



KAUNAS UNIVERSITY OF TECHNOLOGY

SCHOOL OF ECONOMICS AND BUSINESS

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**“Business Sustainability Improving Opportunities for Automobile
Industry Suppliers from CEE Countries”**

Final Degree Project

Supervisor

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**“Business Sustainability Improving Opportunities for Automobile
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International Business (code 6211LX029)

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SUMMARY

Global business operations have created visible impacts on the environment around us and one of the main concerns in modern world is global warming which all the countries and organizations fight against together. Currently, sustainable development is the best possible solution against the environmental degradation and creating fair working environment. Among the sectors that contribute the most to the global GDP automobile industry comes in the top places. Therefore, it worth to do a research on the sustainable development trends in automobile industry. As the suppliers are providers of 60% of all the finished product in that industry the author has focused on them throughout the project. Recently after joining European Union the countries in Central and Eastern Europe region has attracted a number of companies that are specialized in automobile industry. Considering that, the main aim of the research was to explore the opportunities gained by automobile suppliers in CEE region as a result of implemented sustainable development framework. The objectives were to find out the issues faced by automobile suppliers while developing their sustainability strategy, develop a solution to those issues based on existing methods in the literature, develop methods to analyze and draw conclusions from selected companies experience and find out supplier specific opportunities gained as a result of implemented methods. The main findings of the research were that the suppliers have multiple specific sustainable development methods implemented in their operations, the main motivation of creation of the sustainability is the certificates and regulations by OEMs and government. Implementation of sustainable development brings multiple opportunities to companies mostly being emission and cost reductions, better reputation, better workplace and cleaner environment. The research was qualitative and done by analyzing the sustainability reports of the supplier companies operating in CEE region. The findings can not be generalized as the research was about different parts providers and the sample size was not adequate. Future research can contribute to better understanding of specific parts suppliers by observing the operations and developing specific theory on sustainable development and benefits of it.

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SANTRAUKA

Visuotinio verslo veikla žymiai paveikė mus supančią aplinką, o vienas iš didžiausių susirūpinimą keliančių klausimų šiuolaikiniame pasaulyje yra visuotinis atšilimas, prieš kurį kovoja visos šalys ir organizacijos. Šiuo metu darnus vystymasis yra geriausias galimas sprendimas kovojant su aplinkos būklės blogėjimu ir kuriant tinkamą darbo aplinką. Automobilių industrija užima aukščiausias pozicijas sektoriuose, kur labiausiai prisidedama prie visuotinio BVP. Dėl šios priežasties yra naudinga ištirti darnaus vystymosi tendencijas automobilių pramonėje. Kadangi tiekėjai pagamina 60 % visų produktų toje pramonėje, viso darbo metu dėmesys buvo kreipiamas būtent į tai. Vidurio ir Rytų Europos regiono šalys, įstojusios į Europos Sąjungą, pritraukė didelį skaičių įmonių, kurios specializuojasi automobilių pramonėje. Atsižvelgiant į tai, šio tyrimo tikslas buvo ištirti automobilių tiekėjų įgytas galimybes VRE regione, pritaikius darnaus vystymo sistemą. Tyrimo uždaviniai buvo išsiaiškinti, su kokiomis problemomis susiduria automobilių tiekėjai plėtodami tvarumo strategijas, remiantis literatūroje randamais metodais surasti šių problemų sprendimą, sukurti analizės ir išvadų teikimo metodus remiantis pasirinktų įmonių patirtimi ir išsiaiškinti konkrečių tiekėjų įgytas galimybes, kurios buvo pastebėtos pritaikius metodus. Pagrindinės tyrimo išvados buvo šios: tiekėjai turi daug konkrečių darnaus vystymosi metodų, kuriuos pritaiko savo veikloje, pagrindinė tvarumo sukūrimo priežastis yra pirminės įrangos gamintojų (angl. original equipment manufacturer) ir vyriausybės teikiami sertifikatai ir reglamentai. Darnaus vystymo vykdymas įmonėms suteikia daug galimybių, tokių kaip išmetamųjų teršalų ir išlaidų mažėjimas, geresnė reputacija, geresnė darbo vieta ir švaresnė aplinka. Kokybinis tyrimas buvo atliktas analizuojant VRE regione veiklą vykdančių įmonių tvarumo ataskaitas. Rezultatų neįmanoma apibendrinti, kadangi tyrime buvo analizuojami skirtingų automobilio dalių tiekėjai, o imties dydis nebuvo pakankamas. Ateityje atliekami tyrimai gali būti naudingi siekiant geriau suprasti konkrečių automobilio dalių tiekėjus stebint gamavimo procesus ir kuriant konkrečią teoriją apie darnų vystymąsi ir jo naudą.

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INTRODUCTION

The UN Commission on Environment and Development issued Brundtland report named “Our Common Future” in the end of 1980s that was requiring new kind of economic development which included balanced growth of all economic, environmental and social factors called sustainable development. Sustainable development should not only consider economic development but also its relevancy with society and environment. The main idea behind this concept was economic growth alone was not enough to secure the welfare of present and future generations. In addition, it is hard to reach targeted outcomes with considering all 3 outcomes separately (Algimantas MISIŪNAS, 2009). Nowadays, companies are behaving more ethically as a result of the government requirements for companies to issue sustainability reports annually and the society is putting huge pressure on companies.

In 2017, the annual turnover of automobile industry was €2.75 trillion which is 3.65% of world GDP (Sabeti, 2018), while in 2015 the combined export value of automobile industry in CEE region was €133.6 billion (Robinson, 2017). The automobile industry is considered as one of major producers of CO₂ during its life cycle and also one of the biggest industries with number of employees. As automobiles are combination of around 30000 parts it is impossible for one company to do it solely. All original equipment manufacturers are part of a big supply chain that bring the end product to customers.

Considering all the facts above, implementation of sustainability to automobile industry is crucial and majority of the manufacturing companies are taking some actions by issuing annual sustainability reports and implementing new measures on their supply chain. There are various methods like Lean management, Life-cycle Assessment, Green Sustainable Supply Chain management and Design for sustainability which are currently used by different automobile industry members. It is considered that implementation of those methods may be motivated by the different standard requirements of the original equipment manufacturers and general stakeholders. To implement all these methods and standard the companies usually invest considerable amounts on their business process. In case of the original equipment manufacturers the studies suggest that the sustainability implementation bring various qualitative and quantitative benefit. However, when it comes to suppliers there are little information on how they are performing on triple bottom line requirements, what methods they deploy to be sustainable, what motivates them to implement those methods, what kind of benefits they get and how OEMs manage their suppliers in terms of sustainability standards.

Throughout this research project the opportunities of sustainable business development for automobile industry suppliers in Central and Easter European countries will be studied. The opportunities include the governmental grants, increased reputation, increased competitiveness, decreased production costs, decreased environmental impacts and decreased emission. The reason for choosing CEE region is the growing pace of automobile industry in the region and after joining to EU, there are big foreign direct investment coming to the region. The research is going to shed a light on the sustainable development framework of automobile suppliers who are providers of around 60% of all components of a modern automobile. By deploying the qualitative method, the reasons for implementation of specific sustainable development methods, acquired standards and gained benefits will be studied in several companies of the region.

Aim

The main aim of the research is to explore opportunities gained by automobile suppliers as a result of implemented sustainability measures.

Objectives

- 1- Highlight the issues faced by automobile suppliers while developing sustainable management strategy.
- 2- To present theoretical model linking methods, regulations, benefits and opportunities of existing sustainable management methods.
- 3- To develop a method to analyze the sustainable development linkages among methods, regulations, benefits, opportunities of selected companies.
- 4- To reveal specific opportunities gained by automobile suppliers in CEE region and make recommendations for other suppliers in the region.

The research will be based on the following 3 questions:

- 1- What is automobile industry supplier specific sustainable management methods?
- 2- What kind of standards and certificates required by OEMs and Stakeholders, do the companies acquire certificates reactively or proactively?
- 3- What opportunities does sustainable management bring to suppliers after implementation of those methods?

To reach findings and discussion a predefined structure was followed. Firstly, the cruciality of sustainability in automobile industry and current trends in CEE region were analyzed to find out potential issues faced by suppliers while developing sustainably. Then theoretical solutions and literature review were carried out to find what are existing ways for solving the mentioned problems. What methods suppliers use to implement sustainability, what are manufacturer requirements and how does it affect suppliers, how does sustainability implementation affect some companies. Later a methodology was developed where the sustainability report of the 8 companies that operates in the region was extracted and possible ways to screen them is explained. Based on the methodology the existing reports were screened, data analysis and findings were drawn. The research is finalized by conclusions and recommendation according to the findings. Throughout the research when the discussions were about potential advantages the term opportunity is used while when the discussions were about already exploited advantages it is written as benefits.

1 PROBLEM ANALYSIS: SUSTAINABILITY IN AUTOMOBILE INDUSTRY AND CURRENT TRENDS IN CEE REGION

1.1 General overview of automobile industry in CEE region

Automobile industry has changed both the daily life of the people and the global economic growth since last century. Efficient transportation is crucial to economic development in regional and global level (Liikanen, Sustainability in the Car Industry, 2001). In Europe, Japan and US all together around 25 million people are working for automotive industry (McKinsey & Company, 2013). However, all these big numbers come with a cost. During the last century the raw material usage has grown 2 times faster than population growth and it ended up with unscalable damages to environment. To overcome these issues governments, NGOs and industry leaders are working together to create sustainability in automotive industry (SAMUEL, 2017).

In the following sections, the sustainable supply chain management of automobile industry and the methods for creating sustainability with suppliers' focus was studied on existing literature, then the problems were examined.

Generally, the automobile industry supply chain consists of different tier suppliers before the manufacturers which usually includes tier 1, tier 2, tier 3 and tier 4 suppliers (Silver, 2016). The automobile supply chain scheme is depicted on figure 1 where both horizontal and vertical integrations are included.

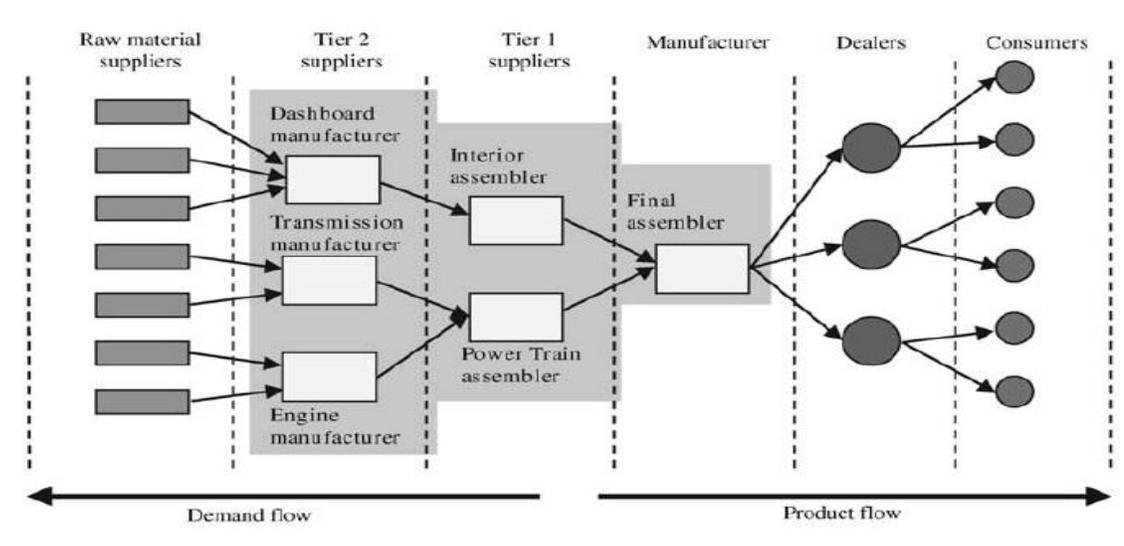


Figure 1. A generic Supply Chain scheme illustrating automotive supply chain adapted from (Charu Chandra, 2004)

Tier 1 suppliers directly supply to Original Equipment Manufacturers (OEMs) and they are usually global companies that has their own innovations and production methods. The main focus of this research is tier 1 suppliers as they are the main providers of parts and crucial as OEMs. Tier 2 suppliers are companies that produce according to the given designs by tier 1 supplier. Those companies usually focus on specialization both on production and chosen market so that they can provide high quality products. Tier 3 suppliers are producers of basic materials and they usually compete on price. Tier 4 is the raw material providers. Tier 1 usually work with 2 or 3 companies for longer terms. The total manufacturing costs of

an automobile usually consist of 60-70% purchased materials (Scannell, 2000). Which means 60-70% of the products that are used on automobile are from suppliers, therefore the OEMs usually require some standards that are their own or international which customizes the products according to their needs. For the suppliers to be successful in the industry and stay competitive they usually implement most standards themselves or according to the manufacturer requirements.

The OEMs requirements to become a supplier does not differ from typical supplier requirements in other industries which include price, capacity and quality. Price is usually the most crucial and the OEMs usually push the suppliers to decrease the prices. In addition, there are some more qualities that the suppliers should possess which are: big company size and stable financial history, JIT (Just in Time) delivery capacity and compliance with lean procedures, ISO quality standards, good reputation and communication skills.

The process to become a supplier usually takes 1.5-2 years and usually has more than 8 steps. OEMs generally ask for some materials about the company history, does inspection on company site, check the proposal, ask for sample products and then contract the proposed partnership (Canadian Trade Commissioner Service, 2014).

As it is mentioned above the automobile productions requires thousands of parts which are made of various materials. Those raw materials include iron, aluminum, glass and petroleum. Iron is used to produce steel and petroleum is used for plastics and special fibers. Those processes are usually done by Tier 4 companies. As the industry develops the materials and amount used to produce different parts have changed however significant part of the materials used are common. The main requirements for materials use in automobile production are high strength, ability to produce complex parts with minimum effort, minimum weight and corrosion resistance (Hovorun T. P, 2017).

Steel is one of the most used components in car production and weights around 80% of an average vehicle. The body, roof, door panels and exhaust are made of steel. As steel is one of the most recycled material the raw materials produced for automobile industry is also following sustainability requirements. Most of big steel producers for automobile industry is specialized and called WorldAutoSteel producers. Some of the CEE region countries has steel production experience and Slovakia is also a big steel producer for automobile industry in CEE region.

Plastics are made of oil and gas by chemical companies and it is second most used material in car production. Almost 50% of a modern automobile is made of plastics. The main parts that are made of this material are door handles, air vests, air bags and dashboard. Plastics is useful for producing lightweight vehicles which helps to decrease oil consumption and also it is cheap and easy to mold.

Rubber and aluminum are mostly used in tires. As aluminum is light and easy to shape its usage has increased recently and some parts of engine is made of it. While 80% demand for all rubber is from automobile in total rubber production and it is used for belts, hoses and engine seals (Maverick, 2017).

Overall, the raw material producers are not usually considered as the participant of automobile supply chain. However, while considering the life cycle of a vehicle the suppliers and manufacturers usually set different sustainability requirements from them. In addition to that the life cycle assessment method is considered as one of the relevant sustainable development methods for suppliers and therefore some

background information is needed. The CEE region has different raw material producer which is focused on automobile industry and therefore it worth to mention those different industries.

When it comes to the trade of the different materials, to understand the origin of the materials used in the automobile production the World Input and Output Tables are used. The CEE region countries Automobile sectors were chosen to see what kind of sectors provide input and from which origins. According to those data, the main products are metal, chemicals, petroleum products and electronic equipment. When it comes to the providers of those inputs it is usually the CEE countries itself and some countries like Netherlands, France, Italy, Spain and Germany where the automobile industry is mature (World Input and Output Database, 2015).

Majority of big and multinational automobile suppliers has opened their production sites in CEE region in last decades. According to the data related to 2017, 15 of the largest 50 suppliers to Europe, ranked by sales of original equipment parts in 2017 are mostly Spanish and German (Federal Mogul Powertrain, 2018). Berylls’s Study on the International Supplier Industry indicates that none of the world’s biggest 100 automobile suppliers are from CEE region based companies but most of them has a branch in one or multiple CEE countries. However, some of the western engine producers and Volkswagen itself has some supplier plants in various CEE countries. Automobile industry is main driver in CEE economy according to the Coface annual CEE top 500 study. 102 of those 500 companies are car manufacturers and producers of components and spare parts which mostly export to Western Europe as a main market (Staff, 2017).

