Ange-Marie Tuyishime and Omid Fatahi-Valilai

Sustainable Last Mile Delivery Network using Social Media Data Analytics

HICL

Published in: Changing Tides
Wolfgang Kersten, Carlos Jahn, Thorsten Blecker and Christian M. Ringle (Eds.)
ISBN 978-3-756541-95-9, September 2022, epubli

Sustainable Last Mile Delivery Network using Social Media Data Analytics

Ange-Marie Tuyishime[1] and Omid Fatahi-Valilai[1]

1 – Jacobs University Bremen

Purpose: *The purpose of this research was to identify effective strategies to engage consumers to participate in the creation of a sustainable last-mile delivery network using social media and data analytics.*

Methodology: *The research uses the data gathered through surveys to evaluate the customer motivation to contribute to the sustainability paradigm. Also, interaction models have been designed to elaborate the conceptual model and stakeholder interactions.*

Findings: *Using social media as a tool, there would be a considerable potential to motivate the customers for contributing and enabling allowances for the last mile delivery problems. Customer engagement and communication will increase their role to achieve sustainable last-mile delivery. The application of autonomous methods of delivery should be considered to increase the awareness and trust of customers.*

Originality: *This research is unique in terms of engaging the customers for sustainable last-mile delivery planning. Most of the sustainable last-mile delivery research focuses on business responsibility while also they are required for fulfilling the best service level for customers. Increasing awareness among customers can increase their participation for a trade-off in delivery service level while fulfilling sustainability.*

First received: 9. Mar 2022 Revised: 24. Aug 2022 Accepted: 25. Aug 2022

1 Introduction

1.1 Research motivation

Logistics and supply chain activities saturate almost every aspect of our daily lives. Thus, their capability to affect the natural environment is essential. Last-mile logistics is judged as the most polluting section of the supply chain. With the rapid growth of the e-commerce industry, it is now considered one of the giant emitters of Carbon dioxide (Co2) (Awwad, Shekhar and Iyer, 2018a), which has led to climate change. Climate change has become increasingly apparent to everyone, either heard about its effect or experienced it. It is no longer just a concern; instead, it is an enormous threat to our environment. It is generally understood and confirmed by science that human-induced climate change. Here is a lucid cycle that explains better the process of climate change and its effects. Human activities are the leading cause, primarily through forestation and burning of fossil fuels, for example, industry, electricity generation, driving cars, flying planes, and space heating, which led to the release of carbon dioxide (Co2) and other heat-trapping "greenhouse gases." The increase of greenhouse gases led to increased radiative forcing (Global warming), further leading to surface heating, increasing the temperature, precipitation rates, latent heating, and storm intensity. As a result, increased Runoff and increased flooding (Trenberth, 2018).

1.2 Co2 and last mile delivery

The question might arise, why focus on reduction of Co2 in last-mile delivery? In the European Union commission report, they raised their concern about the greenhouse emissions released in the transport sector. They demonstrate how a quarter of all Europe's greenhouse emissions are made by transport and are the primary reason for air pollution in cities. While road transport (last-mile delivery) itself makes 70% of all greenhouse gas emissions from the transport sector, insofar as the first emitter in that sector. The vulnerability is that compared to the other sectors, the transport sector was left behind in terms of a progressive decline in emissions (EU commission, 2021). Moreover, carbon dioxide (Co2) gets more attention than other greenhouse gases, even if it is considered the second worst greenhouse gas after "water vapor." Proven by more

than 100 scientists in the Intergovernmental Panel on Climate (IPCC), reviewed quantity wise carbon dioxide (Co2) as the first greenhouse gas emitted by human activities and takes the first place as a contributor to climate change than any driver of climate change (Sabine, 2014).

