufacture phase show a lack of the incorporating sustainability.

4.4 A Comprehensive Corporate Sustainability Comparison Between Car Companies

In the previous sections (4.1-4.3), the car companies were analysed and labelled separately in accordance to the CCSM criteria. To enable a useful comparison between the car companies concerning their current commitment to and practices of sustainability, the CSH of each car company will be combined to one CSH in the figure below (see figure 4.4).

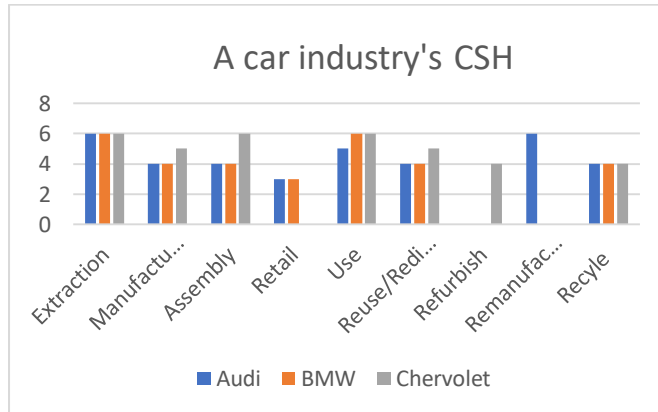


Figure 4.4: 'The combined CSH of the car companies Audi, Chevrolet and BMW'.

The figure above (see figure 4.4) enables a useful comparison between the car companies concerning their current commitment to and practices of sustainability in the different phases. The CS model of Dunphy et al (2007) failed to make such a comprehensive comparison. For example, in the assembly phase Chevrolet performed better than BMW and Audi because four points are allocated to BMW and Audi and six points are allocated to Chevrolet. Also, you could see that each company has opportunities in the retail phase since Audi and BMW have been allocated a score of three points and Chevrolet has not mentioned anything about implementing sustainability in their retail phase. Besides, incorporating sustainability in the refurbish phase and the remanufacture phase seem challenging because Chevrolet is the only company incorporating sustainability in the refurbish phase and Audi is the only company incorporating sustainability in the remanufacture phase. Nevertheless, all the three companies appear to highly incorporate sustainability in the extraction phase. Thus, each company has the possibility to evaluate their own performance concerning their current commitment to and practices of sustainability and compare their performance to other companies. These outcomes can be used to strengthen in which they are good at, and to grasp opportunities which pop-up.

5 Conclusion

This section will give a brief answer to the formulated research questions (see section 1.2) and findings of this literature study in order to answer those questions. Hereby, there will be referred to the chapters in which a broader explanation is given.

Due to the growing interest in the field of corporate sustainability (CS), the array of concepts has increased such as corporate social responsibility (CSR) and sustainable development (SD), which often share a common end. However, there is an increasing difficulty in understanding these concepts (Schwartz, and Carroll 2008). Therefore, it is important to answer the SRQ 1: 'what are the characteristics to define corporate sustainability according to literature'. CS is based on three core principles: social equity, economic integrity and environmental integrity (Bansal 2005, see section 2.1)). It is essential to keep in mind this research examined CS according to **the ecological characteristics of** the CS model of Dunphy et al (2007). Therefore, a table is designed to define ecological sustainability characteristics to avoid miscommunication (see table 2.1).

In order to enable a useful comparison between companies concerning the current commitment to and practices of sustainability, a CS model was designed by Dunphy et al (2007). This CS model illustrates a process to label the commitment to and practices of sustainability of a company. However, it could be argued that model is focussed too much on labelling the end-product instead of the commitment to and the practices of sustainability. For example, a car company delivering a sustainable end-product – the electric car- is automatically labelled as 'strategic proactivity' or even as 'the sustaining corporation', since the company uses sustainability as an important part of the firm's strategy with a focus on innovation to create a potential competitive advantage. Thus, the CS model of Dunphy et al (2007) fails to enable a useful comparison between the companies delivering a sustainable end-product concerning their commitment to and practices of sustainability.

Therefore, there is a need for a comprehensive corporate sustainability model (CCSM), which includes the commitment to and practices of sustainability behind the end-product. The Value Hill is examined as an addition to the CS model of Dunphy et al (2007), since the entire resource loop is mapped in the Value Hill. The addition of the Value Hill helps to answer the SRQ 2: 'which aspects do need to be included in a comprehensive corporate sustainability model'. Thus, the Value Hill provides the possibility to compare companies concerning the current commitment to and practices of sustainability from the extraction phase till the recycling phase. For that reason, it enables a useful comprehensive comparison. Thereby, the Value Hill is known to be easily be enhanced with additional models (Achterberg et al 2016, see section 2.3).