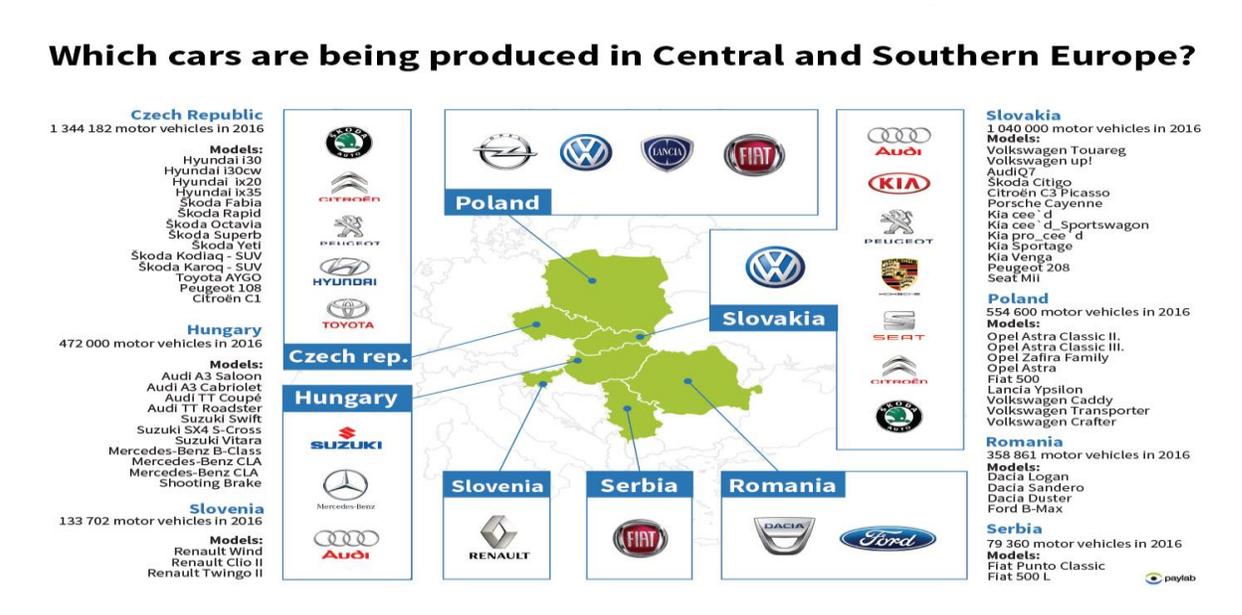


Figure 2. OEMs in CEE region adapted from (Beráková, CEE attracted 18 car brands, which have active assembly plants for personal motor vehicles, 2017).

According to the Figure 2, 18 car brands are operating in CEE region close to the automobile suppliers. The main motive for existence of both the suppliers and manufacturers in this region is cheap and skilled labor, small costs of operating in this region and closeness to Western European market. Automotive sector is the main source of employment and GDP growth in the region (Beráková, CEE attracted 18 car brands, which have active assembly plants for personal motor vehicles, 2017). These data prove the cruciality of study on the automobile suppliers of this region and understand what can motivate them to operate sustainably.

Usually those motivations are two folded either it is required by them or they develop sustainably to get some advantages. Requirements are usually in the form of standards. Implementation of all those requirements create various challenges for the suppliers. They should develop energy efficient production methods, implement new requirements to their own suppliers, educate their employees, develop automated technologies and innovate regularly to meet original equipment manufacturer's requirements. All these and additional steps require big investments and time.

1.2 The importance of sustainable supplier development in CEE region

During the last decade the CEE region has become the biggest car manufacturer in whole Europe. The reason for this growth is cheap labor, political stability, geographical location, development orientation of government, low interest rate, multilingual labor force and developed infrastructure (Vorotnikov, 2019). In 2015 only Czech Republic, Hungary, Poland and Slovakia produced almost 5% global vehicle production (International Organization of Motor Vehicle Manufacturers, 2016). As an example, the volume of automobile industry exports in 2009 in Poland was 15.7€ billion and majority of those products were sold to Germany and Italy (Buliński, 2010). Majority of those end products are exported, as an example 90% of all the produced cars were exported in Hungary (Canadian Trade Commissioner Service, 2014). According to the World Input and Output Tables data from 2014 the main buyers of end products of automobile industry from CEE region are Austria, Belgium, Czech Republic, Germany, Spain, France, Great Britain, Italy and Sweden. While outside the European Union the main buyers are USA and China (World Input and Output Database, 2015).

Over the last couple of decades, the necessity of sustainable development has increased significantly. The stakeholders are demanding responsible business activities from different industry participants. The European council and parliament have implemented many regulations to decrease the negative environmental and social effects (European Parliament, Council of the European Union, 2006). Automobile industry is one of the main centers of attention. In 2003 96% of the mobility sector was based on petroleum, the transportation sector accounted for 40% of the overall oil consumption which means 75 million barrels of oil per day (Mcauley, 2003). From 1960 to 2002 the global vehicle ownership has increased from 47.6 million to 573 million (Dargay J. Dermot Gately, 2011). More than 20% of the pollution created by an automobile throughout its life time comes from the production stage. However, almost three quarter of a modern car can be recycled including all parts (National Geographic, 2016). In addition, there are some regulations in European Union where 80% of all materials should be recyclable. It is estimated that manufacturing a car starting from extraction of iron ore, copper, lead, and much more to make the glass, steel, aluminum, and plastic produces 29 tons of waste and 1207 million cubic yards of polluted air until it reaches to customer (Jaherget, 2016). These numbers prove the cruciality of sustainable development measures in the automobile industry. In case of non-compliance with the regulations from the government or different customer groups the companies usually get penalties or boycotts by society, which has happened several times in experience. Usually, during those cases the Original Equipment Manufacturers (OEM) are the ones blamed for all issues, thus they implement standards or certificates which ensure minimum level of CSR in the supplier companies. The automobile production requires around 30000 part including smallest screws which makes it impossible for manufacturers to produce it solely (Toyota, 1995). Nowadays the bargaining power of the suppliers and the number of automobile industry participants are increasing compared to the 80s. Their contribution from suppliers increased 26% by reaching 82% in 2015 during 30-year period (Kallstrom, 2015). The

reason for the growth of the mega suppliers is the entrance of the automobile manufacturers to new markets. By entering new markets manufacturers attract suppliers to build new and better factories in less costly countries. One more incentive of building new factories in different countries is meeting the environmental requirements where the suppliers use renewable energies and utilize less wasteful technologies. The complete knocked down principle is one of the biggest reasons of span of automobile production plants globally that is going to be explained in the next sections.

1.3 Possible sustainable development methods and motivations for selection of those methods.

The pressure from stakeholders is growing gradually and most of the companies respond to these pressures by either issuing sustainability reports or taking some actions. Those taken actions help the supply chains to optimize the resource usage and processes, save costs and obtain better CSR. Even though the companies increase their attempts for sustainable development, yet they are having issues with implementation of the sustainability theories (Velislava Ivanova, 2014). According to a study in automobile industry, there are some definite barriers to implementation of sustainable development methods. Those barriers are high cost, knowledge of sustainability, lack of commitment, lack of preparation and lack of infrastructure and tools (Elita Amrina, Drivers and Barriers to Sustainable Manufacturing Initiatives in Malaysian Automotive Companies, 2012). In addition to all these barriers while implementation of sustainable development methods, the selection of the method to implement is also challenging for companies as each sustainable development method is based on different outcomes and has different challenges (Heloisa V. de MEDINA, 2003). Some of the most used methods in automobile industry are lean management and life-cycle assessment where one is mainly focused on economics outcomes while the latter is focusing on environment (Wai M. Cheung, 2017). In regard to these challenges the existing methods to implement sustainability and the ones that are used the most by the automobile industry suppliers in the CEE region is going to be studied in the following sections of this research. The focus is going to be what are the relevant methods for the suppliers to create sustainable development and what are the practical outcomes of implementation of those methods. To find out the outcomes of implementation of these methods and the potential outcomes were also studied. The sample company sustainability reports were screened to find answers to the developed questions.

Based on the past business cases the manufacturers are the first one blamed by the society in the event of non-compliance with sustainability requirements. As a result, the manufacturers usually introduce special requirements to their suppliers which is typical to automobile industry too. In April 2014, 10 biggest European automotive manufacturers together with CSR Europe launched a common self-assessment questionnaire for automobile parts suppliers to weigh their sustainability performance. The main goal of launching this self-assessment tool is to improve the sustainability performance of automotive supply chains. The questionnaire is used by suppliers to assess their sustainability performance in socially and environmentally, business conduct and compliance, and supplier management (European Automotive Manufacturers Association, 2014). Those top 10 companies created a partnership program which is called “Drive Sustainability” that work for improving sustainable development practices in automotive supply chains. Since 2012 they have assessed more than 20000 suppliers in 100 countries and did 1500 supplier capacity building activities (Drive Sustainability, 2017). Drive sustainability has introduced guiding principles to enhance sustainability in the supply chains. Those guiding principles include three core areas that are Business Ethics, Environment and Human Rights and Working conditions.

Even though there are enough research done and enough data about the manufacturer requirements and the methods to create sustainable business practices there are little and almost no information about which of those requirements are most relevant in the industry currently and how the suppliers deal with all these challenges and if implementation of sustainable development methods bring positive or negative consequences in general and in the CEE region. Considering these pressures from society and OEMs requirements the suppliers should implement different standards to their manufacturing sites. Therefore, one of the focuses of this research is going to analyze if the suppliers only implement different standards and certificates when they are required to do so, or they implement them voluntarily to beat competitors and get reputation.

Implementation of the various sustainable development methods does not only help to meet different stakeholder and standard requirements but also brings additional benefits to companies. The following section summarizes some of those benefits found during different researches.

Some studies revealed that implementing the sustainable business models is bringing enough ROI to the companies (Kearny, 2011). As the companies include measurements to cut the environmental effects, they also optimize their business and supply chain systems which end up with decreasing costs. A global project called Carbon Disclosure Project has analyzed more than 1000 big and medium companies and according to the study results the sustainability implementation decreases the production costs. In addition, they found that responsible business manners from companies bring additional turnover which around 7% in average depending on the business sector.

During the last decades companies from every industry publish sustainability reports and the CEOs usually mention the cruciality of the concept. The social pressure may not be the only reason for that initiative. McKinsey, Deutsche Bank, EY and some researchers did research on benefits of sustainability, the findings suggest that over the long-term sustainability creates competitive advantages for companies. As reported in on the research 1\$ investment on high sustainability in 1993 would value 22.60\$ in 2010, in addition high sustainability companies perform better on ROE and ROA (Robert G. Eccles, 2012). Being more efficient and using lean technologies is financially beneficial for companies and it decreases the costs significantly. The investors usually prefer socially responsible companies.

Acting sustainable brings reputation to companies among the potential partners and customers (Swartz, 2014). According to survey done by PwC the customers value the companies with better CSR practices more than its name and reputation (PwC, 2013). These factors lead to ethical consumerism. To conclude, acting sustainable creates a better public image and brings more customer, which brings more revenue and revenues increase profit and share price of companies (Mefford, 2011).

Many governments have some tax and regulation privileges for the responsible businesses (Rogers, 2016). Meeting triple bottom line requirements helps the companies to attract top talents. As the company meets all the social requirements and have better working conditions it becomes attractive for potential employees (Ernst & Young, 2015). Majority of these opportunities are general outcomes of sustainable development, however when it comes to the automobile suppliers the literature on opportunities are really scarce and the main focus of this research is that.

Based on the found issues that lack information in the existing literature the following research plan is concluded.

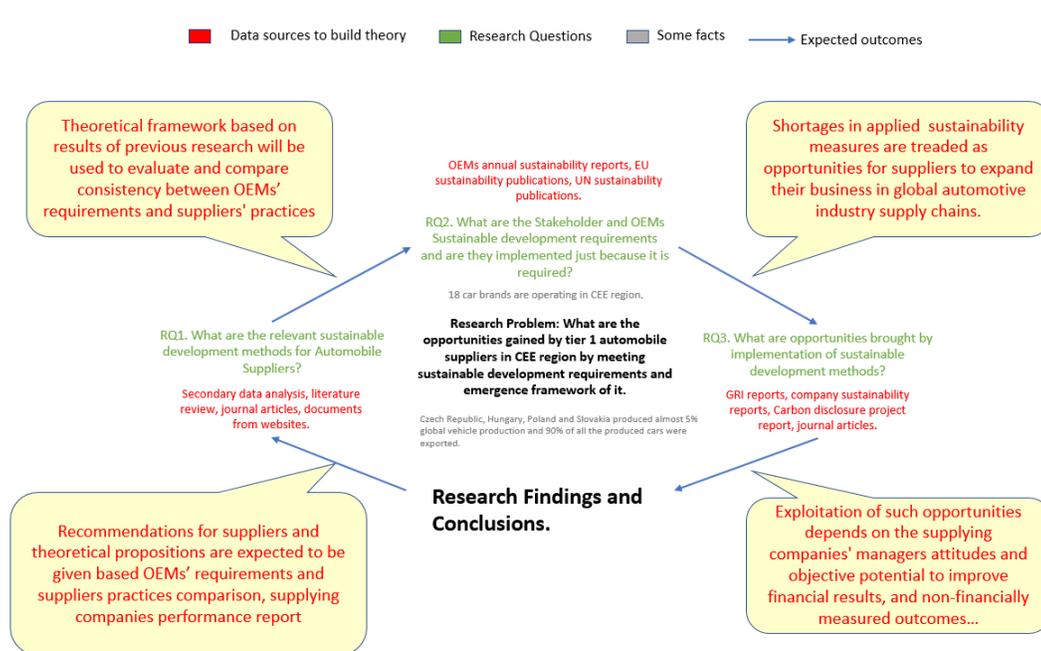


Figure 3. Research Questions and Aim

To answer the research questions sustainability reports of supplier companies operating in CEE region were screened. Generally, it is expected to get some data about the automobile suppliers sustainability situation in general and explain the sustainable development framework for them in CEE region. As around 60% of all the finished products is contributed by the suppliers it is crucial to study their sustainable development manners. However, till now most of the studies done were about the OEMs as they are the sellers of the product.

It is expected to get information on the methods the suppliers use, if those methods are common in the industry or specific to the suppliers. Their motivation for implementation of sustainability, if they are developing sustainably just because they are required to, or they do it for some incentives. The next step is regardless of the motivation for implementation of sustainability do they get any benefits other than getting customers and if yes what kind of benefits. Later it is going to be analyzed if the companies have any cost benefit analyses for the methods they implement, as the implementation of sustainable development methods can be costlier, do they assess the opportunity costs and if yes is the sustainable development good investment option for them or should they invest in quality or process efficiency more.

2 OPPORTUNITIES GAINED THROUGH SUSTAINABLE DEVELOPMENT (THEORETICAL SOLUTIONS)

In this section the existing theories and practices about the above-mentioned research objectives were evaluated. In the beginning the definitions of supply chain, sustainability and sustainable supply chain management in the automobile industry context is given. Following that the existing sustainability implementation methods are considered which are relevant to automobile industry in general and later some of the currently used standard and certificate requirements by OEMs are studied. The last parts of this section are about the opportunities that are found in automobile industry and similar industries in general after implementation of sustainable measures and some cost-benefit analysis done up to date which are available in different sources. The word opportunities used by author means emission reductions, cost reductions, gained reputation and awards and better workplace conditions. In some sections opportunities are given as benefits as the companies already exploited them, benefits as factors reasoning opportunities, motivating companies to use these opportunities. The main purpose of this section is getting better overview of the current position in the industry and prepare questions that can lead to required data from reports to reach the findings.

2.1 Supply Chain in General

The supply chain management notion was created in the end of 20th century as a developed version of logistics management which includes the procurement of raw material, manufacturing of product and services, customer delivery and the after-sale services (flashglobal.com, 2016). The supply chain in automotive industry is complex as each OEMs are producing dozens of automobile models they should ensure on time and efficient production. The reason for this complexity is market size and intense competition. Manufacturers usually deploy the completely knocked down CKD principle while internationalizing their business. By this method, instead of shipping the final product to target markets they deliver components to company's own factories in the region provided by international and local suppliers. The costs of CKD products are considerably less than end products as it has lower duties and freight fee. During the inbound logistics process as the manufacturers produce multiple car models, they use just in sequence principle where each supplier should provide different assembly parts in different production stage. In case of failure of the fulfillment of the delivery by the supplier all the process halts. However, the method helps to decrease the storage cost for manufacturer and supplier by creating demand driven system (Advantech iService Business Group, 2016).