To find a solution to detrimental health, economic and social impacts caused by greenhouse gases, particularly Co2. From InterContinental's level to the nation, to companies up to the individual consumer, every party should engage in making it possible. On the national level, for example, Germany is pledged to an EU action to enhance corporate social responsibility in global supply chains (Burkhardt, 2020). The aim of 2020 to reduce 40% of the greenhouse was met through likely extraordinary factors. However, with a target to reduce 55% by 2030 and complete the greenhouse gas neutrality target by 2050, it will take more than enough effort to achieve it (umweltbundesamt, 2021). In that regard, A decision of March 24, 2021, by the Federal Constitutional Court in Karlsruhe is, therefore, a novelty in the history of environmental policy in the Federal Republic of Germany. It forces politicians to make changes in their climate protection planning. The court criticized the lack of sufficient requirements for further emission reductions from 2031 onwards. However, Germany takes it more seriously than ever; recent events such as the flood disaster that shook the Federal Republic in July 2021 with more than 180 deaths (Jacobsen, 2021).

1.3 The logistics firms and consumers' roles

Logistics Companies are the dominant generator of Co2 emissions. However, Logistics is more than just transporting goods and people; it includes storage and material handling. In other words, it is the fore and aft from the origin point, up to the consumer, and in between dealing with the movement of goods, related information, and services to archive customer's need. Of the five major phases in the supply chain, last mile logistics is the last and the most challenging as it is specified as the final leg of the journey as it has to convey the product to the customer's hands. It focuses on customer satisfaction, cost, and time. There is always a conflict between those three points, making the last mile delivery a considerable challenge. Not only in terms of cost but harm to the environment

(Co2 emissions, noise, safety, congestion, and the list goes on), which will get worse (Awwad, Shekhar and Iyer, 2018a).

The government's environmental policy's strength requires logistics companies to shift to sustainable logistics. Sustainable logistics is structured to evaluate, analyze, and reduce the negative impact of logistics operations. Therefore, it is a beneficial key to using the digital calculation of Co2 emissions due to the high volume of transactions made by logistics companies. Although there are standards and regulations, companies fail and still struggle to adhere to them (waves, 2021). Although Logistics companies frequently use market research to access consumers, it primarily improves their sales by introducing new products. However, not about working with consumers to reduce CO2 (Jaworska, 2018).

1.4 Social media and data analytics

Social media have offered a novel possibility to consumers to engage in social interaction on the internet. Consumers utilize social media, for instance, an online community, to create content or campaigns to connect with others. With the rise of digitization, social media is defined as a great advantage for business gain (Hajli, 2014). It is the primary weapon used in sharing information. It has become a marketing key tool between consumers and brands. In parallel, it is a safe place for consumers to express themselves and advocate the change they need about any company or product.

The rise of social networks has highly promoted users' consumption experience, which affects the trends in one way or another despite the location. It has also enhanced better communication between two parties, allowing consumers to have a closer connection with the brands in terms of endorsement or even a solid and balanced association. Daily internet usage statistics from Euromonitor international demonstrate how almost 99% of mobile devices in 2022 will be connected to the internet. Moreover, that increases sharing of information about consumers' experiences through social media. Consequently, it plays a crucial role in product, brand, or service trends (Post DHL, 2018). Reviews made on social media influence the buying behavior of millions of customers. Social Media information extensively predicts, attracts, and influences consumers' decisions. The wide use of social media platforms has generated massive user-generated

content (UGCs). To leverage user-generated content UGCs, organizations need to develop the capability of collecting, storing, and analyzing social media data for harvesting information and actionable knowledge for decision making and forecasting (He et al., 2019).

In this paper, research is conducted on how logistics firms can execute mitigation of green gas emissions in last-mile delivery, using social media to enable consumer engagement concerning their perspective. Together, creating a sustainable (reduction of Co2), the last-mile delivery network could be provided involving both sides. A survey was conducted in the Federal Republic of Germany through a local company's social media platform and reached 6000 consumers. Only 360 subjects volunteered to participate in the whole study.

