

Measuring sustainability in supply chains: comparative study of 15 top logistic companies operating in Slovenia

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Abstract — Our research work refers to measuring sustainability in supply chains. First of all we will touch the topic, what means measuring sustainability in supply chain and how it can be measured. We will focus on our research area of fifteen companies, where we will investigate how much Slovenian companies deal with sustainability in their companies, how much sustainability means to them and how they measure it, if their company contributes a lot to the sustainability of supply chain or to the sustainable operation of the whole company. In recent years, have the supply chains undergone significant changes as a result of the COVID-19 crisis, which has forced companies to change the way of their operating in order to make their supply chains more efficient. The COVID-19 crisis has therefore made companies realize that they need to move to a circular economy, as it has shown the disruption or vulnerability of current supply chains. About sustainability is more and more speech and also more and more companies are recognizing its importance, because sustainable supply chain affects to the entire production process, from the sourcing of raw materials to the recycling of products or raw materials, if this is possible. A sustainable supply chain increases a company's competitiveness and also reduces costs for the company.

Index Terms — Sustainable supply chain; supply chain management; logistics companies; Sustainable development

I. INTRODUCTION

Supply chain is a logistics network consisting of suppliers, manufacturers, production centers, distribution centers and warehouses. It is important for companies to have an efficient supply chain, because this affects on manufacture of the products and it is important that customers are satisfied. The company has also different costs, which is one of the reasons why it is important to keep the supply chain efficient and try to keep these costs as low as possible (Lee & Chung, 2022). In addition to costs, each product in the supply chain also has an impact on the environment (Faccio, Persona, Sgarbossa & Zanin, 2014).

In the 21st century, we are increasingly hearing about sustainable supply chains. Sustainable supply chains provide benefits to a company based on three aspects: environmental, economic and social. It is very important for companies to define sustainability in their supply chain, as this allows them the best configuration of the logistics network or supply chain. This allows the company to improve long-term benefits based on these three aspects mentioned before. (Lee & Chung, 2022)

Sustainability is defined as persistence into a seemingly indefinite future, including certain characteristics of the ecosystem and the human subsystem in it (Pater & Cristea, 2016). Sustainability meets current needs without compromising the needs of future generations (Fricker, 1998). This means linking the goals of quality of life, health and maintain the social justice and decency of the Earth to be able to support life on it in all its diversity (Szczuka, 2015). Sustainability in the supply chain is therefore divided into three pillars, namely environmental, social and economic. The measure for sustainability is Triple Bottom Line, which focuses on comprehensive investment results related to performance, profits, people and the planet (Borah, 2018). The goal of sustainable development is to provide an expanded and up-to-date understanding of sustainable development within these three pillars (Kroll & Zipperer, 2020). The environmental pillar includes the recovery of a used product, the reuse of products or 2014). It also includes various measures to reduce greenhouse gases, packaging, water consumption and other negative environmental impacts (Beattie, 2023). It also measures how optimally natural resources have been used throughout the cycle. (Borah, 2018). The economic pillar refers to the company's profit, but in order to achieve this, it must properly manage risks. (Beattie, 2023). In order to achieve an economic aspect in the supply chain, it is necessary to change the flow of consumer preferences and production techniques that are effective in terms of economic conditions and without environmental impacts (Harris, 2003). Also are measured consumption and production factors, job creation, active labor force, diverse employees in the workplace, taxes, etc. (Borah, 2018). Social pillar include five types of indicators namely: informative, predictive, problem-oriented, program-oriented and goal-oriented (Fricker, 1998). The social pillar includes costs within the supply chain (Faccio et al., 2014). It also includes training and education of employees, care for their safety, well-

being, motivation, etc. This pillar is somehow the most important, as it is used to achieve environmental and economic aspect (Harris, 2003). The cooperation of the company with their suppliers, employees, stakeholders and the entire community in which they operate is also important (Beattie et al., 2021), as these relationships lead the success of the company (Lazar et al., 2021).