The possible additional value of the Value Hill to the CS model of Dunphy et al (2007) is explored via a demonstration on car companies delivering the electric car to answer the SRQ 3: 'what kind of sustainability challenges arise for companies in the car industry concerning the commitment to and practices of sustainability regarding the end-product – the electric car – according a comprehensive corporate sustainability model'. This demonstration shows several sustainability challenges arise concerning the current commitment to and practices of sustainability in the different phases, which the CS model of Dunphy et al (2007) fails to take into account. Examples of these sustainability challenges are the extraction of Lithium during the Pre-Use Phase, the importance of green energy during the Use Phase and the lack of knowledge for keeping the value of batteries during the Post-Use Phase (Verbeek et al 2016). Thus, the additional value of the Value Hill is shown (see section 2.4).

As a consequence, a CCSM was designed via a merge between the CS of Dunphy et al (2007) and the Value Hill (see section 3.1). Subsequently, the CCSM was operationalised in accordance to the table (see table 2.1) which defined ecological sustainability characteristics of each phase (see the result in section 3.2). Each phase of the Value Hill could be allocated a score on 1-6 scale, whereby a maximum of six points is allocated to a phase when the commitment to and practices of sustainability of a company in that particular phase are labelled as 'the sustaining organisation'. In order to visualize the allocated scores, the corporate sustainability hill (CSH) is used (see figure 3.6). The CSH is a created tool in which the allocated scores are shown separately for every phase of the CCSM. So, the CCSM enables a comprehensive comparison between companies concerning the commitment to and practices of sustainability and the CSH is used to visualise the comparison.

The application of the created CCSH is demonstrated on an industry – the car industry – helps to answer the SRQ 4: 'which strategies/solutions do companies in the car industry have for the sustainability challenges for the current commitment to and practices of sustainability according a comprehensive corporate sustainability model'. Therefore, the car companies Audi, BMW and Chevrolet are be analysed by making use of their published sustainability reports (see section 4.1-4.3). For instance, Chevrolet tries to accelerate a zero-emissions future by stimulating consumer acceptance and improve renewable power sources, which they do via partners in the supply chain. Subsequently, scores are allocated to the strategies/solutions in order to answer the SRQ 5: 'how are the different commitment to and practices of sustainability labelled according a comprehensive corporate sustainability model'. Accordingly, six points will be allocated to the use phase of Chevrolet for their strategies/solutions in this phase (see section 4.1-4.3)

Finally, the CSH of each car company will be combined to one CSH to visualize a comprehensive comparison between the car companies concerning their commitment to and practices of sustainability. As a consequence, each company has the possibility to evaluate their own performance concerning their current commitment to and practices of sustainability and compare that performance to other companies. For example, in the assembly phase Chevrolet performed better than BMW and Audi since Chevrolet has been allocated a score of six points (see section 4.4).

Thus, the CCSM could be used to allocate scores to the different phases and the CSH could be used to visualize the outcome. This is a brief answer to the GRQ 1: 'which comprehensive corporate sustainability model could be used to enable a useful comparison between companies concerning their current commitment to and practices of sustainability'. Due to the use of the CCSM and the CSH, each company could have the possibility to evaluate their own performance concerning their current commitment to and practices of sustainability and compare their performance to other companies. So, the CCSM could be used to enable a useful comparison between companies concerning their current commitment to and practices of sustainability and the CSH could be used to visualise the outcome.

6 Discussion

This section will discuss the interpretation of the concept corporate sustainability (CS), the ability of the comprehensive corporate sustainability model (CCSM) to include all sustainability aspects and the idea to label a company's phase. Next to that, the interpretation of the CCSM model will be discussed, even as the eventual allocated scores and the corresponding comparison between companies concerning the current commitment to and practices of sustainability.

First, the concept sustainability is used in many varieties, wherefore it could be seen as an empty concept. This thesis is focussed on the ecological part of CS, wherefore an own summarised table (see table 2.1) was designed. The CCSM is based on that table (see table 2.1). However, it should not give the impression that the current commitment to and practices of sustainability should be limited to these criteria.