The Research questions are answered using an internet panel survey of participants between the age range of 17-25 up to 66+ years old, inquiring about their preferences for last-mile delivery options, which all act in reducing CO2. A German residence only simple as the company used in this research had only access to those subjects. The novelty of this research is how consumers assess different last-mile delivery services. Not only in terms of cost and time but values insofar as the emission of local air pollutants and greenhouse gas emissions (CO2); furthermore, logistic companies should invest in market research to gain consumer knowledge to fight climate change together.

The rest of the paper is organized as follows: Section 2 provides a literature review and research gap analysis. Section 3 introduces a proposed conceptual model. Section 4 briefly discusses the preferable sustainable model and elaborates all the options given to consumers. Section 5 concludes the paper results and future insights.

2 Literature review

This study focuses on the engagement of consumers. It contributes to creating a sustainable last mile delivery using social media to communicate with logistic companies. It discussed different attitudes which support this study. In this chapter, the researcher defined the term Last mile delivery, sustainability in this matter, Consumers

related to last-mile delivery, and explained the use of social media technology and data analytics to improve the relationship between consumers and Logistics companies and evaluate it. The Literature review also discussed the previous studies on those four perspectives (which include Last-mile delivery, sustainability, consumers, social media, and data analytics) and the relationship between them. In the end, Research Gap Analysis will provide a foundation to create a conceptual model and propose a solution.

2.1 Last mile delivery

Last mile logistics is the last step of the supply chain from the final distribution center to the receiver's favorite destination point (Gevaers, Van De Voorde, and Vanelslander, 2009). It operates in the business-to-customer (B2C) market and footed on home deliveries (Iwan, Kijewska, and Lemke, 2016). Subject to several factors, Last mile delivery is the most expensive, polluting, and inefficient. Assessment from many studies confirms that 13%-75% of the whole supply chain is for the last mile alone (Gevaers, Van de Voorde, and Vanelslander, 2014). The Causes for that inefficiency depend on different factors such as concentration of consumers, timeframe, fragmentation of deliveries, congestion, and shipment size. Last mile logistics are an external factor for mainly Greenhouse gas emissions, air pollution, noise, and congestion (Olsson, Hellström, and Pålsson, 2019). For these reasons, last mile logistics has attracted much attention and has become an alarming topic worldwide. However, the following triggers are the provoker of the concern seen in last-mile delivery (Boysen, Fedtke and Schwerdfeger, 2020; Sodachi and Valilai, 2021).

- A tremendous increase in demand, rapid population growth and the majority of consumers are urbanized. E-commerce is blooming unexpectedly, where internet retail quintupled from $290.4 billion to 1.6 trillion (Post DHL, 2018).
- Sustainability, the rise of urban parcel demands stimulates many city-delivery vans (Hu et al., 2019).
- Costs, the traditional way to handle the parcel to a recipient using a regular delivery van is expensive. A study based on real-world data in Finland demonstrated that a standard (traditional) van-based delivery costs 2 to 6 euros (Punakivi, Yrjölä, and Holmström, 2001).
- Time pressure: Last mile delivery encounters a very tight deadline and significant time pressure. Additional online orders fluctuated weekly, making

Monday's peak workloads (Prodhon and Prins, 2014). The situation worsened during the seasonal sales (Boysen, de Koster, and Weidinger, 2019). It requires the last mile concept to be expandable even on short notice to resist a steady varying workload (Boysen, Fedtke, and Schwerdfeger, 2020).

- The aging workforce is still a concern in industrialized countries regarding staffing requirements (Otto et al., 2017). Primarily in physically demanding conditions, such as delivering the parcel to the customer's home (Peterson, 2018).

2.2 Sustainability in last mile delivery

Several works of literature addressed the function of sustainability in logistics and supply chain management (SCM). One of the highlighted terms is "green SCM." As the term implies, the focus is on the environmental facet of supply chains (Brockhaus, Kersten, and Knemeyer, 2013). Sustainable evolution has encouraged numerous green and sustainable logistics operations to reduce the negative impact of transportation (Abbasi and Nilsson, 2016). Sustainable logistics is structured to evaluate, analyze and reduce the negative impact of logistics operations (Awwad, Shekhar, and Iyer, 2018b). Green and sustainable logistics are specified to plan, control, manage and implement logistics systems within advanced logistics technologies and environmental management to decrease contaminants and promote logistics performance (Bask and Rajahonka, 2017).