As mentioned, it is very important, that companies operate sustainably, which also includes sustainable product development and is related to the general supply chain management practices. Sustainable product development includes product design, without negative impacts on the environment and society, throughout the product life cycle or its whole supply chain, not just development (Watz & Hallstedt, 2022). Sustainability is increasingly present in all companies and for example schools around the world employ people in corporate sustainability, which means employment in jobs in the field of sustainability (Montiel & Delgado-Ceballos, 2014). The sustainability of the supply chain can be measured by assessing the performance of social, environmental and economic principles. The balance of all three is an ideal goal, but it often cannot be achieved (Clift, 2003). Often, companies themselves misjudge the impact that the production of a particular product has on a sustainability of the supply chain. In case of Slovenian companies it is evident that they are still more reluctant in this regard and they have an opinion that the global trends do not concern them yet. Businesses may not yet fully believe that a company focused in sustainability contributes to competitive advantage and not just as an additional cost. Of course, there are companies that are aware that they can achieve a competitive advantage through sustainable business and prove it to others (Volfand, 2018).

In this research, we will mainly focus on the three previously mentioned principles. Defining how customer requirements affect the sustainability of supply chains, and how it may change its complexity might be challenging. Using various metrics used to measure sustainability, this study investigates how supply chain sustainability is measured in companies. Emphasis will also be on determining the process, how companies define sustainability desires, and what are the challenges in a chosen field. Study also enlightens the challenges and problems that companies face in their desire to implement sustainable aspects in the supply chain. Throughout this research work, new insights on actions to make the supply chain more sustainable will be identified with the focus on Slovenian logistic sector. The purpose of the research work is therefore in addition to the established results, so how much different companies use sustainable development and also that we maybe encourage companies to sustainability.

II. METHODS

Research work is focused on studying the sustainability of Slovenian companies which analyze or measure with fundamental three pillars of sustainability. These are: environmental, social and economic aspect. In our research, we limited ourselves to larger logistics companies, and selected 15 most impactful logistics companies in this area defined by the DHL study. From all 15 companies, we tried to obtain information through online sources and investigation of annual company reports, articles about the company and other published sources. We have removed the sources that do not contain useful information for our research work. Therefore, only sources related to measuring sustainability in the supply chain through these three pillars of sustainability were eligible and formed our dataset. Once we had a set of useful resources, all data were visually presented in a Table I. Data of 15 companies based on the three pillars of sustainability for each company were than cross-compared and analyzed.

Based on the obtained data, we listed six areas within each sustainability pillar that companies use to achieve an individual aspect or sustainability pillar. For each pillar for we made a graph showing the number of companies that use each activity. This graph shows which activity within an individual pillar of sustainability companies is used the most or which they work on the most in order to maintain sustainably. We also made a graph of areas for the other two pillars of sustainability, and so in the end we had a graph for each pillar of sustainability, which shows which areas company pay the most attention to.

In the end, we combined sustainability pillars from our analysis and tried to summarize sustainability as a whole, where we compared individual companies with each other. Results are graphically presented separately for each sustainability perspective and they represent companies that are most sustainably developed.

III. RESULTS

In our research 15 bigger logistics companies in Slovenia were analyzed. The companies are analyzed by three pillars of sustainability: environment, social and economy.