The main focus of this project is the manufacturing part of the automobile industry which includes different tier suppliers and the OEMs. To start analyzing the mentioned problems firstly the main notions will be evaluated to reach better theoretical solutions. Understanding the main management methods in the supply chain in general can simplify the working mechanism of the different methods that will be studied in the following chapters.

2.2 Essence of Sustainability

As the main focus is opportunities brought by sustainability implementation it is reasonable to start with defining the Sustainable Development and what is the main idea behind, the motivations for creation this term and why it is crucial to study.

” Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs “ (United Nations, 1987). The definition implies a development model where the economic, environmental and social aspects are in balance and considered. In general, the environmental and social aspects mean labor use, water use, pollution prevention, energy efficiency, loss of biodiversity, biosecurity, sustainable use of living resources and forest conversion and land use. While the economic aspect means smart growth, cost saving, long-term planning, regular investment on R&D (Wanamaker, 2018). There are multiple definitions given by different authors to the sustainable development. Some examples are: ” It can be seen as a framework for companies and their management to transform their responsibility for environmental, economic and social behavior into business practices within the legitimacy of our society ” (Ulrich, 1995), ” The guiding rules are that people must share with each other and care for the Earth. Humanity must take no more from nature than nature can replenish. This in turn means adopting lifestyles and development paths that respect and work within nature's limits. It can be done without rejecting the many benefits that modern technology has brought, provided that technology also works within those limits ” (Munro, 1991), Ashford (1995) and The World Commission on Environment and Development (1987). In the Commission's words: "... sustainable development is ... a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with the future as well as present needs".

Those 3 pillars of sustainable development are used for triple bottom line accounting in companies where the changes and development after implementation of new measurements can be analyzed. However, based on the description of those three pillars it is easy to see that changes in some variables are easy to track and has material value while some has no material value. Therefore, there are different global indices created by some NGOs. Those indices create a measurement tool for the companies to report to public. Ecological Footprint, Sustainable Society index, Happy Planet index, Genuine Saving index, Global Well Being index are some examples of measurement tools (Vladimir Strezov, 2016). Considering this issue, the sample companies were analyzed if they have any measurement tools and indices deployed in their business.

Automobile is the biggest pollutant and main source of atmospheric warming beating all other pollution sources (Unger, 2010). In the modern and globalized society everyone demands sustainable development efforts from the companies because of raising concerns about climate change and other environmental and social issues like use of child labor (Marjolein C.J. Caniels, 2013). To comply with those requirements, companies deploy various methods, but the ultimate way is publishing sustainability reports annually. The sustainability reports are common among automobile OEMs. The reports are usually prepared on GRI (Global Reporting Initiative), UN Global Compact, Management’s Discussion and Analysis and company special guidelines. Each of the guidelines has different methods however they more or less cover all 3 pillars (Chartered Professional Accountants Canada, 2013).

2.3 Supply chain sustainability

Generally, the supply chains compete on cost, quality, flexibility and delivery. However, after the rise of environmental and social concerns nowadays the companies start competing on the sustainability as well. “Sustainable Supply Chain Management is the strategic, transparent integration and achievement of an organization’s social, environmental, and economic goals in the systematic coordination of key inter-

organizational business processes for improving the long-term economic performance of the individual company and its supply chains” (Carter, 2008). During the past century the supply chain management was considered as mechanism of creation of end product and delivery of it to end customer from extraction and exploitation of raw materials. In modern world the globalization and climate change pressures has introduced economic, social and environmental concerns into supply chain management. Sustainable development is included in every stage of production by different tier suppliers, OEMs, third party logistics providers and agents and distributors. To be sustainable in the production stage there are some methods used by different entities which are Life Cycle assessment, Environmental Conscious Design, Green manufacturing, Reverse Logistics and waste management (Punit Sanghavi, 2015). Some of these methods which are relevant to suppliers are going to be explained in the following section.

Additionally, Sustainable Development cannot be achieved in one level of supply chain and all the participants should be involved in this process. However, most of the sustainability creation methods are based on the manufacturers and the suppliers are not considered enough.

As understood from above sustainability is a broad term and it can differ from industry to industry according to the indicators. When it comes to the sustainability of the automobile industry supply chains and the indicators which define the level of sustainability there are some research done on specific qualitative and quantitative factors. The term sustainability indicator means the data used to measure the progress towards more ethical business. According to a study done on electronics and automotive supply chain sustainability indicators in European Union there are 69 indicators which could be considered as relevant to automobile industry after taking into account the industry and technical requirement. The following table summarizes those indicators that could be used to assess the sustainable development progress of automobile industry members (Josef-Peter Schöggel, 2017).

Table 1. Sustainable Development Indicators designed according to (Josef-Peter Schöggel, 2017)

| Environmental | Social | Economic |
|-----------------------------|--|------------------------------------|
| Hazardous substances | Corruption and bribery | Decreased energy cost |
| Wastes management | Child labors | Decreased material cost |
| GHG and other air emissions | Injuries, occupational diseases, lost days, absenteeism and fatalities | Decreased environmental penalties |
| Energy | Training per employee | Decreased accidental compensations |

| | | |
|--|--|--|
| consumption | per year | |
| Use of renewable materials | Incidents of discrimination | |
| Number of identified impacts on biodiversity | Employees covered by minimum wages | |
| Total use of water per year | Freedom of association and collective bargaining | |
| | Gender awareness | |

2.4 Sustainable management methods (potential methods that could be used by suppliers)

As long as this research is focused on sustainable supply chain management in the automobile industry, in the following sections the existing methods of implementing sustainability on automobile supply chains is going to be explained by referring to existing literature. Additionally, as it is mentioned in the problem analysis the selection of the methods for the sustainable management is one of the main focus throughout the research. Generally, some of the most relevant methods to implement in that industry are Lean management, Life Cycle Assessment (LCA), Design for X, Design for end of life and Checklist for Sustainable Product Development (CSPD). All these methods are tested and being used by various level participants of supply chain to reach sustainability goals.

According to the ISO 14040 standard the Life Cycle Assessment is a method of calculating all the potential environmental impacts of a product or service throughout its life-cycle. The life cycle of an automobile products goes through the extraction of raw materials, manufacturing, distribution, use and end of life. The LCA assessment is crucial in the earlier stages of the production. The assessment is done in 4 stage that starts with goal and scope, inventory analysis, the impact assessment and end with interpretation stage.

1-The goal and scope stage are for identifying the purpose and the units of inputs (can be the materials bought from suppliers) and outputs are being evaluated on this phase,

2- During the inventory analysis the data related to the inputs and outputs are collected. These first two steps are further analyzed in the ISO 14041 standard.

3-The environmental impact of those inputs and outputs are calculated

4- On the last interpretation phase the conclusions and decisions are drawn (Pennington DW, 2004).

As a result of usage of this method suppliers of inputs are affected as well, because manufactures require them to provide less environmentally dangerous product also consider low cost and high quality.

Implementation of this method can end up with some negative consequences for suppliers like additional costs and operations.

Usually, the life cycle of the vehicles is varying from country to country according to the development level. In underdeveloped countries it is sometimes around 45 years which end up with degradation of vehicle and additional environmental impacts (Ahmad Mayyasa, 2012).

Design for sustainability (DfS) is created within the framework of design for excellence (DfX) which is including some principles that could be used to create sustainable automobiles. Those principles are design for manufacturing, design for recyclability, design to minimize the material use, design for durability and design for energy efficiency.

Design for manufacturing (DfM) is aimed at decreasing the manufacturing time and costs. This method mostly focuses on decreasing the number of components and also using the same material for most of the components.

Design for recyclability is mostly focused on design for disassembly and design for remanufacturing. Here the main focus is to be able to disassemble with the minimum cost and by that way be able to use the same product longer periods by renewing the parts. The design for remanufacturing is focused on decreasing usage of virgin raw material and increase the ability to use the parts again. The ultimate goal here is to save the resources. In addition, it helps to save money and environment. This method requires some innovativeness in the industry because most of the materials in the automobile is steel however steel is not recyclable with 100%. To combat this problem BMW uses lots of plastics on its cars and almost 70% those plastics are recyclable (BMW, 2002)

Design to minimize material use is aimed at decreasing overall environmental effect in the life-cycle of product by different ways. One example is decreasing the weight of the vehicle by usage of aluminum and carbon fiber reinforced polymers. By decreasing the weight, the fuel usage decreases on average.

Design for Durability is aimed at producing a vehicle that lasts longer without any failure and maintenance. This method decreases the resource usage and waste generated. However sometimes this method is criticized as the product lives longer and the end user do not want to upgrade for new and more environmentally friendly product.

Design for energy efficiency is a complement of design to minimize material use and here some innovations are required for the engine or usage of light-weight materials (Ahmad Mayyasa, 2012).

Vehicle Design for end of Life is another method used in automobile industry mostly used by different tier suppliers. During 2014 only in US 11 million cars were scrapped as the useful life of the automobiles ended (Jaherget, 2016). Considering that huge numbers the vehicle parts producers should use recyclable and less harmful materials. The producers should not include harmful chemical while production which is aimed at to decrease environmental impact after disposal. European union had implemented some rules on restriction of lead, mercury, cadmium or hexavalent chromium. Additionally, all the manufacturers should call back the vehicles that is new and require disposal. The automobile waste because of end of life of vehicles in EU was exceeding 8-9 million tons annually according 2002 data (Ferrão P, 2006)

Checklist for Sustainable Product Development (CSPD) is developed by a Contract Manufacturer and automotive engineering center and tested in engineering, production, use and end of life phases for 3 years. The CSPD is a qualitative assessment tool used during early stages of production to develop sustainable products. The method mentions the importance of the consideration of sustainability issues in the early production stages. By that way the suppliers can develop more competitive products. It consists of 9 categories: resource efficiency, resource consumption, use of low impact materials, optimization of the EOL phase, health and safety aspects, transport and logistics, social and ethical aspects, decrease of environmental pollution, and economic efficiency and profitability. This method is developed in regard to the less availability of social aspects of sustainability in the automobile industry (Josef-Peter Sch€oggl a, 2016)

As it is seen above all these methods are mostly focused on environmental issues and the CSPD has some parts related to both economic and social aspects. When it comes to the economical methods of reaching sustainability in the supply chains, we can consider the optimization methods, just in time (JIT) and lean manufacturing methods which are developed to decrease the production costs that is focused on demand driven economy.

Lean management is based on the Toyota Production system which was coined in 1980s (Lean Enterprise Institute, 2000). The main idea behind this manufacturing method is zero waste and best quality possible by continuous learning and improvement. Lean is based on demand driven economy which is called pull management system. It focuses on achievement of zero waste, minimum set-up time between different operations, minimum lead time and zero breakdowns. By doing so the manufacturer usually have no inventories which incurs no warehouse costs (Mohan, 2011).

The implementation of lean process management is costly and time consuming as it requires commitment from all members, and it is hard to deal with some suppliers and customers who are from different business cultures. Some industries like apparel production focus on low cost material providers which makes the business among them less loyal and short-term relations. While in case of automobile industry the companies should sustain long-term and loyal relations if they want to create lean management. The successful implementation of lean management methods brings high quality and low cost to both manufacturer and supplier as a result of specialization and the employees are usually trained to be capable of working in a lean environment. All these factors comply with triple bottom line requirements as the employees are trained and usually work in 3 shifts, the waste is managed and minimized and the costs of production is decreased (Mefford, 2011).

The table below summarizes the sustainable development methods that are popular and relevant to automobile industry, the possible benefits of those methods as well. The actual methods used by the suppliers will be analyzed similar to these information and opportunity emergence process will be understood.

Table 2. Existing Sustainable Development Methods

| Method | Main Focus of TPL | Main aim | Opportunity created |
|--------|-------------------|----------|---------------------|
| | | | |

| | | | |
|--|------------------------------------|--|--|
| Lean Management | Economic and Environmental | Zero waste, zero inventory holding cost, pull driven system. | Less CO2 emissions, decreased manufacturing cost, reputation, continuous learning. |
| Life-cycle Assessment | Environmental | Evaluation of environmental impact of used raw materials and selection of the least harmful materials. | Less pollution, cheap recycled raw material, measured impacts. |
| Design for X | Economic and Environmental | Usage of recyclable materials, less material usage, efficient energy usage | decreasing the manufacturing time and costs, less pollution. |
| Checklist for Sustainable Product Development (CSPD) | Economic, Environmental and Social | resource efficiency, less resource consumption, use of low impact materials and it also covers social aspects like employee health and safety. | Better workplace, decreased manufacturing cost, less pollution, reputation. |

During the screening stage of the reports the researcher tried to understand which of these are used by them or do they use their own system. What kind of benefits and drawbacks these systems have? How those opportunities emerge after implementing that method? Are they required by manufacturers or is it implemented proactively to grow faster? Was it costlier and time consuming to implement those systems?

2.5 Standards required to be sustainable (by manufacturers, governments, NGOs)

In addition to different modes of sustainability creation mentioned above there are some requirements from the parties that are concerned about sustainability issues. Those parties are usually the governments and some NGOs that is balancing the impacts of business through different regulations. Non-compliance with those rules usually end up with boycotts by the society which has happened to companies like Shell, Nike and Carbide (J., 2001). Considering that, OEMs usually ask for those standards when they get new suppliers in their chain. Some of the standards that exists for implementation of sustainability are ISO 14000 which is environmental and SA 8000 which is social standard. In addition to those two there are AA 1000, EMAS, Global Compact, Global Sullivan principle, GRI Guidelines, ICC charter, ILO Conventions, OECD guidelines which is implemented in German Mobility industry. The implementation of these standards by companies is a way of showing the responsibility they take and their awareness. Some manufacturers also require mostly quality standards like ISO 9000 and other environmental ones (Philip Beske, 2008).

ISO 14000 is global environmental management standard which is usually implemented voluntarily. The family of ISO 14000 includes more than 10 standards itself. It mostly deals with creation of environmental policy, determination of impacts of product or service and planning environmental goals, attempts to decrease environmental impact and management review. The rules were all created on 1992 (asq.org, 2018).

SA 8000 is a global Social Accountability standard for companies all over the world to show their commitment level corresponding social aspects. It was created in 1997. It assesses the business regarding 9 aspects that are crucial for social accountability. Those aspects are: Child Labor, Forced or Compulsory Labor, Health and Safety, Freedom of Association and Right to Collective Bargaining, Discrimination, Disciplinary Practices, Working Hours, Remuneration, Management System (Social Accountability International , 2018).

AA 1000 is an assurance standard that is focused on evaluation of organization’s sustainability reports, their main process, systems and competences. It is generally acceptable tool. It has 3 principles which are: Materiality, Completeness and Responsiveness. (SIGMA Project , 2003)

EMAS is a management instrument from European Commission for companies to evaluate, report and improve their environmental practices. It stands for Performance, Credibility and Transparency. By implementing EMAS, organizations are able to decrease environmental impacts, strengthen legal compliance and employee involvement, and save resources, money (European Comission, 2018).

Overall, those standards mentioned above are some of the most globally known ones and required by majority of the OEMs. Considering that information, the sample company reports were screened if they have applied any of those requirements? Did they implement it reactively or proactively? Does implemented standards bring them more reputation? How the implementation process was?