The aim of sustainable logistics does not only cease supplying green goods or services to customers (Pourhejazy, Sarkis, and Zhu, 2019). However, it also includes the green and sustainability of the whole lifecycle of the logistics routine. It enhances good environmental and social feedback (Zhang et al., 2015; Sodachi, Sahraei, and Valilai, 2020). Because it will increase resource utilization, decrease resource consumption waste, mitigate environmental contamination when performing logistics activities during rational planning, and maximize resource allotment and environmental technology (Hasan Qaiser et al., 2017). More literature emphasizes the importance of innovation in sustainable logistics. Björklund and Forslund (2018) Stated innovation as the primary driver of sustainability. Innovation through sustainability can considerably impact companies' performance due to their reputation and beneficial market effects. Research has shown that Innovation thinking is a must in solving the environmental and social problems in building sustainable logistics (Andersson and Forslund, 2017).

Björklund Maria, Forslund (2015) continued to show that a better way to achieve social and environmentally sustainable progression, implementation of innovation will significantly make progress. However, there is still a lack of research on the measurement of innovation in Sustainable logistics (Andersson and Forslund, 2017)

Few research papers have focused on consumer preferences for last-mile deliveries in the sharing economy. Nevertheless, few, like Caspersen and Navrud (2021) conducted a study on females between the age of 18-70 regarding their preference for environmentally sustainable last mile deliveries. Results showed that females have a disutility from delivery time and a positive utility from information services. Female consumers will likely agree to the increased delivery time if it implies reduced emissions.

2.3 Consumers and sustainability

Other literature has discussed the role of consumers in a corporation and its sustainability. Collins, Steg, and Koning (2007) stated that Consumers are the predominant stakeholders. Thus, corporations must consider consumers in determining corporate policies and priorities. Collins, Steg, and Koning continued to stress that customers' power can impact their buying behavior when exercised as a stakeholder group. By purchasing or not purchasing a product from a particular company, customers have a crucial power to influence that company. Agle, Mitchell and Sonnenfeld (1999) In their journal publication "Who matters to CEO? An investigation of stakeholder attributes and salience, corporate performance, and CEO values", managers' reports revealed that customers are the most salient stakeholder group; they are the priority before the manager's team. Thus, customers are "principally" stakeholders. Therefore, if customers' demands demand social and environmental performance, corporations should respond or gamble the corporation's downfall (Hillman and Keim, 2001). Nevertheless, customers' opinions have been chiefly expressed through market research to ascertain a product and services they order. Seldom studies are done from the stakeholders' perspective (Consumers) (Collins, Steg, and Koning, 2007).

2.4 Social media and data analytics in sustainability

A variety of literature argues about the role of social media in promoting sustainability. Zeng et al. (2010) stated that the main force behind the surge of social media is the internet and mobile, offering technological platforms for information distribution, content generation, and synergistic communications. In the for-profit domain, social media has been a gold mine of information and a Business-performance platform for innovation and product design, consumer and stakeholder relationship supervision, and marketing (Olad and Valilai, 2020). Young (2014) stated how social media has rapidly escalated and turned out to be a sustainable essential in daily life; he continues to demonstrate the benefits firms will get in the presence of social media. Howells and Ertugan (2017) discussed how social media can assist firms in supporting the promotion and marketing of their brands to their customers. Which will improve the external communication, awareness, and reflection leadership. Tseng (2017) stated that social media is a public channel company could use to broadcast information. However, little work has considered combining qualitative and quantitative information or discussed social media's role in decision-making. Social media endorses customers' requirements and enhances the firm's performance (Effing and Spil, 2016), even if social media is a challenge for firms due to its inherent pitfalls. For instance, end consumers' amorphous, qualitative, and subjective perceptions of subjects placed on social media platforms (Chan et al., 2016). Social media can immensely impact consumers' decision-making (Tseng, 2017).