Table I: 15 bigger logistics companies in Slovenia

	Environment	Social	Economic
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<p>Post Slovenia (Pošta Slovenije b.d.)</p>	<ul style="list-style-type: none"> -Reducing fuel consumption for means of transport by 12% -Reducing overall energy consumption per building surface area by 6.4% -Increasing the proportion of electric vehicles to 46% -Implementing procedures for responsible waste management -Reducing energy consumption by 6,4% -Reducing carbon print of buildings by 14% 	<ul style="list-style-type: none"> -Training of employees -Working against discrimination -Increasing the motivation of employees 	<ul style="list-style-type: none"> -Reducing the costs of workplace related injuries and absents -Reducing the transport costs by route planning -Working on energy efficiency which help lower price of energy
<p>Port Koper (Luka Koper b.d. a; Luka Koper b.d. b)</p>	<ul style="list-style-type: none"> -Modernization of machinery and equipment -use of alternative fuels -use of alternative sources of heating -use of alternative energy sources -near-zero energy buildings -Obtaining 50001 certification -Waste prevention -increasing the re-use rate of generated waste -reducing noise at the port 	<ul style="list-style-type: none"> -Training and educating of employees -Possible work from home -Good developed promotion program 	<ul style="list-style-type: none"> -Obtaining great employees -Increasing goods rotation -Lowering operation costs
<p>Intereurope (Intereuropa, 2020; Intereuropa b.d.)</p>	<ul style="list-style-type: none"> -Regular servicing of work equipment and machinery -Compliance with vehicle ECO standards -Following ecological standards in building renovation -Regular maintenance of air-conditioners and chimneys -Waste water analyses 	<ul style="list-style-type: none"> -Ensuring safety at work -An adequate system for staff promotion 	<ul style="list-style-type: none"> -Recovering from Covid 19 crisis --Reducing inventory
<p>DSV transport (DSV b.d.)</p>	<ul style="list-style-type: none"> -Reducing emissions from vehicles for 40% -40% energy reduction for electricity, heating and cooling -Better defined waste management -Integrating recycling in every area of the company 	<ul style="list-style-type: none"> -Gender equality -Fair working conditions 	<ul style="list-style-type: none"> -Reduction of total rail costs -Increasing the number of business partners
<p>Schenker (DB Schenker b.d.. a; DB Schenker b.d. b; DB Schenker b.d. c)</p>	<ul style="list-style-type: none"> -Reducing CO2 emissions for 30% -Reduction in the number of kilometres travelled -Using energy efficient solutions 	<ul style="list-style-type: none"> -Ensuring fair working conditions -Building a reputation as a top employer -Motivating employees -Raising the quality culture 	<ul style="list-style-type: none"> -Focusing on quality to increase income -Investments in digital expertise to generate new business -Increasing performance
<p>Cargo Partner (Cargo partner b.d.)</p>	<ul style="list-style-type: none"> -Installation of 1400 photovoltaic panels -Recycling of used truck tarpaulins 	<ul style="list-style-type: none"> -Donations - e. g. hospital for the Syrian wounded -Sponsoring humanitarian aid transport - Project funding for eco and electric vehicles and aircraft 	<ul style="list-style-type: none"> -Lowering costs by increasing fuel efficiency -Improving the efficiency by implementation of new technology