Second, the created CCSM is an attempt to create a comprehensive model to enable a useful comparison between the companies concerning their commitment to and practices of sustainability. The CS model of Dunphy et al (2007) failed to enable such a comparison. Still, the CCSM fails to include the commitment to and practices of sustainability of the general section (see chapter 4.1-4.3) to that comparison. Thus, it could be argued that the model is an improvement to the CS model Dunphy et al (2007), but not able to enable a comprehensive comparison about the commitment to and practices of sustainability after all.

Third, the idea to label a company's phase is a simplification of the reality. A company could have ecological strategies that place the company in the fifth phase 'strategic proactivity'. Although, the company could lack on incorporating sustainability into another ecological context, by ignoring the environmental impacts whereby a company could be placed in the second phase 'non-responsiveness'. Thus, a company's extraction phase could be labelled as 'strategic proactivity', while criteria of previous phases do not necessarily have to be met.

Fourth, it should be taken into account that the CCSM criteria could be interpreted differently. For example, the extraction phase could be labelled as 'rejection' when a party who tries to put a constraint on the company's activities is actively fought. The way 'is actively fought' is interpreted could differ per company, per party, etc. Next to that, when no information is found in accordance to the CCSM criteria, zero points will be allocated to that particular phase. It does not imply that a company is doing worse than the rejection phase. It implies no information was found in the particular sustainability report about that particular phase. This results in an unfair allocation of scores, e.g. BMW is allocated a score of zero points in the rejection phase which could currently be evaluated as worse than fighting activists who try to put constraints on the company's activities. Thus, the CCSM fails to enable a comparison in which no room is left for interpretation and discussion.

Fifth, the way information is formulated in the sustainability reports has an influence on the labelling according to the CCSM criteria. A company is labelled in accordance to the formulated commitment to and practices of sustainability throughout the different phases. It makes a difference whether a company states that it is able to meet a certain standard, just to be proud of, or they explicitly mention that they try to exceed the minimum requirements. For example, BMW's manufacturing phase (see chapter 4.2) is labelled as 'efficiency' because they mention that they comply with the statutory limit worldwide. However, they also mention to become a leader in the use of renewable energy in the production and value creation. So, the information in a sustainability report could be presented such that it is line to most sustainable phase of the CCSM. Thus, labelling a

company in accordance to the CCSM criteria is affected by the way the information of that company is formulated.

At last, it is hard to say which company is the most sustainable company. That kind of question is too complicated to be answered via the CCSM. For example, one company has been allocated respectively score of three and four point in the extraction phase and a manufacturing phase. Another company has been allocated a respectively score of four and three point in those phases. The total scores are equal, but that would not mean the companies are equally concerning their current commitment to and practices of sustainability. Therefore, I suggest applying weight criteria to the different phases. These weight criteria could make an adjusted comprehensive comparison by specifying which phases have the biggest impact on the sustainability performance of a company. For that reason, the allocated scores to the phases with the biggest impact on company's performance concerning the commitment to and practices of sustainability should be weighed the most. The exact weights should be examined in the future in order to make such an adjusted comprehensive comparison.

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8 Appendix

2. Manufacture Phase	Prevailing Theme	Reference	CCSM2 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Resources are manufactured, purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies' activities during the manufacture phase.
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	Resources are manufactured, whereby environmental consequences of activities during the manufacture phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	Resources are manufactured, whereby the demand of the environment to move toward more sustainable activities during the manufacture phase is accepted. But the effort of the company is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	Resources are manufactured, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	Resources are manufactured, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral manufacturing phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability in the extraction phase.

Table 3.4: 'Ecological sustainability characteristics of the manufacture phase of the CCSM'

3. Assembly Phase	Prevailing Theme	Reference	CCSM3 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Resources are assembled purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies' activities during the assembly phase.
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	Resources are assembled, whereby environmental consequences of activities during the assembly phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	Resources are assembled, whereby the demand of the environment to move toward more sustainable activities during the extraction phase is accepted. But the effort of the company is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	Resources are assembled, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs during the assembly phase. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	Resources are assembled, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral assembling phase are seen as a business opportunity instead of a threat.

6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability during the assembly phase.
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Table 3.5: 'Ecological sustainability characteristics of the assembly phase of the CCSM'

4. Retail Phase	Prevailing Theme	Reference	CCSM4 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	The product is retailed purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies' activities during the retail phase
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	The product is retailed, whereby environmental consequences of activities during the retail phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	The product is retailed, whereby the demand of the environment to move toward more sustainable activities during the retail phase is accepted, but the effort is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	The product is retailed, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	The product is retailed, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral retail phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability during the retail phase.