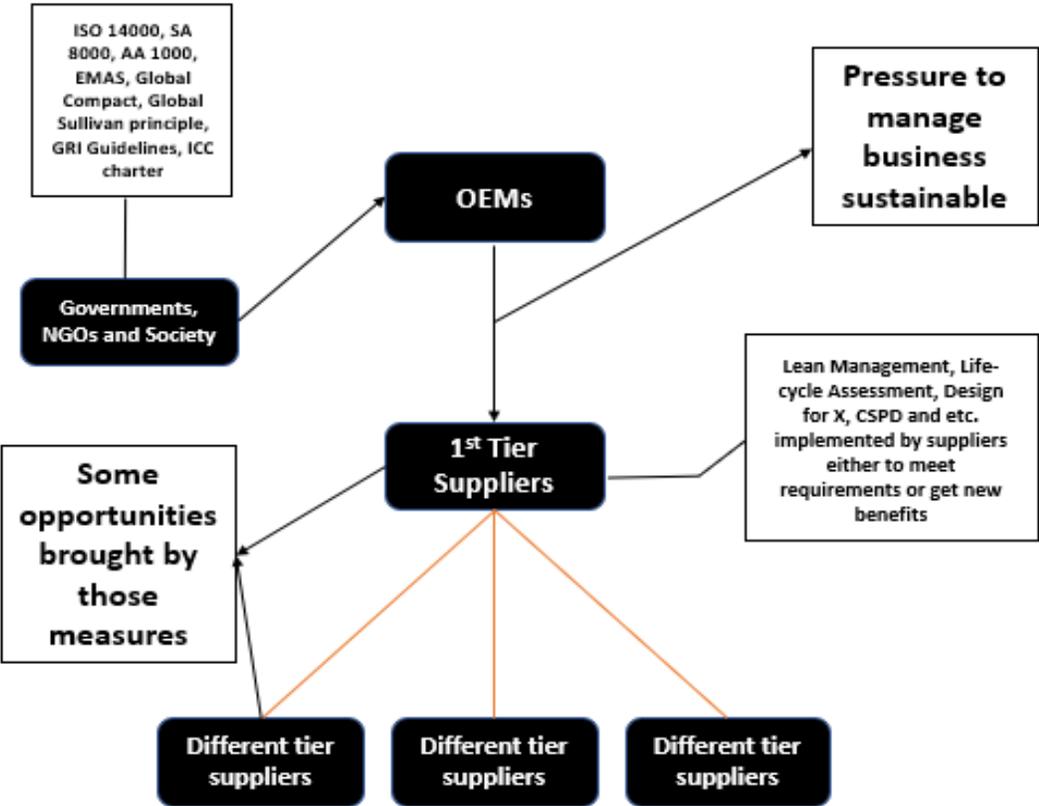


Figure 4. Framework of sustainable automobile supply chain management

The sustainability implementation methods mentioned above could be deployed to meet the standard requirements and also get new opportunities. The graph above depicts the automobile supply chain and

stakeholder relations and the outcomes of it based on the existing data. The sample supplier's sustainability implementation framework will also be studied to find difference and similarities.

2.6 Some examples of sustainability requirements by Volkswagen for suppliers

Volkswagen is one of the biggest automobile industry participants globally engaging in different level of industry activities. Their main goal is implementation of environmental, social and economic aspects of sustainability in their process and additionally the identification of risks in the early process of production so that they can fulfill all the standard requirements. Their relationship and requirements with business partners are analyzed on 4 different levels including Normative Requirements for Sustainable Supply Management, Early Detection of Supply Related Risks, Operational Implementation of Supply Processes and Monitoring and Supplier Development.

The Normative Requirements for Sustainable Supply Management level mostly focuses on requirement of some globally used quality, environmental and social standards from the suppliers. In addition to these requirements they have some of their own requirements as well according to the different business units. As they have sustainability in their mission statement, they have clear ambitions on this topic.

Early Detection of Supply Related Risks includes the global internal and external issue screening systems. The main aim is to detect weak points of the suppliers in the social or environmental concerns. To collect data, they require internal reporting.

Operational Implementation of Supply Processes while contracting with its business partners they require the suppliers to ask for the same standards for their own suppliers so that the product would be acceptable on all levels.

Monitoring and Supplier Development, sometimes the teams from Volkswagen can visit the supplier site and do monitoring additionally the sustainability reports of the suppliers are audited regularly and in case of non-compliance the partnerships are ceased (Koplin, 2005).

To summarize, as it is seen from literature review there are various methods to implement sustainability to business processes for each level supply chain participants and there are multiple standards required to achieve triple bottom line while production. However, most of these systems are not focused on the suppliers and the outcomes of the implementation of these methods for suppliers is not studied. Considering these lacking points, the sample companies were examined about the practical consequences of implementation of these systems and requirements. The exact benefits and costs are meant by consequences. The report screening seeks to check if the companies have any assessment system for the implemented sustainability resolutions.

2.7 Opportunities brought by sustainability.

The opportunities gained by implementation of the sustainable development methods are indicated as benefits in this section as it is more relevant. According to a research done on the Malaysian Automotive industry companies in 2012 the main benefits of the sustainable development are waste reduction, increasing reputation and better health after the implementation of sustainability measures. The research was done by surveying 51 companies mostly consisting of suppliers. The most interesting finding of the research was cost reduction which perceived as the least beneficial part of sustainability implementation.

The respondents were asked to rate the benefits of sustainability in 5 scale and the following results were found.

Table 3. Benefits of Sustainable Development adapted from (Elita Amrina, Drivers and Barriers to Sustainable Manufacturing Initiatives in Malaysian Automotive Companies, 2012)

| The Benefits | Mean |
|---|------|
| Reducing waste | 4.06 |
| Enhancing the company reputation | 4.04 |
| International recognition | 4.02 |
| Improving personnel health | 4.00 |
| Using resource more efficiently | 4.00 |
| Improving waste recycling | 3.98 |
| Innovation developments | 3.96 |
| Improving product quality | 3.96 |
| Enhancing operational safety | 3.94 |
| Reducing energy consumption | 3.90 |
| Enhancing environmental friendliness | 3.90 |
| Reducing consumption of non-renewable resources | 3.86 |
| Emissions reductions | 3.86 |
| Productivity improvement | 3.84 |
| Cost reductions | 3.75 |

As it is seen from the results the cost reduction has the lowest mean value (Elita Amrina, Drivers and Barriers to Sustainable Manufacturing Initiatives in Malaysian Automotive Companies, 2012).

Almost all of the big companies are investing on sustainability and CSR practices and according to a study by Zhihong Wang and Joseph Sarkis suggests that those investments can bring big profit in turn. Yet if the companies consider both the environmental and social aspects, while the companies that implement only one of those aspects usually lose their investment. The authors have taken the report of Newsweek's green rankings report on 500 publicly traded firms and analyzed their CSR practices in their supply chain and the financial performance of the companies. According to the findings the companies that implemented both environmental and social measures had more financial gains and the financial performance improved typically after 2 years of implementation of sustainability measures. Additionally, it was found that the sustainability strategy should be solid and if it just focuses on one aspect either environmental or social then the investments are usually waste and there are no financial gains (Zhihong Wang, 2013). This finding is surprising because implementation of 2 aspects can be seen more costly and the possible explanation for this finding can be the learning effect, if the company implements measures for 2 aspects simultaneously then the learning costs for the employees is less than learning separately (Palmquist, 2014).

Generally, sustainability and environmentally friendly development are perceived as beneficial for each company. However, according to a research sustainability can also bring no added value sometimes. The focus of the research was why sustainability brings added value and how much the investment should be on it? The researchers analyzed the return on investment on high quality and the sustainability and they have found that firms that focus on high quality products should continue investing on quality while firms that are focusing on mass market should invest on sustainability and CSR. The explanation of this

finding is based on 2 factors. Firstly, the sustainability is paid by both the customers and the companies therefore the companies that focus on mass market invest on it because the cost is spread among both. While the high-quality product customers understand that maintaining both high-quality and sustainability is challenging, and it can decrease the quality of the products (Sumitro Banerjee, 2017). This finding can be relevant to automobile suppliers as well because the OEMs usually require quality standards from them in addition to environmental and social standards. Considering these factors, the suppliers should understand their customer demand and invest on their production methods accordingly.

In an article by Swedish Committee on Transport and Communications has described its cost-benefit analyzes in regard to sustainable development measures has been taken. The main focus on preparation of material was to reflect on efforts made on sustainable development and deepen knowledge on cost-benefit analysis. Generally, cost-benefit analysis is an economical method where the revenues and costs are compared from a project. In the current cost-benefit analysis the timing is reflected in 3 ways, those are during the current measure time, forecast of future and in the chosen discount rate. Based on EU’s explanation, CO2 emissions, impact on the landscape, security, air pollution, noise, benefits for pedestrians and cyclists, walking times in different environments and equal opportunities and gender equality aspects can be included in a sustainability perspective in the transport sector (Committee on Transport and Communications, 2014). According to the aspects described, some of them has material value and can be assessed while the others like noise and benefits for pedestrians are non-valuable affects and it is not possible to do cost benefit analysis. By considering those material aspects like CO2 emissions and gender equality the companies can calculate values before and after implementation of some measures and costs and benefits incurred then conclude if the sustainability projects were really bringing value.

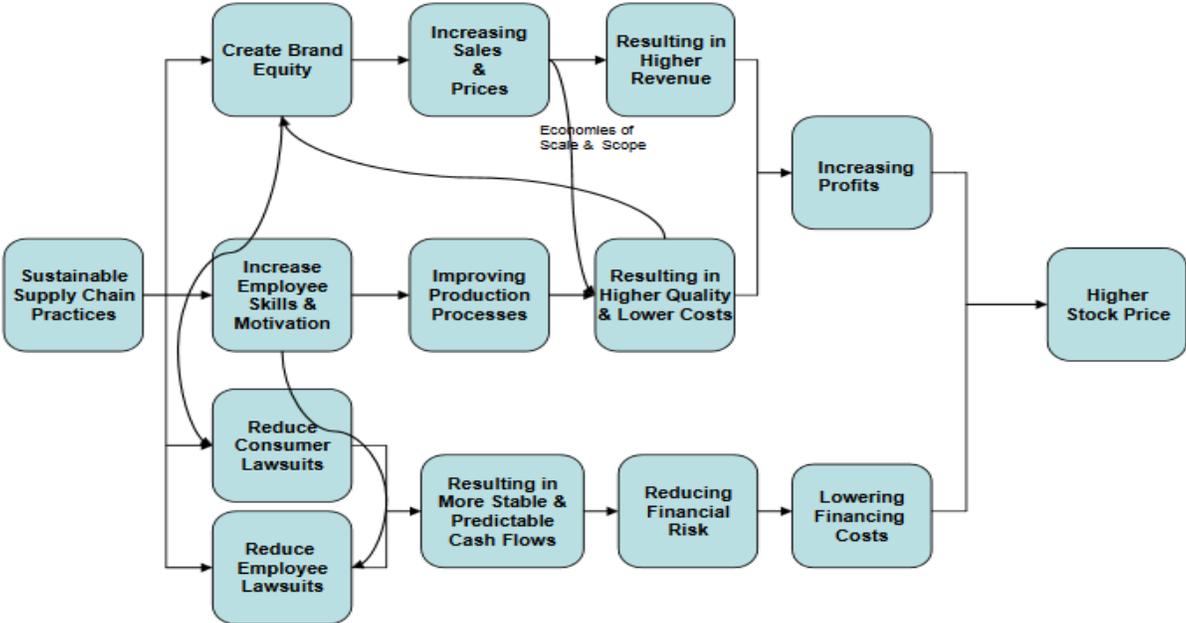


Figure 5. Sustainable Supply Chain Linkages adapted from (Mefford, 2011).

Figure 4 depicts the benefits of sustainable supply chain management systematically in general. It is based on the main requirements of triple bottom line and the outcomes it brings accordingly.

In regard to different studies the attitudes of the managers also do affect the benefits created through sustainability. According to the study on SMEs in Czech Republic the attitudes of managers while taking decision of sustainable development are influenced by 4 groups of factors which are benefits, opportunities, costs and risks.

Benefits mostly include better reputation, owning and knowledge on usage of cutting-edge technologies. Opportunities are more competitiveness, participation on sustainability and shaping the future and possibility to internationalize easily. Costs are the buying new technologies, training employees, operational costs. Risks are the possibility not to get profit, not meet requirements and decreasing quality. Based on the study out of these factors the risks and the costs are the ones that affect the attitude of the managers the most (Mikušová, 2016).

To conclude, the suppliers should understand the demand of their partner companies and implement sustainability as a whole program to get a positive outcome. Additionally, the companies can utilize the cost-benefit analysis for each project they implement by creating some measurements.

2.8 Some Examples of practical benefits gained

Automobile industry is one of the biggest contributors to global economic development however it is also one of the most harmful industry to climate change, human health, air quality, congestion. In 2001 the European Council created a sustainable development strategy for automobile industry. Implementation of those strategy had a significant impact on design and performance of automobiles produced and also the customers considered sustainability as a crucial characteristic while buying a car (Liikanen, Sustainability in the Car Industry, 2001). However, do the sustainability really pay back all the investments and does all those changes in design and performance are worth to be done are analyzed according to secondary data in this section. To see the exact result the sustainability reports of different original equipment manufacturers on Global Reporting Initiative report were taken and the reported data is compared. The reason to choose OEMs were there were less automobile supplier that has sustainability report and the data there was not full.

According to Fiat Chrysler Automobiles' report on 2016, the gender distribution of employees has changed positive from 2014 to 2016 and the proportion of women have increased around 1% to 21.2% of whole employees. The number of employees overall increased around 6000 from 2014. The value added by Fiat Chrysler Automobiles (FCA) and distributed to stakeholders in 2016 totaled €18,056 million (about 16% of revenues). Which means equitable working conditions pays back. When it comes to the number of certifications in the production, it goes up slightly each year and the environmental violations by FCA groups only happened during 2014. Total energy consumption and the energy consumption per vehicle has decreased 1% and 40% accordingly throughout 3 years period and €70 million was saved on production during 2016. The emission of harmful chemicals (Nitrogen Oxides (NOx), Sulfur Oxides (SOx)) and dust has decreased slightly. Total waste reduction per unit of vehicle was 34% on average. Additionally. €58 million saved as a result of low CO₂ emissions (Fiat Chrysler Automobiles, 2017).

BMW group has decreased its CO₂ emissions to 124g/km in 2016 from 210g/km in 1995. Share of renewable energies in vehicle production has increased in recent years while the amount of energy and water used per vehicle produced increased which effects the amount of savings as a result of efficiency creation. Overall, since 2006 the following indicators per vehicle has decreased by these percentages: Energy consumption 35.4%, CO₂ emissions 48.6%, Waste for disposal 81.5%, Water consumption 31.0%, Process waste water 48.8%, Solvent emissions 54.6 %. When it comes to the employees the share of female workers is growing annually and was 15.8% in 2016 and the accident rate is 4.0 in 2016 while it was 5.8 in 2012. They also focus on offering job to disabled people. As a result of implementation of these sustainability initiatives the net value added was €23623 million in 2016. In addition to financial benefits the company developed new business fields like URBAN-X accelerator program and the BMW Startup Garage which are relevant to sustainability requirements. They got €69 million tax reduction and €126 million performance-based subsidy from the governments during 2016 which were also mainly result of responsible business operations (BMW Group, 2017).

Volkswagen group's CO₂ emissions were 120g/km during 2016 which decreased roughly 15g/km since 2012. The company has 626715 employees 16% of which is female workers and during the recent years the proportion of female workers has stayed stable. Accidental frequency in the workplace is 3.5 per year which has been fluctuating during the last 5-years period. Energy consumption in general have increased as well while the consumption per vehicle has decreased during the 5 years period. The justification for the increase of energy consumption is growth in the production annually. The waste for recycling has increased 2 times during the 6 which proves the consideration of ELV method. Direct nitrogen dioxide and sulfur dioxide emission has also decreased. The Group saved €0.5 million worth of freshwater in 2016 as a result of efficient production. Overall the environmental protection costs decreased from €21 million to €11 million from 2015 to 2016. In the 2016, the Volkswagen Group received €435 million in performance-related public subsidies, government grants of €218 million were deducted from the costs of property, plant and equipment, and another €12 million in noncash benefits received were not capitalized as asset costs (VOLKSWAGEN KONZERN NACHHALTIGKEITSBERICHT, 2016).

One of the only Global Reporting Initiative partner supplier with sustainability report was ZF Friedrichshafen AG. It is a German company that produces gears and transmission for automobile industry. The company had 136820 employees in 2006 which is 1% compared to 2015. 16% of all employees are female and the accidents per one million working hours – was 11.5 which declined 5% compared to 2015. In three years from 2014 the company increased energy efficiency 27%. CO₂ emission were 967000 tons which was fluctuating during last three years however 36% less than the baseline emission of 2006-2010. The emission of other harmful gases has also increased as a result of growth. However, the water usage has decreased considerably. The environmental protection costs decreased to €54.87 million which decreased in comparison to 2015. The various sustainability related projects entered into force saved ZF a total in excess of EUR 300 million. The company got €12 million investment grants and €6 million expense subsidies (ZF Friedrichshafen AG, 2017).