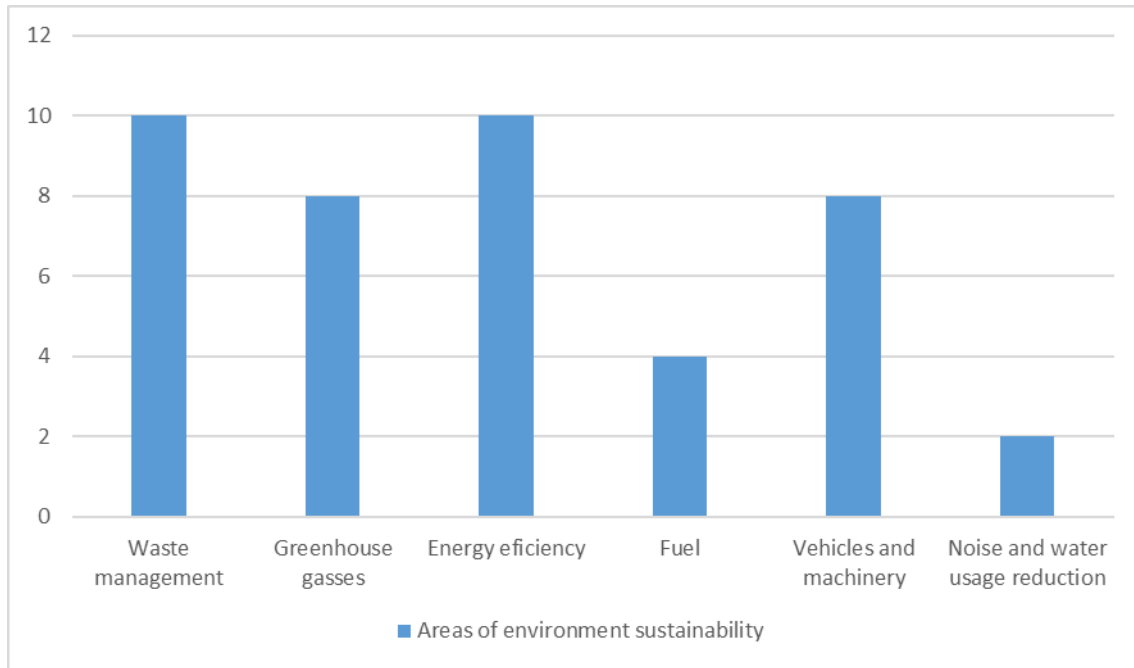
<p>Kuehne + Nagel (Kuehne + Nagel, 2020; Kuehne + Nagel b.d.)</p>	<ul style="list-style-type: none"> -Using biofuels to reduce emissions -Reducing empty container movements -Commitment to waste management 	<ul style="list-style-type: none"> -Respect and promotion of human rights -Ensuring fair working conditions -Giving back to society -Ensuring health and safety -Integrating positive business-to-customer engagement 	<ul style="list-style-type: none"> -Creating the additional value through customer excellence and expansion into new services and leveraging the Group's strengths to extend from supply chain to value chain services -The overall aim is to reach an EBIT to gross profit margin (conversion rate) for the entire Group in excess of 16 per cent by 2022
<p>DHL Global forwarding (DHL, 2021)</p>	<ul style="list-style-type: none"> -Reducing greenhouse gas emissions below 29 million tones -Increase the use of sustainable fuels in aviation above 30% -Electrification 60% of last mile deliveries -Introducing carbon-neutral buildings 	<ul style="list-style-type: none"> -Introducing measures for a safe and engaging working environment -Increase the proportion of women in management to 30% -Abstinance due to work-related injuries reduced to below 3. 1 -Motivating employees -Participation in employee social commitment programs -Introducing a company policy -High level of data protection 	<ul style="list-style-type: none"> -Lowering the transport costs with implementation of green logistics -Investments in green energy studies to help lower the costs
<p>Rhenus logistic (Rhenus b.d.)</p>	<ul style="list-style-type: none"> -Making new from old -Implementation of the 50001 standard -Smart container management (avoid empty journeys) -Lowering your carbon footprint by implementing sustainable take-off -Use of electric vehicles and other machinery 	<ul style="list-style-type: none"> -Respect for human rights -Introducing measures to ensure adequate working conditions 	<ul style="list-style-type: none"> -Implementation of measures to ensure the best link between price, quality and environmental impact
<p>TNT Express worldwide (TNT, 2017)</p>	<ul style="list-style-type: none"> -Improving Co2 emissions in the operations area -Giving customers information on Co2 emissions so they can reduce them -Staff training in environmental management 	<ul style="list-style-type: none"> -Commitment to health and safety at work -Regular risk assessments -Spreading good practice to other companies 	<ul style="list-style-type: none"> -Increasing the number of costumers by improving company's name -foreign sponsorship
<p>Global logistic system (GLS) (GLS, b.d.)</p>	<ul style="list-style-type: none"> -Purchase of 6 electric vehicles -10 charging stations for electric vehicles -Purchase of 80 photovoltaic package machines - Installation of a solar power plant in Ljubljana -Optimizing transport routes -Obtaining Climate Protect (Co2-linked) certification 	<ul style="list-style-type: none"> -Regular training and professional development -Humanitarian donations -Sponsoring sport and culture -Sponsoring socially responsible organizations 	<ul style="list-style-type: none"> -Development of delivery solutions -Reduction of gas costs -Optimizing maintenance costs
<p>FMS logistic (FR. Meyer's sohn, b.d.)</p>	<ul style="list-style-type: none"> -Use of green electricity -Promotion of the use of environmentally friendly means of transport for the employees 	<ul style="list-style-type: none"> -Occupational safety and healthy -Training and development on an equal basis -Work-life balance 	<ul style="list-style-type: none"> -Increasing the value of supply chain -Reduction of company's costs