On the side of Logistics companies, social media is an innovation to reach social supply sustainability by improving efficient information flow from both in and outsources (Orji, 2019). Social media encourages social sustainability in operations and supply chain management (Wang et al., 2019). promoting social media and other innovations in supply chain social sustainability, especially in the logistics industry, has made Critical success factors in managing the entirety of decisions and processes in the firms as well its supply chain. However, literature is still insufficient regarding the critical success factor for using social media in the logistics industry (Ahmadi, Nilashi, and Ibrahim, 2015).

2.5 Research gap analysis

Previous research has approached several aspects of sustainability in last-mile delivery (Hu et al., 2019; Boysen, Fedtke and Schwerdfeger, 2020; Hasan Qaiser et al., 2017). The role of consumers in sustainability (Hillman and Keim, 2001; Stöckigt et al., 2019) (Brockhaus, Kersten, and Knemeyer, 2013) and how social media is a tool to facilitate a sustainable last mile delivery (Ahmadi, Nilashi and Ibrahim, 2015; Wang et al., 2019; Orji, 2019).

However, in addition, research on the combination of sustainability in the last mile delivery and sustainability in consumption using social media encompasses several new dimensions that lately have attracted research attention in other disciplines (Young, 2014; Hu et al., 2019; Olsson, Hellström and Pålsson, 2019). Some of these new combinations appear essential and worthy of investigation in achieving a sustainable last-mile delivery. Investigating these issues is essential because consumers' contribution is crucial in this matter. Furthermore, previous empirical research has focused primarily on customers' opinions expressed through a market research perspective; very little research has been done on consumers' genuine opinions (Collins, Steg, and Koning, 2007; Stöckigt et al., 2019).

In this study, the seek was to extend the research by addressing the gap in the engagement of consumers (their opinion on their perspective) in diminishing Co2 emissions in last-mile delivery (Björklund Maria, Forslund, 2015; Collins, Steg and Koning, 2007). Even though corporates have put effort into market research to get consumers' opinions. But it was most of the case solely to promote their products, not in the matter to work together with consumers to resolve climate change issues (Jaworska, 2018) and using social media data analytics as a tool (Ahmadi, Nilashi, and Ibrahim, 2015).

The study investigates the impact of four perspectives, Last mile delivery, sustainability, consumers, and social media & data analytics. In addition, interrelationships among them are examined.

3 The proposed framework and workflow solution

The paper proposes a framework model to enable the sustainable last mile delivery by benefiting the data analytics in social media platforms. The conceptual model is shown in Figure 1. The interaction among the model elements can be described as:

1. Last Mile Delivery Firms in their digital campaign, send triggers to social media audiences in order to figure out which Consumers are interested. E.g., The firm will post #environment .... or send a request to consumers.
2. Data analytics will be used to analyze data, using information fed by social media.
3. Willing consumers and None-Willing Consumers ones will be recognized with the help of data analytics.
4. Using the data from workflow 4. And the assessment model, the decisions for delivery will be model and result are shared with consumers individually to gather their opinions.
5. The feedback from willing consumers would be Analyzed and the required modifications will be considered in order to select the most likely propositions.
6. The firms will finally create the final sustainable last mile delivery models with a participation of consumers.