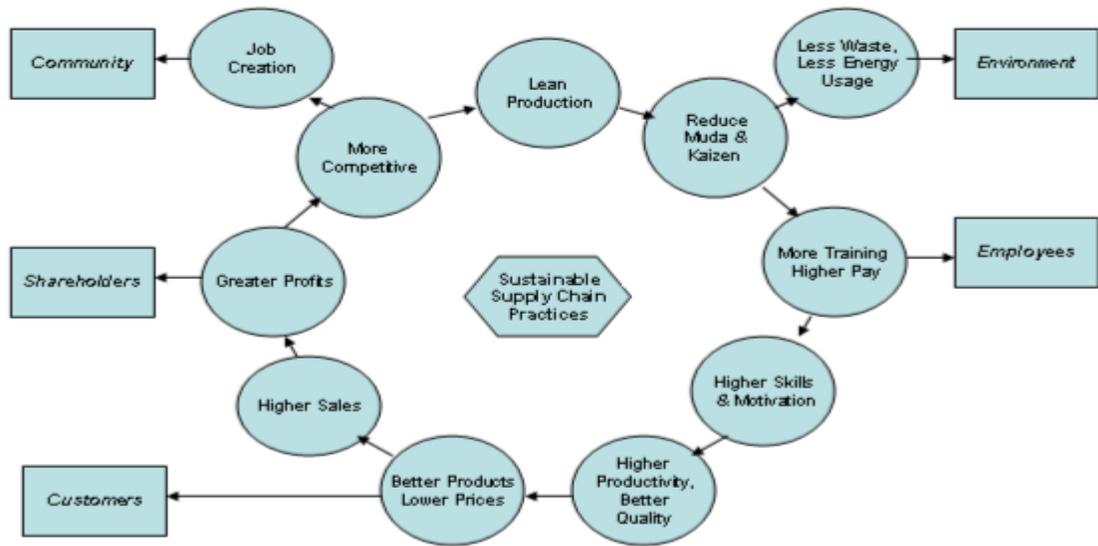


Figure 6. Sustainable Supply Chain Management Stakeholder Benefit adapted from (Mefford, 2011).

Regarding to Figure 6 it is clear that not only shareholders gain benefit from sustainable supply chain management. The customers usually get the most out of sustainable development because they get a high quality and less ecological footprint product, in automobile industry customers are OEMs. Employees are getting specialized trainings and better working conditions as a result of implemented social requirements from community and ultimately better salaries. Sustainable supply chain management ends up with more competitive industry and growth which brings more employment opportunities for community. The environmental effects are decreasing as well.

To summarize, the GRI is international sustainability reporting method used by many companies and according to the reports of above 4 companies we can conclude that implementation of triple bottom line measure in business operations bring some obvious results like decrease in energy consumption, waste disposal, increases the amount of recyclable materials and creates an equitable working environment, above all these initiatives brings government grants and additional revenues in the form of decreased costs and increased customer satisfaction.

Based on these indicators and numbers some automobile suppliers from CEE region will be analyzed and conclusions will be drawn if those companies can also benefit from sustainability.

Table 4. Benefits of Existing SD methods

| <i>Conceptualized Benefits.</i> | <i>Indicators used to evaluate</i> |
|---------------------------------|--|
| Decreased CO2 Emissions | The annual emission record will be compared (if exists). |

| | | |
|--------------------------------|--------|---|
| Decreased Consumption | Energy | The annual energy consumption costs will be compared. |
| Gender Equality | | The ratio of female/male employees. |
| #Accidents in work environment | | The number of accidents will be compared annually (if exists). |
| Government Grants | | The number of grants will be compared before and after implementation of SD methods. |
| Increased Product Quality | | The number of ISO certificates before and after implementation of SD method will be compared. |

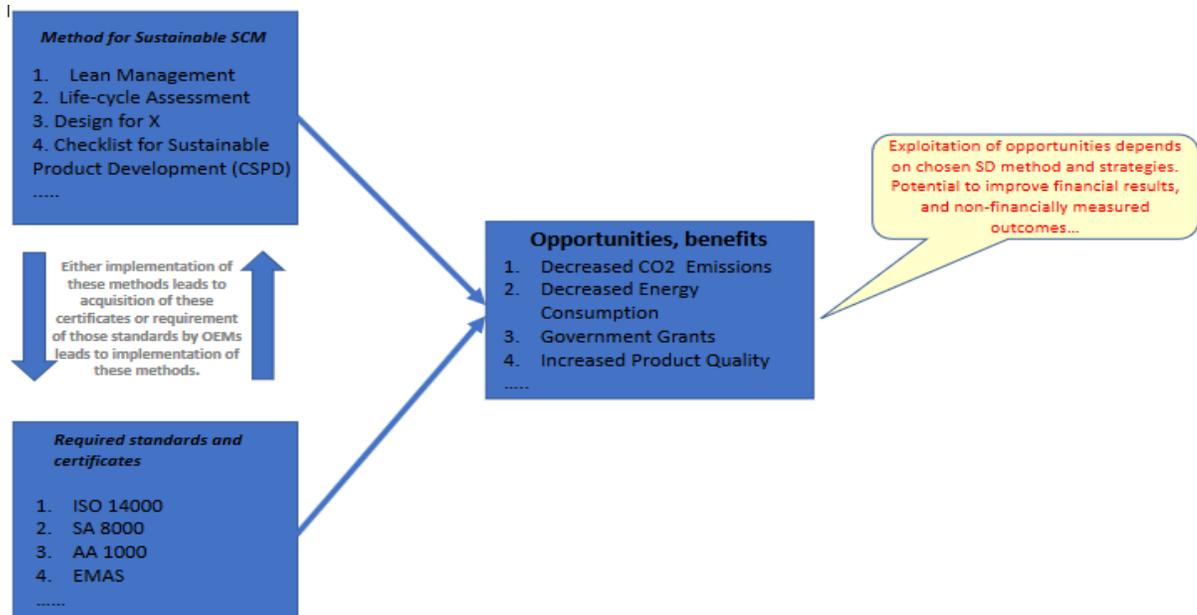


Figure 7. Sustainable development framework of suppliers based on secondary data

The graph above is based the existing information related to each research question and here we can see that the implementation of different sustainable development methods and standards are mutually related. Simultaneously with implementation of them, the companies get different benefits which are explained above, and those benefits usually are gained when all the pillars of sustainability are considered at the same time. The exploitation level of those benefits usually differs from company to company. However, according to the findings from literature those benefits are common for all sustainability measures and there is no specific study done on the automobile supplier sustainable development methods, standards, benefits and outcomes. This framework will be used as an example and the differences in the methods, standards and the benefits will be analyzed, and a similar framework will be drawn to understand the sustainable development opportunities for automobile suppliers in selected region.

3 SUPPLIER SPECIFIC OPPORTUNITIES DIVULGING METHODS

The goals of the study are to find out the sustainable management methods used by suppliers in CEE region, the main motivation for their sustainable business process selection, the outcomes of chosen methods focusing on the benefits gained. According to the findings it will be clear if automobile suppliers has a specific sustainable management method and does it really wort to implement those methods. The following methodology is designed to answer these 3 research questions:

- 1- What is supplier specific sustainable management methods?
- 2- What kind of standards and certificates are required by OEMs and Stakeholders, is there any certificates that are acquired voluntarily?
- 3- What opportunities emerge comparing supplier practices and OEMs requirements?

3.1 Research approach

The research is exploratory as its main focus is to investigate the supplier sustainability in the automobile industry which is not studied much. The findings of this research may not be used as a new theory however it can help to understand the current opportunity creation framework for suppliers better and can be used as source to do competitor analysis for some companies.

The qualitative data collection method is deployed. Qualitative research method is used to understand different processes and answers how and why questions. This method is used mostly in social research areas. The main questions that qualitative methods answers are how and why (Mohajan, 2018). This research is also based on those two questions to understand how sustainability is created and why the opportunities occur in this process. The quantitative method is used to transform findings into numerical data which can be statistically analyzed and usually the sample size should be big for this method. Additionally, as majority of sustainability indicators are non-material and hard to quantify. Considering that the qualitative method is more relevant to this research.

To answer research questions and solve the problems sustainability reports of 6 companies operating in CEE region were analyzed. At first the author planned to carry out interviews with the different level employees from companies meeting the criteria of operating in CEE region and being an automobile supplier, however there were not enough consent given to be interviewed. Only one interview carried out where the given answers were not adequate as it was expected. The answers did not include enough data about the methods used and how the opportunities emerged. The certifications were not explained clearly if those are sustainability specific. Then, after clear consideration of alternative data resources some company reports from Global Reporting Initiative database were extracted.

The screened supplier companies may have different approaches in implementation of sustainability as they are providers of different parts. However, during the analysis phase the similarities in their methods were examined and a generalized conclusion are drawn.

The research is based on deductive approach as on the beginning some problems were defined and according to those problems existing methods and theories were studied and from those findings' some questions developed to analyze the contend of reports if the existing framework are relevant to practice or they are different.

3.2 Data collection

As mentioned above 28 sustainability reports of 8 supplier companies operating in central and European union were extracted from Global Reporting Initiative (GRI) database. GRI is an independent organization which help entities to publish their sustainability reports. They offer tools and facilities that help companies to track performance on sustainability indicators and report them annually. The chosen 8 companies were found after the analyze of existing supplier companies in the region. The list of automobile supplier companies was found in the CEE countries one by one and then name of the companies were entered to database to find the relevant reports and only 8 companies had sustainability reports meeting the minimum requirements.

The main criteria to choose the sustainability reports were:

- 1- Being an Automobile supplier and having operations CEE region.
- 2- Having a sustainability report published in GRI database covering all 3 bottom lines.
- 3- Similar reporting style to GRI Guidelines.
- 4- The contend of the report should cover operations internationally (Not only one country operations).
- 5- Should have reported at least 2 consecutive years to be able to differentiate.

After preliminary assessment of the reports, only 6 reports were decided to be fully analyzed. 2 reports were not meeting the criteria of operating in CEE region and covering all three bottom lines. Voss Automotive report was about only the operations in India and Kansei being only environmental report and not covering all triple bottom line. Overall, the covered years of the reports and the relevance of them with GRI guidelines are given on the below table. Some companies report was designed on GRI guidelines which covers all the sustainability factors and has list of requirements to be given on the report. While some had company specific reports which were designed by either relevant to Carbon Disclosure Project guidelines or company specific methods.

Table 5. Information about extracted sustainability reports

| Company Name | Disclosure Year | GRI Relevance | Covered Areas |
|---------------------|--|----------------------------|---|
| Valeo | 2011, 2012, 2013, 2014, 2015, 2016, 2017 | GRI-G3, GRI-G4 and Non-GRI | Social, Environmental, Economic (R&D, Innovation) |
| ZF TRW | 2013, 2014, 2015 | GRI, Non-GRI | Social, Economic, Environmental |
| Faurecia | 2013, 2014, 2015, 2016 | Non-GRI | Social, Environmental, Economic (R&D, Innovation) |
| NSK | 2015, 2016, 2017 | GRI-G4 | Social, Environmental, Economic |
| Nexteer | 2016, 2017 | Non-GRI | Social Environmental |
| LEAR | 2016, 2017 | Non-GRI | Social, Environmental |

| | | | |
|------------------------|------------------------|---------|---------------------------------|
| VOSS Automotive | 2015, 2016, 2017, 2018 | GRI-G4 | Social, Environmental, Economic |
| Kansei | 2013, 2014, 2015 | Non GRI | Environmental |

All of the companies were international companies that had some production sites in either one or multiple CEE countries. They all were not from the same sector providing similar parts but from different sectors and offering different automobile parts. However, all of them were Tier 1 supplier. The table below summarizes the main information about those companies.

Table 6. Sample Companies' overview

| Company | Origin | Countries Operated in CEE | Parts Supplied |
|-----------------|---------------|--|---|
| Valeo | France | Poland, Czech Republic, Romania and Hungary. | Driving assistance systems, Powertrain Systems, Thermal systems, Visibility systems. |
| ZF TRW | USA | Poland and Czech Republic. | driveline and chassis systems, active and passive safety technologies, sensors and transmission systems |
| Faurecia | France | Czech Republic, Poland, Slovakia and Romania | Seating products, Interior systems, Electronics products, Clean Mobility products. |
| NSK | Japan | Poland | chassis, drivetrain, powertrain, steering systems and electrical vehicles parts. |
| Nexteer | USA | Poland | steering and driveline products. |
| Lear | USA | Poland, Czech Republic, Slovakia and Romania | seat and electrical systems. |

While analyzing the reports of the companies which includes big amount of data keywords were used to make the process more efficient. Those keywords were based on the findings from the theoretical analysis and the learnings while screening them. During interpreting the data from reports, a predefined structure was followed. Firstly, the strategy and sustainability position of the company were analyzed. Later sustainability creation initiatives related to social, environmental and economic were found and concluded as methods. Then the mentioned sustainability certifications and regulations affecting their business were found. Based on the methods and the regulations the motivations were analyzed if the methods led to certification or certification lead to creation of methods. In the last step, the numbers

related to each sustainability indicators reported by the company were analyzed to understand if there were any improvements on the performance and did those improvements lead to new customers and awards.

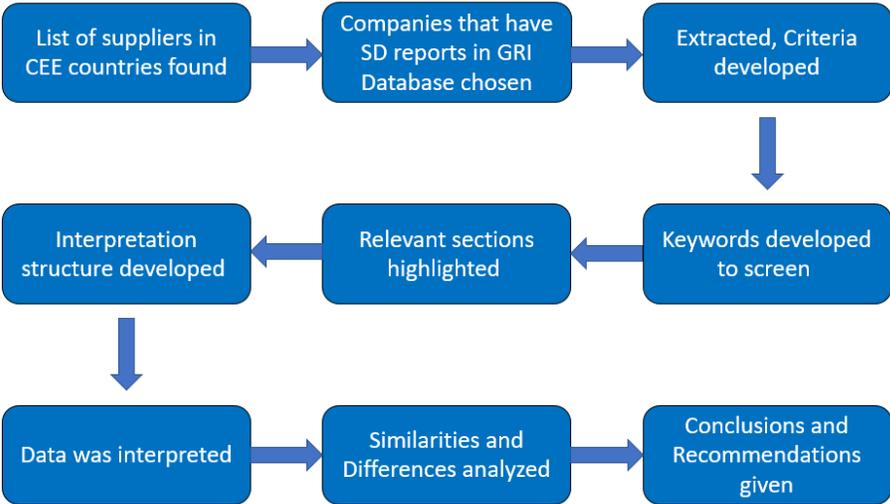


Figure 8. Methodological Workflow

Figure 8 above depicts all the stages taken to analyze the reports and draw a conclusion from them. The figure is based on the main actions taken which are explained on the text above.

4. RESEARCH FINDINGS AND DISCUSSION

In the following section the findings from the screening process of the sustainability reports of the companies is given according to the research questions. Each research question is answered by explaining the company specific information.

4.1 Sustainable management strategies of the companies

Valeo-

According to the company CEO the sustainability is in the DNA of the company as most of its products and innovations are focused on CO2 emission and fuel consumption reduction. In 2017 50% of the sales were products that directly or indirectly decrease CO2 emissions. To have clear goals and increase efficiency the company did a materiality analysis internally where the results were going to enable better interactions with stakeholders and the company, give its R&D department environmental and social data to have a clear focus on key issues and offer better information flow inside the company. The analysis was done through interviews in different departments, document reviews. As a result of these studies, 20 key sustainability issues were identified.

Since 2017 they have started doing non-financial risks analysis which include ethics, child labor and human rights. Those risk analyses are done in each country they operate in regard to the legal frameworks. There are Valeo risk management standards that include assessment of potential natural risks like earthquakes, floods and strong winds before building plants in new sites. It also has chapters about water and waste management, damage limitation in natural events and etc.

Since 2009 they have targeted new strategic technologies which is developed to decrease CO2 emissions, increase autonomous and connected mobility. The main purpose of this strategy was to take advantage of mass-market penetration of technologies that is environmentally friendly. Those new technologies were powertrain automation, digital mobility and vehicle automation. These strategies were based on the megatrends existing in the market.