	<ul style="list-style-type: none"> -Carbon emission mapping -Careful route planning -Sustainable advertising materials 	<ul style="list-style-type: none"> -Social benefits, perks (insurance, etc.) -ISO certification 	
Rail cargo logistic (Rail cargo group, 2021; Rail cargo group b.d.)	<ul style="list-style-type: none"> -ISO 14000 series certification -Sourcing of power in Austria from 100% green traction power -Promotion of recycling activities 	<ul style="list-style-type: none"> -Opportunities for further training -Health management -Equal opportunities for everybody -Supporting local people with activities 	<ul style="list-style-type: none"> -Link with ports which have prospering economic growth -Prevention of employee rotation
Transocean Shipping (Transocean, 2018)	<ul style="list-style-type: none"> -Zero spills while reducing energy consumption -Reducing water usage -Reducing the impact of waste on the environment 	<ul style="list-style-type: none"> -Improving overall health -Respect to gender diversity are that women hold -4 million \$ donations -40 hours volunteer per employee -Investment in training and education -Respect for people of different nationality, gender equality, etc. 	<ul style="list-style-type: none"> -Rising the revenue in south America -Lower the cost of technology
Ekol logistic (Ekol b.d. a; Ekol b.d. b)	<ul style="list-style-type: none"> -undertake initiatives to promote greater environmental responsibility -Encourage the development and diffusion of environmentally friendly technologies -Collecting and sorting of food waste for feeding animals 	<ul style="list-style-type: none"> -pursuing public good -looking out for employee rights and work conditions -effective abolition of child labor -elimination of discrimination between employees 	<ul style="list-style-type: none"> -working against corruption for making profit -Improve turnover of retail -rising the number of costumers

A. Environment

We found that companies are defining measures to reduce fuel consumption or use alternative and green fuels, reduce greenhouse gases, noise, and water consumption. It also defines measures to improve waste management and optimize the fleet and modernize equipment and machinery. Some companies defined obtaining environmental certificates and standards as an advantage.

Fig.1: Number of companies based on areas of environmental sustainability



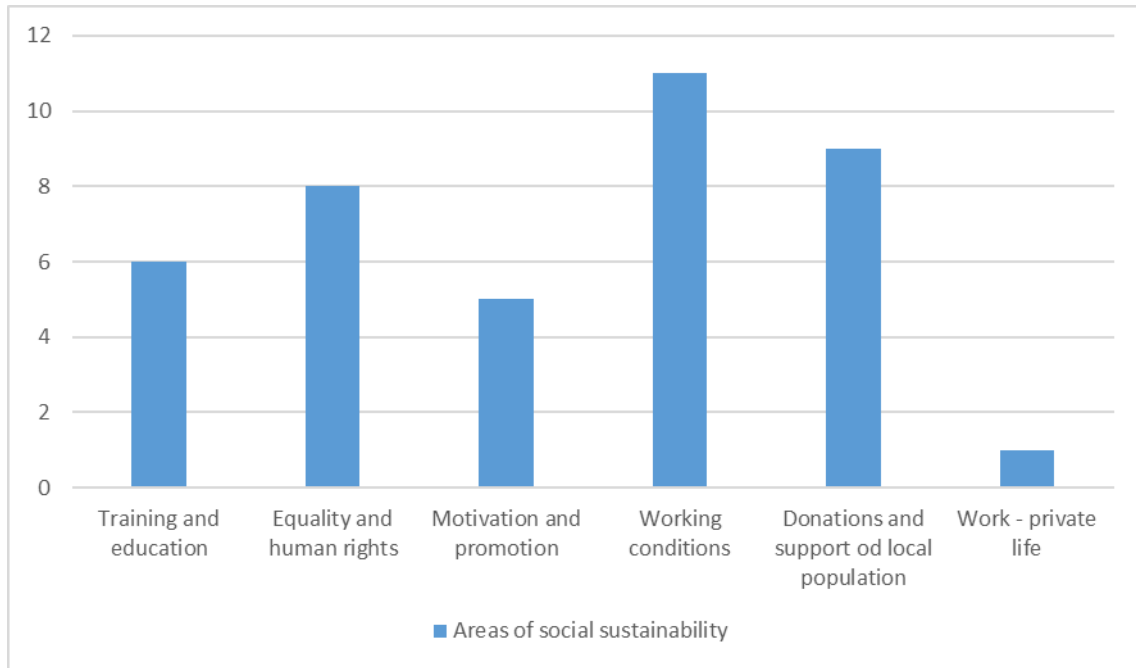
As we can see on Fig. 1, 10 companies defined in the sustainability plan that they practice activities for waste reduction, reuse of material and better-defined waste management. Eight (8) companies defined that they practice activities of greenhouse gasses reduction, 10 companies defined that they practice activities of improving energy efficiency such as reducing energy consumption, green energy usage and usage of alternative sources of heating and cooling. 4 companies are or want to lower fuel consumption, replace fossil fuels with electricity or sustainable fuels. 10 companies defined that they practice activities such as replacing old vehicles, buying new electric vehicles, optimizing machinery usage as well as modernization of machinery and equipment and optimizing routes. Only 2 companies included in the sustainability plan reduction of noise and areas to reduce water usage.