Table 3.6: 'Ecological sustainability characteristics of the retail phase of the CSH'

5. Use Phase	Prevailing Theme	Reference	CCSM5 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Selling a product is done purely for economic gain, whereby the community is expected to pay for the environmental consequences in the use phase of the product. Also, the company actively fights parties who try to put constraints on the companies' activities during the use phase
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	The product is sold, whereby environmental consequences of activities during the use phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	The product is sold, whereby the demand of the environment to move toward more sustainable activities during the use phase is accepted, but the effort is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	The product is sold, whereby environmental policies and practices during the use phase are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic	'Lead in value	'Proactive	The product is sold, whereby sustainability is seen as an

Proactivity	adding and innovation'	strategists'	important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral during the use phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability during the retail phase.

Table 3.7: 'Ecological sustainability characteristics of the use phase of the CCSM'

6. The Reuse/Redistribute Phase	Prevailing Theme	Reference	CCSM6 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Reusing/redistributing products is done purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies' activities during the reuse/redistribute phase
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	The product is reused/redistributed, whereby environmental consequences of activities during the reuse/redistribute phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	The product is reused/redistributed, whereby the demand of the environment to move toward more sustainable activities during the reuse/redistribute phase is accepted. But the effort of the company is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	The product is reused/redistributed, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	The product is reused/redistributed, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral reuse/redistribute phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability in the reuse/redistribute phase.

Table 3.8: 'Ecological sustainability characteristics of the reuse/redistribute phase of the CCSM'

7. Refurbish Phase	Prevailing Theme	Reference	CCSM7 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Refurbishing products is done purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies' activities during the refurbish phase
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	The product is refurbished, whereby environmental consequences of activities during the refurbish phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive	The product is refurbished, whereby the demand of the

		minimalists'	environment to move toward more sustainable activities during the refurbish phase is accepted. But the effort of the company is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	The product is refurbished, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	The product is refurbished, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral reuse/redistribute phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability in the refurbish phase.

Table 3.9: 'Ecological sustainability characteristics of the refurbish phase of the CCSM'

8. Remanufacture Phase	Prevailing Theme	Reference	CCSM8 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Remanufacturing products is done purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies' activities during the rejection phase
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	The product is remanufactured, whereby environmental consequences of activities during the remanufacture phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	The product is remanufactured, whereby the demand of the environment to move toward more sustainable activities during the remanufacture phase is accepted. But the effort of the company is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	The product is remanufactured, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	The product is remanufactured, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral remanufacture phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	All key members of the supply chain are influenced in sustainability practices to improve sustainability in the remanufacture phase.

Table 3.10: 'Ecological sustainability characteristics of the remanufacture phase of the CCSM'

9. Recycle Phase	Prevailing Theme	Reference	CCM9 Criteria
1. Rejection	'Exploit resources for short-term financial gain'	'Stealthy saboteurs and freeloaders'	Recycling products is done purely for economic gain, whereby the community is expected to pay for the environmental consequences and the company actively fights parties who try to put constraints on the companies'

			activities during the recycle phase
2. Non-Responsiveness	'Business as usual'	'Bunker wombats'	The product is recycled, whereby environmental consequences of activities during the recycle phase are not taken into account in decision making. These environmental consequences are taken for granted.
3. Compliance	'Avoid Risk'	'Reactive minimalists'	The product is recycled, whereby the demand of the environment to move toward more sustainable activities during the recycle phase is accepted. But the effort of the company is limited to the minimum requirements.
4. Efficiency	'Doing more with less'	'Industrious stewards'	The product is recycled, whereby environmental policies and practices are seen as a stimulus for increasing efficiency and reducing costs. Waste could be valuable to other companies and scarce and costly resources are used maximally.
5. Strategic Proactivity	'Lead in value adding and innovation'	'Proactive strategists'	The product is recycled, whereby sustainability is seen as an important part of the firm's strategy with a focus on innovation to provide a potential competitive advantage. Climate change and the transition towards carbon neutral recycling phase are seen as a business opportunity instead of a threat.
6. The Sustaining Corporation	'Transform ourselves: lead in creating a sustainable world'	'Transforming futurists'	An integrated approach is used to fulfil three main streams of sustainability (economic, social and ecological), while refurbishing the product. Also, all key members of the supply chain are influenced in sustainability practices to improve sustainably recycle the product.

Table 3.11: 'Ecological sustainability characteristics of the recycle phase of the CCSM'