Overall, the general sustainable development policy is based on Valeo's 4 axes, the code of ethics and Valeo business partner code of conduct.

The 4 axes include innovation, employees, environmentally friendly products and commitment to corporate citizenship. They have included circular economical management to their processes through waste prevention, waste recycling, recycling of packaging materials, efficient water consumption, alternative energy usage and efficient raw material consumption.

The company has created a Health, Safety and Environment (HSE) which is committed to oversee compliance of its activities with international treaties and standards, ensure better environmental performance, decrease emissions from transportation of employees and goods, limit resource usage and prohibit dangerous chemicals.

According to the report almost all the metal waste is sold for recycling, wood waste is used for heating and some part of the plastics are recycled. Each site has a waste storage area where the waste should not harm the environment and the employees, from there the recyclable substances are recycled and the rest is sent for disposal.

On top of all these general strategies they have measurement system of sustainable performance which include the environmental and social achievements and compliance with the regulations related to sustainability.

ZF TRW-

They have modified their engineering relevant to life cycle assessment requirements. They assess the outcomes of their processes on each stage and try to support creation of hybrid, electric and automated vehicle production, produce lighter and fuel-efficient parts, include more recyclable materials and avoid usage of harmful chemicals.

To balance sustainability in their supply chain system they follow the *Automotive Industry Action Group's (AIAG) "Guiding Principles to Enhance Sustainability Performance in the Supply Chain"*. All of the partner suppliers are required to fulfill the requirement of that standard. In addition, they deploy *Global Working Conditions (GWC)* standard as well for ensuring social sustainability of their partners.

There is country of origin requirements to some of the minerals that are imported from downstream partners as some of the countries use child labor in extraction of those materials which also ensure ethical business. They have also implemented the REACH regulation on chemicals in their business by adding some more chemicals on the list

The company has *Health, Safety and Environmental excellence foundation (HS&E)* which is focused on social and environmental sustainability goals. The foundation gives multiple trainings and new method implementations in all sites. The main aim of safety excellence program is ensuring employee engagement, safety and prevention of illnesses in the workplace. Environmental excellence program is created to decrease the harm of the produced products on the manufacturing and usage stage by developing more innovative and sustainable engineering methods. The foundation also ensures the compliance of sites with standards like ISO 14001, OHSAS 18001 and ISO 50001 on all the sites. The Policies of HS&E are available on 11 languages so that all the site managers could understand. They have organized HS&E awareness awards where according to predefined criteria some sites are awarded for their achievement for accomplishments annually and the site in Poland was leader in 2015. The award program helps to increase commitment level by different sites.

Faurecia-

They consider environmental impact of their processes in every step of production from design to end of life of the product with collaborating its suppliers. Their main aims are produced parts that have less impact during usage, use recyclable materials, limit chemical usage and minimize natural resource usage.

By increasing energy efficiency through energy recovery, decreasing vehicle weight, evaluating emissions and using more bio sourced outputs the company is aiming to decrease its GHG emissions.

To control and minimize consumption of materials and waste the company has created simulation processes for all designed products so that during those simulations the waste and breakdowns are eliminated.

The Environmental Committee of the company did a materiality analysis for the company through interviews with some important stakeholders and then they developed the key focus areas for 2017 which were creating a strategic environmental policy, increasing energy efficiency, circular economy and managing environmental risks.

The company has a strategy of buying maximum amount of raw materials from the local providers that are close to their sites which brings benefit to the local communities and revives the local economies.

They operate in cooperative way with all the suppliers and ensure the triple bottom line requirements are maintained by all the partners. To develop continuously they held conventions where they plan future strategies and award suppliers on quality, environment and CSR achievements.

They developed a program called FUELS (“Faurecia Unites its Employees around Local Solidarity Actions”) where the main aim is supporting local communities on different sustainability related actions. They provide supportive actions on fighting hunger, children education and prosperity and health development.

NSK-

The environmental concerns are included in the company’s mission statement and management principles include the needs of current and future generations by developing flexible, agile and dynamic. To make the employees embrace the company values they are published in multiple places and also to achieve the goals planned for 2026 they have created a department. That department is conveying the vision globally to all sites.

The company understands the value of ethical business processes and as they work with more than 9000 suppliers globally, they try to create a socially responsible procurement system. Long-term relationship with those partners is important for growth of the company. The company holds procurement policy briefings with partner companies annually to set the aims and regulations. They ask majority of the partners to conduct self-assessment of CSR compliance and according to the results they aid in better sustainable development strategy creation.

They have developed environmental code of conduct which consist of 8 goals that they want to achieve in all their operations. Those goals are employee environmental trainings waste, energy, emission and chemical related regulations. 461 trainings were carried out by the company on the environmental sustainability topic. The disclosure system and the sustainability indicators, data collection and analysis framework are also included in environmental the code of conduct.

Nexteer-

Since 2015 the company has started issuing sustainability reports and after through audit of the company, they have chosen 5 key sustainability areas as a result of this audit. The actions are called sustainability monitoring and reporting framework (SMRF). Those 5 key areas are Business Ethics, Health Safety and Environment, Value Creation, Community and Supply chain covering all the triple bottom lines of the sustainability. The new framework helps the company to keep track of sustainability indicators and assess their performance. They participate in supportive actions to the local communities which brings benefit to the stakeholders. As an example, they have given financial aid to the community in Poland for the

education of the children. They also do manufacturing capacity assessment with all suppliers by visiting the sites to decrease economic risks.

LEAR-

Their main aim is building a growth strategy where the environmental impact is minimum. To achieve that goal, they implement lean management and efficient resource usage. They have created environmental, health, safety and supplier sustainability policies. *Lear Environmental management system* is focused on minimizing the impact by identifying the main causes of environmental issues in each plant and each site is recommended to get ISO 14001:2004 and ISO 14001:2015 environmental certifications. Additionally, each plant is designed to get those certificates after 1 year of commencing the operations.

4.2 Environmental sustainability methods implemented by suppliers

Valeo-

To incorporate environmental sustainability into their processes they have created action plans which is aimed at decreasing carbon emission of its products, minimum usage of raw materials and chemicals and usage of recycled and recyclable materials.

They have developed and *EcoDesign standard* for all their products with the focus of assessing the environmental impact of the products in all stages of its life. Those stages include raw material stage specifications, production and packaging, transportation, use and disassembly. To assess the performance on the EcoDesign standard they have developed a checklist that help the employees to asses easily. The main purpose is reducing CO₂, increasing recyclability and safe material usage. This EcoDesign standard is a company specific version of life-cycle assessment method that is a sustainable development method mentioned on theoretical part.

RAISE Methodology is introduced by them since 2010 and it stands for robustness, accountability, innovations, standards and expertise. It is created to ensure robustness in processes. For each group there are teams that are ensuring this methodology and they set easily understandable standards, communicate those standards and verify implementation.

According to REACH regulation of the chemicals in European union they have specific requirements from the suppliers about the chemicals used in the products and there are lists that prohibit usage of some of those chemicals.

They have started using lighter materials for the products they offer which is a result of creating of eco design tools. The changes mostly done by usage of plastics and resins instead of metal. This strategy can be considered as design for excellence general sustainability creation method.

They have a centralized reporting tool for environmental indicators which is accessed by all the sites through internet. It is called *Valeo Risk Indicators VRI* and includes more than 200 indicators related to environmental performance which is also used in the year end for sustainability reporting and performance management.

To control pollution from discharges and waste each site has identified the prohibited materials by the government and society. All those prohibited discharges are listed on ***Banned, Regulated and Declared Substances (BRDS)***.

To prevent the soil from being contaminated they have ***banned*** usage of the ***underground tanks***, the ***effluents*** that exceed the normative levels are gone through special ***processing*** and then discharged, while storing hazardous substances they build retention systems to prevent risks.

During the ***transportation***, to optimize and decrease environmental effects they ***consolidate*** the automobile parts and ship full trucks so multiple trucks are not used, ***the packaging (optimization)*** done in a way that more product could fit safely and in the allowed countries they use ***dual capacity trailers***. Additionally, the ***packaging materials*** are changed to ***renewable*** ones usually from wood, cardboard and plastics.

To control water usage each water supplying place has systems to determine the amount and purpose of usage, ***usage of water for cooling*** in open operations is ***prohibited***, systems created to ***use rain and industrial water*** after treatment.

ZF TRW-

Cost Determination and Reduction (CDR) program is created to achieve efficiency in all operations by the HS&E department. This method is used to reduce risk, reduce material usage, save energy and decrease waste by continuous development. The CDR program is done through workshops in all HS&E related operations in manufacturing and engineering processes. They use ***Six Sigma DMAIC (Define, measure, analyze, improve and control)*** method in potential processes and then narrow down to the processes that are viable for upgrading. This method is similar to the Lean management method which is customized in the company level.

According to the ***World Business Council for Sustainable Development Greenhouse Gas Protocol*** the company assess its GHG emissions regularly and have set 20% reduction target annually considering the growth rate of operations.

Waste Generation Estimation Process collects the data from manufacturing, distribution and engineering processes. Generally, the company has 12 waste streams which are grouped in 3 categories. The disposal category, incineration category where the waste is destroyed and recovery category. By this method the waste is treated.

The company has ***dual phase extraction, enhanced reductive dichlorination and green remediation*** methodologies for environmental remediation of the sites that are contaminated as a result of their operations.

Faurecia-

Eco-Design approach is a checklist for designers where during the development process of a new product the recyclability, environmental impact, air quality and chemicals are tested and redesigned if needed.

Life-Cycle Analysis is done on each product which helps to choose optimal energy consumption methods for existing vehicles and assess the impact of alternative energy sources.

Multiple investment has been done on insulation, LED lightning and *energy efficient* equipment for decreasing energy usage. *Waste management and treatment* systems were also developed and in total €2435 million invested.

Circular Economy methods are used in all production stages where some customers collaborate with company to help in production of lighter weight parts, more reuse and BioSource materials.

Internal Reuse and more recycled material purchases are done for fabrics, plastics and aesthetics so that less raw material used. 7 sites use bio products like cotton, linen and hemp instead of petroleum products for fibers. One site buys wood waste from furniture industry.

To create more efficient energy usage the company did 55 site audits to find out potential energy usage improvement processes. Additionally, they use ISO 15001 requirements as a key guideline for energy management issues.

To control *Volatile Organic Compound Emissions (VOCS)* which is the harmful compounds that affect the atmosphere the company has created some regulations. They use more water-based paint instead of chemicals as a requirement of that method.

The water discharges are usually treated before evacuation. Water is mostly used for cooling purposes in the processes. Most of the local authorities control the discharged water therefore the company has implemented methods to improve discharged water quality.

NSK-

They use *PDCA (Plan, do, check and act)* method for the environmental management of the processes which is a methodology where the complex processes are assessed individually, and action plans are created to decrease their effect. The main benefit here is easily finding the resources of environmental issues. The PDCA method is similar to the Life-Cycle assessment method where all the production stages are considered. The implementation of this method is mostly motivated by the desire to get external certification of ISO 14001 International Environmental management standard. In accordance with that standard there are annual audit carried out by third party specialists.

To ensure the sustainable environmental practices in whole value chain the company has implemented *Green Procurement Standard* where over 80% all the suppliers given consent to these requirements. The GPS standard is a famous sustainable supply chain management used in multiple industries.

To prevent linkages from tanks they have *prohibited usage of underground tanks*. The main reason here is keeping the used soil clean. They are using double wall and over the ground tanks for oil and other chemical in the new plants. For the territories they have used underground and contaminated places they are doing regular remediation actions.

Next Generation Production Lines were developed with the aim of decreasing CO₂ emissions. The framework behind was the equipment was designed in a size which has no hydraulic pressure, less grinding machines and standby power optimized by decreasing changeover time. This method is planned to be used in all the plants in the coming years. 29% of the total energy used by the company was for the heat treatment to reduce energy usage on these processes they have shifted from usage of kerosene and

gas to **electricity heat treatment**. 13% of energy usage is from compressed air for spindles in the grinders and the company has shifted to use inverted compressors and they changed from oil-air spindles to **grease spindles**. One of the production sites has changed from gas air conditioner to electric one which also decreases emissions and planned to be installed in other plants as well. **Solar Power Generation** facilities were built in some sites in Europe which is planned to be expanded to other regions as well to increase renewable energy usage. All the plants are changing the lighting systems to **LED lights**.

To be able to decrease the steel waste the company has changed the shape of the parts of the products they offer through R&D updates. They have started sorting the waste so that the recycling process could be easier and more effective. To decrease water waste, they have used filters in the cooling water which cleans oil and other contaminations from the water and helps to use less water for cooling.

The company has developed a list of harmful substances in accordance with the governmental regulations. The list includes reduced, observed and prohibited substances. To check out the performance of the plants they have done multiple audits internationally.

Nexteer-

In countries where the sunshine is abundant the company decided to use **sky domes (rooftops that is possible to open)** which helps to reduce the energy consumption by not consuming light. According to the global manager it does not only reduce the energy consumption but also increase the employee productivity. They also use **motion sensitive LED lightening** in some sites to decrease energy consumption and CO₂ emissions. The **cooling equipment** is designed with new **flexible power motors** so that its power can be adjusted according to the demand. To warm water in some plants they have deployed compressors that save the sun heat. The ISO 14001 standard is also used as one of the main guidelines to implement new resource, energy and waste management methods. All of the **packaging** materials used by the company are **recyclable** materials being plastic, steel, wood and corrugate.

LEAR-

They have deployed the **Reduce, Reuse, Reclaim and Recycle operation system** which is designed to decrease the waste production. They redesign the processes that create the waste and sometime change it totally when needed.

To decrease the **GHG emissions** they have created a **data collection and analyzing system** which makes it possible to plan to decrease the emissions. They are participating in the Carbon Disclosure Project to report on their GHG emission performance. **Lean** manufacturing methodology is used in the plants to decrease the energy usage and waste creation. Site audits has been done to find leakages and repair, multiple variable power equipment was installed, and cooling and heating pipes were insulated to reduce loss. They have also designed some of the plants to use daylight instead of artificial lightning.

4.3 Social sustainability methods implemented by suppliers

Valeo-

Technical trainings for engineers and technicians as a result of new implemented **product life management strategy**. The trainings help employees to grasp R&D and engineering standards that are focused on sustainable development.

The company has created a ***systematic external audit*** for assessment of workplace risks in each site. Additionally, those audits are done to check compliance with OHSAS 18001 standard and according to the last report they have 95% of sites meeting those standard requirements.

To ensure safety at work they have own methodology as well which is called ***Quick Response Quality Control (QRQC)***. The method creates methods to avoid the accidents that happened earlier. It is usually based on the analysis of the happened accident with external teams and managers and prevention methods are created.

To ensure better wellbeing at work the company has created ***risk-free environment***, the employees can ***work remotely*** to create work life balance. ***Employee recognition*** which means fair pay, recognition of work done and career growth. ***Prevention of harassment and discrimination*** by creating hotline to connect easily and report.

The company also follows ***International Labor Organization (ILO) conventions*** requirements.

ZF TRW-

Health Promotion Programs which is designed to increase health appreciation of employees. It includes cancer, eye and heart health awareness, smoking and alcohol usage prevention programs that help the employees to look after themselves and decrease the amount of sick leaves.

One of the key social sustainability creation programs is ***Safety Leadership*** program where the objectives are creating a corporate level safety values, all the leaders are ensured to have crucial role in managing and building safety and employees are empowered to make decision on their safety themselves. To implement those objectives successfully in all the regions they have developed 4 workshops modules for each site. Those safety workshops take around a week each year in each site.

Since 2015 ***Production Management Audit (PMA)*** system was implemented which is used to audit the effective management of facilities' processes. PMA usually assess the metrics on escalation process, communication, best practice sharing, risk assessment for new technology and ergonomics. By help of that system managers can improve focus on improved health and safety in the work environment.

To further develop and maintain achieved safety levels the company has developed an online based ***Safety Culture Survey***. The survey is used to measure employee engagement and management of safety performance.

To create an efficient and risk-free work environment to employees the company uses ***Ergonomics*** a designing method where all the equipment and job tasks fit the worker requirements. Those designing methods are done through workshops where extra employee motions are excluded to decrease wasted time.