With the analysis we discovered that not even one company included all six areas of environmental sustainability. Post Slovenia, Port Koper included 5 areas, Intereurope, DSV Transport, Schenker, Kuehne + Nagel, DHL global forwarding, Rhenus logistic, FMS logistic and Transocean shipping included 3 areas, Cargo Partner, Rail cargo logistic and Ekol logistic included 2 areas, TNT Express worldwide and GLS only included 1 area.

B. Social

In the sustainability plan companies defined social pillar of sustainability as training and education of employees, working for equality and human rights, motivation employees and giving the optimal promotion plan. They also defined the importance of safe working conditions and the possibility of connecting work with private life. Companies also invest in donations, support of local population and giving back to society.

Fig. 2: Number of companies based on social sustainability



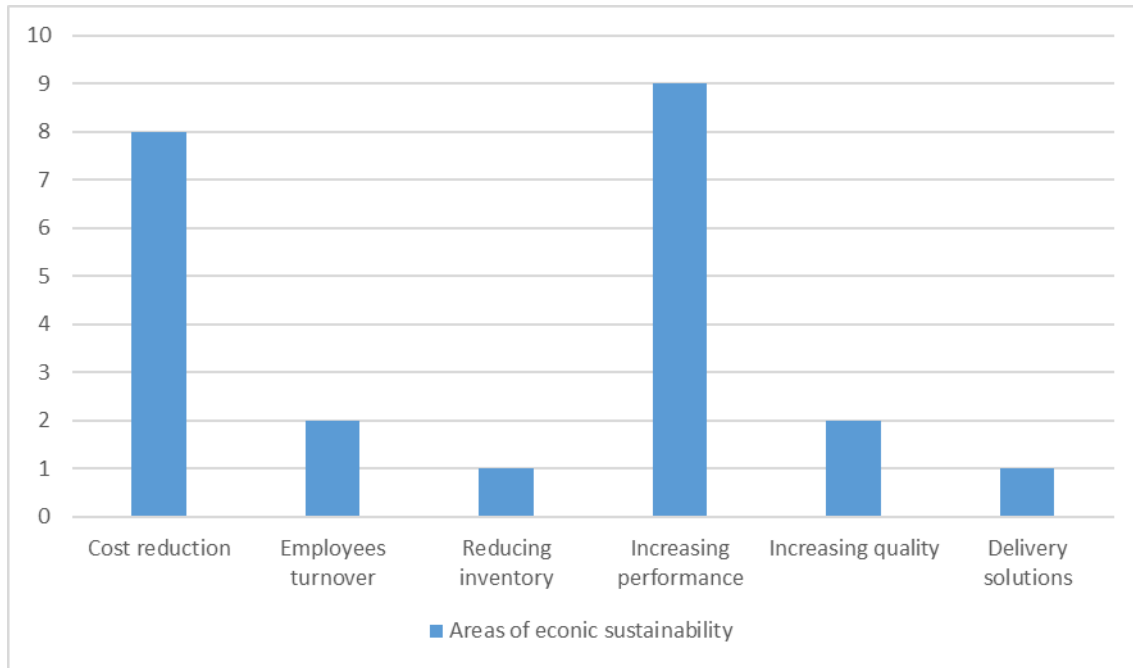
As we can see on the Fig. 2, 6 companies invest in training, development and education of employees to ensure safe and efficient working. Eight (8) companies committed to implement equality regardless of gender, age, nationality, sexual orientation, etc. They are also strong defenders of human rights. 5 companies have or want to have in the future a well-defined promotion program, they also invest time and money to increase motivation. Most companies (11/15) defined that they practice areas to ensure safe working conditions. 9 companies stated that they engage the areas which improve life of local population, they offer donations, free transport of humanitarian aid and some also give back to society. Only one company stated that they help employees to link work with private life.

With the analysis we discovered that not even one company included all six areas of social sustainability. FMS logistic included 5 areas, Transocean shipping included 4 areas, Post Slovenia, Port Koper, Kuehne + Nagel, DHL global forwarding, Rail cargo logistic and Ekol logistic included 3 areas, Intereurope, DSV Transport, Schenker, Rhenus logistic, TNT Express worldwide and GLS included 2 areas, Cargo partner (n.d.) included 1 area.