Since 2015 the company started implementing new training, workplace evaluation and data analysis tool called ***The HumanTech System***. The tool consists of 3 parts. In the Learn section the employees get online trainings about the workplace accidents. The Do section is used to assess the workplace to check if there are any aspects that could be developed. The Manage section is used to see the development of employees through trainings and improvements.

Faurecia-

The employees were trained in regard to the *ISO 14001 Courses*, the trainings were done regularly and when a new employee joined. The main issues covered during trainings were environmental risk regulation, waste categorization and regulation, accident prevention plans, chemical regulation. *The Ergonomics* designing of workplace relevant to employees were implemented in this company as well.

To create a fair working environment the company developed a *code of ethics* relevant to UN Global Compact program where each employee gets that guidelines. It ensures basic human rights, better economic and social communication among teams, training schemes and behavioral regulation. Code of ethics includes reporting systems for breach of human rights as well. Funding of political activities is prohibited, getting gifts from customers or supplier is limited to value of 100€ per year, all the cash operations are prohibited inside company, to create better competitive environment all the suppliers are chosen according to specific requirements and the usage of the position as a privilege to take actions that violate fairness rules are penalized.

The company created *diversity management department* which deals with recruitment of people from different nations and genders and offers equal opportunities. Additionally, the department take into consideration the diversity management of the partners and try to create opportunities for companies managed by minorities or females while choosing long term partners.

Buy Beyond purchasing policy has been implemented by Faurecia which is developed to check the sustainability scores of all the partners who provide raw materials or inputs to the company. It includes the labor practices used by partners, the materials used by them and environmental footprint of them.

NSK-

The company ensures *fair human right practices* through following the Universal Declaration of Human Rights guidelines. They have developed an equal recruitment system where all the candidates are taken into consideration from different backgrounds. The discrimination in the workplaces based on the race, gender, belief, nationality, age or social status is prohibited and a hotline is created to report those cases where the people receiving calls were given trainings to handle those situations.

They have created a *diversity program* where employees from various backgrounds are employed with a belief that they add new creative ways of thinking to the company. During 2016 multiple diversity trainings were carried out. A child care service for employees were created to retain the employees and increase engagement as the company tries to prevent layoffs and early leaves in the company. Additionally, special trainings to manager assistants are given so that they can grow in their career path.

The company has low ratio of female workers only being 10% and to increase the number of positions that the females can work the company has created some initiatives. They created special trainings to bring women to the management roles under the program called *Advancement of Women in the Workplace*. They have also started recruiting people with disabilities and during 2016 there were 121 employees with disabilities.

To increase the work-life balance the company is testing *flexible working hours* regime for the parents who wants to both engage with their families and excel at work. They offer *lifelong learning program* where employees are trained about personal savings, life insurance and health. To foster employee

development and career growth the company has multiple trainings, NSK university, internal job posting systems and foreign languages.

To promote safety in the workplace they have created a department called ***Safety and Fire prevention enhancement committee*** which is proactively taking measures. They also comply with OHSAS 18001 workplace safety requirements and the accidents that happened in the workplace are used to reactively prevent workplace accidents.

They have carried out risk assessment for the machinery, installed interlocks mechanisms, and each machine is double checked before started to use. These methods help to decrease the workplace accidents. The ***interlocks*** mechanisms lock the machine until special safety instructions are taken. ***Safety assessors*** are employed to check the safety of all the new equipment and to design a usage manual for all workers.

There is an annual ***health checkup*** system in the company and according to the results the employees with diseases are suggested to get treatment. The company has a ***health insurance association*** as well. For the employees who has a mental health issues the company created ***employee assistance program*** where external specialists do therapy for them.

Nexteer-

To create a working atmosphere where each employee treated equally with respect, they have created an annual ***training scheme*** where topics like benefits and compensation, human rights, workplace safety, harassment, retention, working hours and discrimination reporting policies of the company is taught. Every employee is responsible to act fair and must report any violation ***of the employment policies*** according to the rules. During 2016 more than 3000 employees were given trainings on the company code of conduct. They have created an ***international hotline*** for reporting any violations by their suppliers in the topic of human rights, like usage of child labor, discrimination and privacy. So that they only cooperate with ethical business partners.

They regularly carry out redesigning (***Ergonomics***) and equipment development activities to create safe workplace for the employees and some of the sites has acquired OHSAS 18001 workplace safety certification. Overall, the certification is used as a main guideline for creation of safety. They have ***common core elements health and safety audits*** annually for a week which is done by observation on each site to check the possible risks. The employees in most sites were ***trained to speak up*** when there is any threat to their safety in the workplace and take corresponding actions immediately.

LEAR-

They have done multiple training on health and safety in the workplaces, the employees were taught how to use the energy and appliances environmentally friendly. The company has forbidden multiple chemicals which protects the surroundings from contamination.

4.4 Economic sustainability methods implemented by suppliers

Valeo-

To decrease the energy consumption the company has done some site optimization processes. Those process are ***air conditioning and lighting optimization*** by using motion detector and other systems which

helps to reduce idle usage. In one plant in Poland they have started to use *heat recovering systems* for future reuse. *Variable speed engines* were implemented so that according to the demand of task the machines consume needed energy. All the lighting systems were changed to LED lights which is more efficient and energy consumption awareness training are done regularly according to reported data.

ZF TRW-

Design for Assembly (DfA) is deployed to create more efficient environment for assembly of the products so that the assembly and design processes are simplified. By creating efficiency in this step less energy and resources are used, and the idle time is decreased which helps to increase the capacity and get rid of bottleneck in the process.

Energy Efficiency Workshops are done to calculate energy used in manufacturing and engineering processes and employees from every facility join where they are taught about basic energy saving methods by managing demand and supply of energy, heating, air conditioning, lighting, heat saving and ventilation systems. During those workshops the employees from different plants evaluate potential energy saving processes they have.

Lean Line Design energy considerations are used while designing new processes where the machines shut of automatically when not used, lighting is optimized, heating ventilating and air conditioning systems are used efficiently.

Machine GreenFit is assessment of existing machines for potential energy reductions by upgrading some parts or the tasks done.

Faurecia-

The methods that were implemented to decrease the energy consumption which are site reformation with new equipment, the usage recycled materials in production and the usage of cheaper and renewable energy resources are examples of economic methods.

NSK-

The reports didn't have a section explaining the measurement taken on this direction however the company's 40% of the R&D activities provides some kind of sustainability which is considered as economic method. Additionally, some of the measurements taken on waste reduction and CO₂ emissions had a direct impact on the amount of expenses. The quality of the products was also mostly certificated in majority of the sites with the ISO 9001 certificate which is also considered as Economic Sustainability indicator.

Nexteer-

Some of the cost cutting initiatives like energy saving and waste recycling are example of economic outcomes of their sustainability. In addition, they have focused on innovative product development by mostly offering fuel efficient, more safe and easy handled materials by investing on quality and R&D which is considered as economic sustainability.

LEAR-

To reach the economic sustainability goals they develop lightweight products which are mostly made out of recycled, sustainable surface materials and innovate regularly.

4.5 Sustainability certificates and regulations affecting supplier companies

Valeo-

International Labor Organization (ILO) convention on human rights, *Organization for Economic Co-operation and Development (OECD) Guidelines for multinational organizations* on human rights.

Since 2013 the French government have created *Genelle II* law, an obligation to companies who report non-financial data to verify their performance on social and environmental issues by independent auditors. For Valeo this verification of disclosed data by independent auditors happened in 3 stages by reviewing the reporting processes, doing site audits and independent audit report on the completeness and issues.

REACH regulation is a European Union requirement that restricts hazardous chemicals for production. Registration, evaluation, authorization and restriction of chemicals is designed to increase the knowledge of the companies about the harmful chemicals and their effects on environment.

The main *certification* they have is *ISO 14001*, *ISO 50001* and *OHSAS 18001*. ISO 14001 is environmental certification, OHSAS 18001 site health and safety certification and ISO 50001 sustainable energy management certification.

Based on the existing regulations and certificates mentioned in the report it is understandable that most of the measurements taken towards sustainability are reactive. They get some pressure from either the partners or the local community and then implement methods to perform better on each indicator.

ZF TRW-

The main certifications that the company's sites have or comply with are *OHSAS 18001*, *ISO 14001* and *ISO 15001*. However, the latter is not gained by majority of the sites as it is a new certification with new requirements.

Other guidelines and requirements that the company have used to comply with the threshold levels are *World Business Council for Sustainable Development Greenhouse Gas Protocol*, *Automotive Industry Action Group's (AIAG) "Guiding Principles to Enhance Sustainability Performance in the Supply Chain"*, *Global Working Conditions (GWC)*.

As it is understood from the company report some of the measurements are taken proactively which are mostly related to cost reduction like less energy, material and water usage while the methods that are related to emissions and employee safety are mostly based on different regulation and certificate requirements.

Faurecia-

The report which is used to get information about sustainability of the company was prepared in accordance with *French Government Code of commerce* which requires companies to report sustainability performance.

European Directive 2000/53/EC requirement related to end of life of vehicle where 95% of the vehicle should be recoverable and out of that 85% should actually be reused after end of life of vehicle. The company considers this regulation while designing its products.

REACH regulation on the management of chemicals is applied in this company as well. The company has identified all the chemicals that is harmful and also created an anticipatory framework with suppliers to decrease usage of those forbidden chemicals.

ISO 14040 and ISO 14044 are requirements related to environmental impact where company deploys Life-Cycle assessment to meet these certificate requirements.

UN Global Compact Principle is signed by the company in 2004 and in accordance to this regulation they have created environmental committee and HS&E department.

ISO 14001 certification requirements compliance is one of the key targets for majority of the plants created by the environmental committee and 80% of all sites acquired it.

ISO 15001 certification is acquired by only 10 sites of the company where the energy consumption methods meet the requirements.

NSK-

Universal Declaration of Human Rights is used as a guideline for creating a diverse and equal working environment inside NSK

OHSAS 18001 is also used to create social sustainability inside the company and meet stakeholder requirements.

ISO 14001 is used to meet the environmental requirements

European Legislative amendments on harmful substances and other host country requirements on the substances were used to develop the NSK harmful substance list.

Overall, most of the actions were taken as a response to different requirements by stakeholders mostly being the OEMs and the government.

Nexteer-

The company has developed its sustainability with the requirements of **Carbon Disclosure Project** in 2015 and following years. The development of SMRF by Nexteer were mostly shaped by the guidelines of **Global Reporting Initiative (GRI)**, **Sustainability Accounting Standards Board (SASB)** and **Automotive Industry Action Group (AIAG)**. Those guidelines were mostly used while describing the indicators and creating the ways to measure them for sustainability reports.

In addition, the company has implemented **ISO 14001 and OHSAS 18001** environmental and social sustainability certifications requirements in most of the sites.

LEAR-

The main standards and requirements are **ISO 14001 and Carbon Disclosure Project**.

4.6 Opportunities exploited by supplier companies

Valeo-

The company got awarded 12 new customers during 2017 for supplying different parts to Original Equipment Manufacturers.

The company was awarded for being leader in automobile manufacturers sustainability in 2017 by Sustainalytics, they won PACE award among suppliers for the comfort and safety those awards helps building a trusted *reputation*. In addition, 95% of all sites got ISO 14001 and OHSAS 18001 certificates in 2017 which also increase reputation.

4 projects were supported by European Commission, 2 projects supported by host countries which are governmental *grants*.

Water consumption decreased 12% €9 million, Energy Consumption decreased 6% €3 million, 1% less waste was produced additionally some waste sales benefits incurred, Carbon dioxide emissions decreased by 1%. The number of containers used for transportation were decreased by 250 as a result of optimization.

98% of employees attended at least 1 training during 2017. Face to face training hours has increased 5% while e-trainings has increased 250% during 1-year period as a result of new training schemes which helps to retain employees.

Even though the number of total workplace accidents increased compared to previous years the severity and frequency rate has decreased.

ZF TRW-

Overall, as a result of implementation of new HS&E programs in their processes they have decreased the overall water usage by 10.2%, energy usage by 10.5% and waste by 14.7% during 4-year period.

The severity rate of the incidents has been decreased 5% from 2012 to 2015 and it was 14.4 %. They have decreased the Total Recordable Incident Rate (TRIR) from 0.99 in 2012 to 0.66 in 2015, the indicator is calculated by dividing the number of incidents to the overall working hours which is an OHSAS certificate requirement. There were around 500 Kaizen safety workshops done in 2015 as a result of safety excellence program implementation which helped the employees.

As a result of ergonomic activities, the amount of the design injuries decreased from 236 to 96 for 9 years period and number of lost workdays decreased from 8286 to 2928 during the same period.

Implementation of cost determination and reduction processes identified around 3150 projects and helped the company to save \$55 million in 2015. 90% of those upgraded processes were done by reducing material, energy usage and waste generation. The electricity usage declined 21%, the natural gas and propane usage declined around 30% and other energy resource usage decreased 22% during 2015.

As a result of implementing new modern technologies which shut down automatically when not used the overall electric usage decreased 5% compared to not having those technologies.

Machine GreenFit operations have helped to reduce hydraulic pump and high-pressure pump energy consumption which helped to save 10 to 15% energy used previously. The investment payback time for the GreenFit operations implemented were calculated as 2 years.

The CO₂ emissions had a decreasing trend for the last 6 years with 37.24 tons in 2015 as the estimation processes helped to see the main source of emissions.

The company spent \$18 million on environmental remediation projects in the countries they operate which is a benefit to the stakeholders.

The company did safety promotion workshops and trainings in some of the local schools to children which also increased their reputation in the areas they operate.

Faurecia-

The Faurecia interiors were rewarded in 2016 for production of biomaterial NAFILean by customers and a research agency, they received Carrefour award for having best HR team. They received multiple awards by the OEMs one example is the Romanian site got best reactivity award by Dacia.

Faurecia Seats uses recycled plastics in around 15-20% of all the products which helps both to decrease waste and reduce material costs.

The energy consumption decreased by €7 million value from 2015 to 2016, The amount of energy that came from renewable energy increased 69% in 2016 by being 9% of total energy consumption. CO₂ emissions decreased 3 tons, 15.36 tons of waste was recycled, and waste recycling rate increased 2% being 58% during the same period. The hazardous waste discharged to environment decreased by 11%. Water consumption decreased by 4% during the last 2 years with a constant speed. 8% of all plastics that were bought to use in production were recycled plastics as a result of new environmental measures.

The number of sites acquired ISO 14001 environmental certificate increased by 8 for 2 years period.

13% more training hours were given during 2016 by being 32000 hours mostly on ISO 14001 related courses. The number of accidents that resulted in lost working hours per one million hours worked was 0.8 which was fluctuating in the last years. The total amount of employee compensation increased 0.78% compared to the last year. The number of women workers increased by 0.7% in 2016.

NSK-

They have been awarded a certification called *Eruboshi* by the ministry of health and labor which is given to companies that promote the women in the management roles. The certificate brings reputation among workforce. The number of employees with disabilities increased in a growing speed during the last 3 years which also brings reputation as an equal opportunity recruiter.

The lost working time due to workplace accidents has been decreased to 0.89 during 2016 decreasing 0.12 from 2014. The indicator is calculated by dividing the total time lost to the total time worked. The amount of workplace accidents in numbers has declined 6% during 2016.

After the implementation of the PDCA method on environmental management now all the production sites have acquired the ISO 14001 certificate.

87 tons of CO₂ emissions were reduced as a result of grease spindle usage in the grinders. Shift from gas to electric air-conditioner helped to save 266 tons of CO₂ emissions. Shift to LED lighting systems helped to reduce 393 tons of emissions. Overall, the emissions of CO₂ were reduced by 11% globally in NSK locations.

Globally, the recycling rate of the company was 98% from the waste produced by the company as a result of systematic waste creation. Industrial waste was decreased by 30% and packaging materials waste cut by 23% in 2016. Water withdrawal decreased by 23% in average in all the plants. As a result of using filters in the cooling water 195 tons of water was saved.

The sale of recyclable waste materials was 793 million Japanese yen which is around €6.5 million in 2016. Waste disposal cost reduction was 51 million yen, 7 million yen more than previous year. Energy savings were 117 million yen 17 million more for 1 year.

Nexteer-

During 2016 50% of the sites did not lose any working hours due to incidents in the workplace, while including all the sites the lost work hours were 0.38 (calculated as all the lost working hours divided by total hours worked). There were 0 fatal accidents in the same year as a result of improvements.