C. Economic

In the sustainability plan companies defined economic pillar of sustainability primarily as lowering costs and increasing performance. They also defined economic sustainability on the areas such as preventing employee turnover and abstinence, reducing inventory, increasing quality to increase prices and also investing in delivery solutions to reduce mileage, empty journeys, etc.

Fig. 3: Number of companies based on economic sustainability



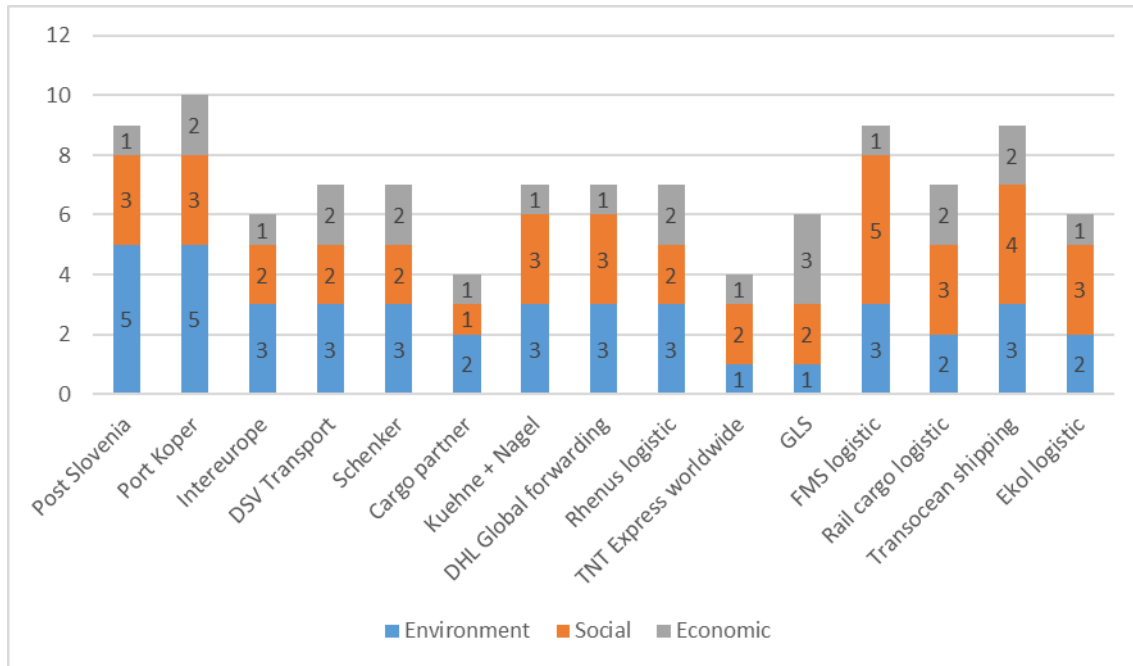
On the Fig. 3 we can see that 8 companies economic sustainability define as lowering transport, operation or other costs of the company. 2 companies engage with the areas to prevent employees turnover. Most of the companies (9/15) believe that increasing performance, goods rotation, partner collaborations and modernization of machinery and vehicles is the key to economic sustainability. 2 companies also plan on improving economic sustainability with increasing the quality of the products / services. Only 1 company is committed to implement delivery solutions.

With the analysis we discovered that also in the economic pillar of sustainability not even one company included all six areas. GLS included 3 areas, Port Koper, Schenker, Rhenus logistic, FMS logistic, Rail cargo logistic and Transocean shipping included 2 areas, Post Slovenia, Intereurope, DSV Transport, Cargo partner, Kuehne + Nagel, DHL Global forwarding, TNT Express worldwide and Ekol logistic included 1 area.

D. Triple bottom line

If we look at the sustainability as a whole (Fig. 4), we can compare companies between each other. Based on picture four we can see that Port Koper is the company with best developed sustainability, followed by Post Slovenia, FMS logistic and Transocean shipping. The companies with worst developed sustainability are Cargo partner and TNT Express worldwide. The environmental areas of all companies are together covered 42%, social areas are covered 44% and economic areas are covered 26%.