The CO₂ emissions were declined by 3751 tons. The utilities cost saving was \$3.8 million and \$2.5 million on electrical savings compared to previous year. Which were result of implementation of new measures. 75% of all the waste was recycled in 2016 and only 6.38% of the waste was hazardous. They have increasing trend in the patents they have acquired annually, and it was 72 more in 2016 which is an indicator of economic sustainability.

LEAR-

The opportunities they have taken were some awards from local communities which increased the reputation, they have been chosen as number 148th by Fortune Global 500 for their growth. They recycled 55% of total waste globally which is 2 million tons. The GHG emission were decreased 7% compared in 2017 compared to 2016. The energy consumption decreased by 15% in the same year. The CO₂ emissions were declined by 1.4 million tons. Water consumption reduced by 10%. The report has not explained all the measurements taken broadly but for most of the sites audits were done to find potential systems to improve and these initiatives could be the main reason why they managed to achieve these numbers.

4.7 Discussion

According to the reports disclosed by the international supplier companies which has manufacturing plants in the CEE region, some sustainable development trends were identified. Firstly, all of the companies had a clear statement of the meaning of sustainability for them and defined clear goals for themselves which they were planning to achieve. Which is considered as one of the main reasons why all the companies had positive outcome from implemented methods. As described in the theoretical part the sustainability strategy is the most crucial factor to get benefits from the process which is proved here. All of the reports were prepared as a result of some regulations from either the government or the partner companies. Based on that it is clear that whenever a fully sustainability related investment done by companies it is only motivated from reactive reasons. They are required to get some certificates or fulfill some regulations.

The table below summarizes findings related to the sustainability creation methods. Among those 6 companies there were some similarities in the methods used. Some of the common methods were life-cycle related measures, changing of equipment to decrease energy consumption, usage of variable power engines, usage of renewable packaging materials, waste recycling, training schemes and ergonomic design, R&D solutions with economic value, LED lights, Green Energy sources and etc. While some differences were seen as well, usage of water for cooling were banned in some companies while some still used water as cooling material. As explained in the reports the methods were implemented to fulfill some requirements and get reputation among customer. Majority of the methods are based on the ones mentioned in theoretical part. However, the main difference is, all the methods are modified to their processes to get better outcome. For example, almost all companies used life-cycle assessment, lean methodology and design for X in different specific ways by naming it differently. However, all the companies deploying those methods used it in a modified and company specific way by adding or removing some steps.

Table 7. Sustainable Development Methods according to the reports

| | Environmental | Social | Economic |
|-----------------|---|---|---|
| Valeo | EcoDesign standard, RAISE Methodology, Valeo Risk Indicators VRI, Banned, Regulated and Declared Substances (BRDS), banned underground tanks, Consolidated Transportation, dual capacity trailers, Renewable and optimized packaging. | product life management strategy, systematic external audit, Quick Response Quality Control (QRQC), work remotely, Employee recognition, Prevention of harassment and discrimination. | air conditioning and lighting optimization, heat recovering systems, Variable speed engines, Innovation on quality and lightweight. |
| ZF TRW | Cost Determination and Reduction (CDR), Six Sigma DMAIC (Define, measure, analyze, improve and control), Waste Generation Estimation Process, dual phase extraction, enhanced reductive dichlorination and green remediation. | Health Promotion Programs, Safety Leadership, Production Management Audit (PMA), Safety Culture Survey, The HumanTech System, Ergonomics. | Design for Assembly (DfA), Energy Efficiency Workshops, Lean Line Design, Machine GreenFit. |
| Faurecia | Life-Cycle Analysis, Eco-Design approach, Waste management and treatment, Circular Economy, Internal Reuse and more recycled material purchases, Volatile Organic Compound Emissions (VOCS) prevention. | The Ergonomics, code of ethics, diversity management department, Buy Beyond. | R&D activities, Innovative technologies, Renewable energy usage. |
| NSK | PDCA (Plan, do, check and act), Green Procurement Standard, prohibited usage of underground tanks, Next Generation Production Lines, electricity heat treatment, | fair human right practices, diversity program, Advancement of Women in the Workplace, flexible working hours, Safety and Fire prevention enhancement committee, The interlocks, | High quality investment, Sustainable R&D, Energy consumption measures. |

| | | | |
|----------------|---|---|--|
| | Solar Power Generation, LED lights. | annual health checkup, lifelong learning program. | |
| Nexteer | sky domes, motion sensitive LED lightening, flexible power motors, Recyclable packaging. | training scheme, the employment policies, international hotline, Ergonomics, common core elements health and safety audits. | Product quality investment, R&D, Energy conservation. |
| LEAR | Lear Environmental management, Reduce, Reuse, Reclaim and Recycle operation system, GHG emissions data collection and analyzing system, | training on health and safety, forbidden multiple chemicals, | Lean manufacturing, lightweight products, sustainable surface materials and innovate regularly |

When it comes to the regulations, in addition to the certifications and regulations found in the theoretical analysis, there were multiple sector specific ones which were mentioned in the reports. The most famous ones were ISO 14001, 15001 and OHSAS 18001 certifications and host country regulations. Overall, the regulations were the main driving factor of sustainability for all the companies. Each of the companies had a goal of getting those certifications in 100% their sites which accelerated their new customer gaining process. The ISO 15001 and OHSAS 18001 were not mentioned in the theoretical part which existed in most of the companies. First being an energy consumption regulation and the latter being a health and safety regulation in the workplace. Additionally, the government regulations which were mentioned by companies were not covered in the theory which also has a big impact on shaping the sector.

Table 8. Standards and Certificates related to Sustainable development

| | Certificates | Standards and Regulation Requirements |
|-----------------|--|--|
| Valeo | ISO 14001, ISO 50001, OHSAS 18001. | International Labor Organization (ILO) convention, Organization for Economic Co-operation and Development (OECD) Guidelines for multinational organizations, Genelle II law, REACH regulation. |
| ZF TRW | OHSAS 18001, ISO 14001, ISO 15001. | World Business Council for Sustainable Development Greenhouse Gas Protocol, Automotive Industry Action Group's (AIAG) "Guiding Principles to Enhance Sustainability Performance in the Supply Chain", Global Working Conditions (GWC). |
| Faurecia | ISO 14040 and ISO 14044, ISO 14001, ISO 15001. | French Government Code of commerce, European Directive 2000/53/EC, REACH regulation, UN Global Compact Principle. |
| NSK | OHSAS 18001, ISO 14001. | Universal Declaration of Human Rights, European Legislative amendments on harmful substances |

| | | |
|----------------|-------------------------|---|
| Nexteer | ISO 14001, OHSAS 18001. | Carbon Disclosure Project, Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB) and Automotive Industry Action Group (AIAG). |
| LEAR | ISO 14001. | Carbon Disclosure Project. |

When it comes to the opportunities gained from implementation of those methods, most of the reports had a predefined structure and they all have reported on similar benefits they have gained. Those benefits were as described in the theoretical model mostly, CO₂ and GHG emissions reduction, Energy savings and recycling savings benefits, possibility to get new customers as a result of gained awards and reputation, safer and more attractive workplaces, better quality and innovativeness as a result of redesigning processes and more skilled and trained employee base.

Table 9. Sustainable management model linking methods, regulations, benefits and opportunities

| Company | Motivations for sustainable management | Methods Implemented | Benefits gained |
|-----------------|--|--|--|
| Valeo | ISO 14001, ISO 50001, OHSAS 18001. | 1-Usage of water for cooling banned, used rain and industrial water. 2-Variable speed engines, air conditioning and lighting optimization, heat recovering systems. 3- EcoDesign standard. 4- Transportation Consolidation, dual capacity trailers. | 1-Water consumption decreased 12%, €9 million. 2- Energy Consumption decreased 6%, €3 million. 3- CO ₂ emissions decreased by 1%. 4- The number of containers used for transportation were decreased by 250. |
| ZF TRW | OHSAS 18001, ISO 14001, ISO 15001. | 1-Cost Determination and Reduction (CDR), Six Sigma DMAIC. 2-Waste Generation Estimation Process. 3- Ergonomics, Safety Leadership. | 1- Decreased water usage by 10.2% and energy usage by 10.5%. 2- Decreased waste by 14.7%. 3- Total Recordable Incident Rate decreased 30%, severity rate of the incidents has been decreased 5%. |
| Faurecia | ISO 14040 and ISO 14044, ISO 14001, ISO 15001. | 1-Eco-Design approach, LED lightning and energy efficient equipment. 2- Life-Cycle Analysis, Circular Economy. 3-Internal Reuse and more recycled material purchases. 4-Volatile Organic Compound Emissions (VOCS) | 1-Energy consumption decreased by €7 million. 2- CO ₂ emissions decreased 3 tons. 3-15.36 tons of waste was recycled. 4- Hazardous waste discharged to environment decreased by 11%. |
| NSK | OHSAS 18001, ISO 14001. | 1-Safety and Fire prevention enhancement committee, | 1-Workplace accidents in numbers has declined 6%. |

| | | | |
|----------------|-------------------------|--|---|
| | | interlocks mechanisms, Safety assessors. 2- Shift from gas to electric air-conditioner, grease spindle usage in the grinders. 3- Electricity heat treatment. | 2-353 tons of CO2 emissions were reduced. 3-195 tons of water was saved. |
| Nexteer | ISO 14001, OHSAS 18001. | 1-Ergonomics, common core elements health and safety audits. 2-Sky domes, motion sensitive LED lightening, flexible power motors. | 1-50% of the sites did not lose any working hours due to incidents. 2- The utilities cost saving was \$3.8 million and \$2.5 million on electrical savings. |
| Lear | ISO 14001. | 1-Reduce, Reuse, Reclaim and Recycle operation system. 2- Lean manufacturing. | 1-Recycled 55% of total waste globally. 2- Energy consumption decreased by 15%, CO2 emissions were declined by 1.4 million tons, Water consumption reduced by 10%. |

Table 9 is a model summarizing the main motivations for implementation of different sustainable development methods and the opportunities that are exploited as a result of usage of that model. This table confirms the information given on the figure 7 which summarizes the findings from the theoretical studies as the stakeholders implement any requirement, the supplier companies respond it by modifying the existing process to manage sustainably and those actions ends up with some benefits which both material and non-material.

4.8 Limitations and perspectives of research

The main drawbacks of using the reports are, the companies were not from exactly the same background therefore it could be hard to generalize the results as they each have different manufacturing styles which requires different methods to implement sustainability. All of the reports were not prepared in the same structure and style. Which means there were some group of information in some company reports that did not exist on the other company report. The extracted reports were not from the same year for all companies as there were not a single year common for each of them, they could have improved in the following years or implemented new methods however, just because not disclosed, they are not included here. The other limitation is as the research was qualitative and there were more than 20 reports screened there could have been some important indicators or methods that were missed. The last drawback was some reports were voluntarily disclosed reports which means there is possibility that external audits were not done, and the company could have included overrated data there. However, the benefit of usage of the reports was it included a thorough information on the sustainability framework of the companies, and it was possible to get enough material compared to the questionnaire results. The findings can not be generalized as the sample size was small and the companies were not all producers of the same parts.

For the future research to overcome these hurdles, the reports from the same reporting structure or direct site observations, the direct competitor supplier companies and manager interview methods could be chosen, so that the researcher would have only the required data and provide more focused information for smaller focus group.

To sum up, based on the studies of those 6 companies, it is clear that the regulations are the main factor creating sustainability in the sector and the companies get valuable material benefits by implementing sustainable development methods. The opportunities are visible after the implementation of sustainability methods. Those opportunities are either material like cost reduction or emission reduction or nonmaterial like increased reputation and better environment. Therefore, the companies should proactively engage in sustainable management initiatives and bring more value internally and externally. As all the competitors disclose their strategy on the issue they can cooperate in this field and create more efficient methods together so that the society can get more benefits and the fight against global climate change can be stronger.

CONCLUSIONS AND RECOMMENDATIONS

- 1- Throughout the problem analysis it was found that automobile industry suppliers face certain issues when they implement sustainable management practices. Those issues were starting by the regulations set by the stakeholders on the sustainable management. To fulfill the regulations the companies should have implemented sustainable management methods to the processes however, it was not clear what kind of methods exist and what the companies chose. Consequently, after implementation of different methods or sustainable development models the companies were getting some benefits which are opportunities can be gained by other companies as well.
- 2- In the theoretical part the sustainability and sustainable supply chain management notions were explained. Different sustainable management methods (Lean management, Life-cycle Assessment, Design for X and CSPD) relevant to automobile industry were analyzed. The regulations that exist in the European region related to automobile industry were found. The opportunities brought by sustainable development were identified which were awards, new customers, reputation, decreased emissions and waste, decrease water and energy consumption, more safe workplaces and gender equality. Later it was proposed that the stakeholder regulations are the main motivations leading to different sustainable management model implementations.
- 3- Methods were developed to analyze the proposed theoretical solutions by extracting and analyzing the sustainability report of 6 companies operating in the CEE region. The data was interpreted in qualitative method as the insights of a process were analyzed. The research questions were what kind of methods were implemented in the processes to meet TBL requirements, what kind of stakeholder regulations exists and what are the benefits that can be exploited.
- 4- Based on the defined steps the findings were drawn which were as following:
 - a) All of companies know the importance of sustainability and have included it to their strategy. However, some of the companies does it because of the risks of not developing sustainably. Only 2 out of 6 companies mentioned that they develop sustainably to get an advantage in the competitive environment. Each company had threshold goals which they wanted to achieve annually relevant to each sustainability indicator defined by them. Some had award schemes for the sites which fulfilled the goals.
 - b) Each company has multiple specific sustainable development method related to all triple bottom line requirements. However, when considered the mechanism of the methods it is clear that it is based on the general sustainable development methods mentioned in the theoretical analysis. Most of the companies use modified versions of life-cycle assessment and lean methodology in the processes. In addition, there were specific tools which were common in some of the companies related to health and safety, waste management and energy savings.
 - c) The base sustainability certifications were the same for all companies being ISO 14001 and OHSAS 18001 while some companies who advanced in energy management practices got ISO 50001 certificate as well. All the companies were adjusting their business practices to the host country requirements. All companies had either one or multiple sustainability reporting guidelines followed like Carbon Disclosure Project, Global Reporting Initiative and government requirements. Overall, the certifications and requirements were main driving factor of the creation of sustainability as all methods were adjusted to fulfill a requirement.
 - d) Based on the reported changes in material and non-material indicators it was visible that the implemented methods brought benefits to the companies. Those benefits were gained awards, increased reputation, new customers, more educated employees, safer and diverse working environment, less environmental waste, less CO₂ and GHG emissions and energy savings. Other

than the company benefits, the sustainable development acts had benefits on the community as well, some of the companies were participating in financial support to education of local children and remediation of the environment in the region.

Overall, the sustainable development framework can be concluded as starting with a regulation or certificate requirement by government and OEMs and then implementation of different tools and methods by the supplier companies into their own operations and requirement of the same rules from their own suppliers. This scheme brings multiple benefits to both the implementing company and the stakeholders as found on the reports. Similar framework was developed as the result of theoretical solutions however the main difference here is the names of specific methods and regulations are given in the findings part and the framework how the opportunities emerged explained.

The main recommendations are proactive approach to the sustainability by the suppliers, cooperation of companies on solving the sustainability issues and cooperation with the stakeholders.

By implementing sustainability proactively in their business the companies can get more benefits that it was found on the reports as there were some tools which were not used by all companies but had a clear benefits, as an example usage of sky domes which fulfills the lightning demand of the workplace. Additionally, the proactive implementation of sustainability methods can lead to new innovations in the overall operations framework as the lean method found by Toyota and used by everyone today. Those innovations can lead to more customers and premium prices as customers are turning to be environmentally conscious buyers. Proactive sustainability creation can also bring patents and intellectual property to company as they innovate new methods.

Cooperation of the companies either horizontally or vertically can ultimately increase the well-being of the society as the sustainability is one and only way of fighting the global climate change which poses big threats on the mankind. By cooperating the companies can learn more from each other and also as modern studies found that open innovation methods are more productive. While cooperation with stakeholders is also important because by understanding the demand of the customers the company can focus on better project which can bring more ROI as it would be customer oriented.

To sum up, as the automobile industry is one of the biggest contributors of the global GDP it is crucial to implement sustainability in this sector. There should be a special focus on suppliers because they are the providers of 60% of the final products.

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