Fig. 4: Sustainability of companies



IV. DISCUSSION

Sustainability of a company, especially if it is global one can have big impact on every stakeholder. The spectrum of areas involved in every pillar of sustainability is very wide. As we already know, there are three pillars of sustainability and we defined six areas in each pillar. And in each area companies can introduce sustainability with various areas to promote the wanted behavior. It is almost impossible that the companies would be able to invest enough money, time and dedication to each activity and that results would be optimal and that would meet the expectation of company. As we can see in Fig. 4 the companies primary chose the pillar or area on which they want to improve their performance. Most of the companies have the best structure of environmental pillar of sustainability, maybe even because costumers now can choose the company with which they want to create the business. We also noticed that the companies that are on the market for many years or even decades have much more defined and well-structured sustainability then the companies who are new on the market.

From Fig. 4 we can see that Port Koper is the most developed company in terms of sustainability compared to the other 14 companies. It pays the most attention to the environment, then to the social aspect and least to the economic field.

Another company that is also one of the most sustainably developed compared to the others in our analysis is Post Slovenia. This company also pays the most attention to the environmental field, the same percentage of attention as Port Koper pays to the social field and the least attention to economic field, slightly less than Port Koper. From results it can also be seen that two companies are emerging from the analysis, which in the framework of our analysis, 15 companies, are the least sustainably developed. These two are Cargo partner and TNT Express worldwide.

V. CONCLUSION

With our research we came to a conclusion on which company is the most sustainably developed and that is Port Koper.

We certainly had some limitations with the preparation of our research work, as it was not possible to find an annual report and necessary information for every company. To do our analysis we obtained data from various websites. It would be a lot easier if we had the possibility to communicate with the employees from each company, as this would provide all the necessary information, in addition, this information would be the most up-to-date and our analysis would be more reliable.

Through our research work, we have achieved our goal and obtained data for individual companies on how much they use sustainability. We discovered individual sustainability areas in more detail and showed the sustainability of individual companies. Our research work can serve as a motivation for all companies to work more on sustainability and try to become the best and rank first in terms of the most developed company in the field of sustainable performance.

Our research work could also be used for further research and possibly conducting interviews with companies, and on this basis, we compare our data, which we obtained through the Internet, and the data provided to us by employees of each company. The same research could be done in a few years and the two compared with each other to see if the companies have improved in terms of sustainable development or it has remained unchanged.

In any case, such research is a motivation for individual companies, as each company wants to be shown as the best and at the same time more successful or greater to other companies.

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Merjenje trajnosti v oskrbovalnih verigah: primerjalna študija 15 vodilnih logističnih podjetij v Sloveniji

Izvleček – Naše raziskovalno delo se nanaša na merjenje trajnosti v oskrbovalnih verigah. Najprej se bomo dotaknili teme, kaj pomeni merjenje trajnosti v oskrbovalni verigi in kako jo je mogoče meriti. Osredotočili se bomo na naše raziskovalno področje petnajstih podjetij, kjer bomo raziskali, koliko se slovenska podjetja ukvarjajo s trajnostjo v svojih podjetjih, koliko jim trajnost pomeni in kako jo merijo, ali njihovo podjetje veliko prispeva k trajnosti oskrbovalne verige oziroma k trajnostnemu delovanju celotnega podjetja. V zadnjih letih so se oskrbovalne verige močno spremenile, zaradi krize covid-19, ki je podjetja prisilila, da so spremenila način svojega delovanja, da so njihove oskrbovalne verige učinkovitejše. Kriza covid-19 je torej podjetja prisilila, da so spoznala, da morajo preiti na krožno gospodarstvo, saj je pokazala motnje oziroma ranljivost sedanjih oskrbovalnih verig. O trajnosti je vse več govora in tudi vse več podjetij se zaveda njenega pomena, saj trajnostna oskrbovalna veriga vpliva na celoten proizvodni proces, od pridobivanja surovin do recikliranja izdelkov ali surovin, če je to mogoče. Trajnostna oskrbovalna veriga povečuje konkurenčnost podjetja in zmanjšuje njegove stroške.

Ključne besede - Trajnostna oskrbovalna veriga; upravljanje oskrbovalne verige; logistična podjetja; trajnostni razvoj