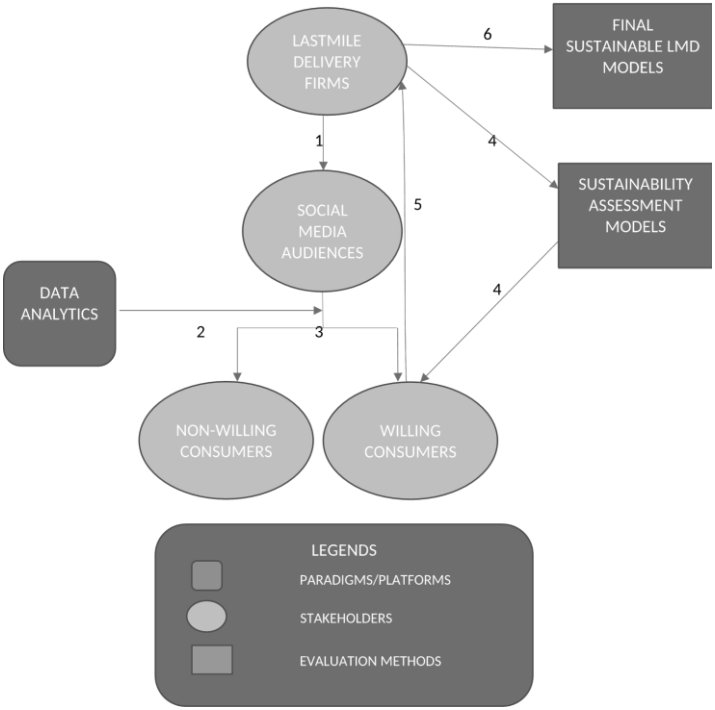

Figure 1: Proposed Conceptual Model

The details of interactions among model stakeholders are elaborated in Figure 2.

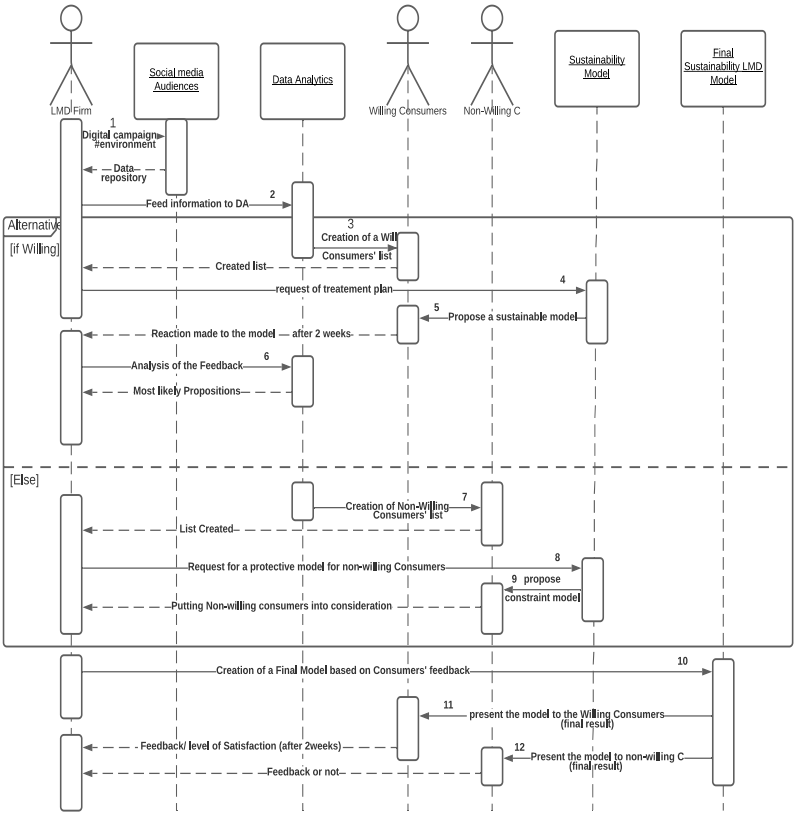

Figure 2: The interaction of model stakeholders

The recommended interactions can be explained as:

1. Last mile delivery (LMD) firm runs a digital campaign to social media platform e.g., sending request and LMD will gather data from social media as a return message.
2. The data will be feed to the data analytics to be analyzed.

3. Data analytics analyze data from social media audiences searching for consumers who responded to the request and classify them as willing consumers. Alternative frame is created to symbolize the choice between willing consumers and non-willing consumers and a willing consumers list is created.
4. Actor LMD requested a sustainable plan for the object “sustainability model”.
5. Then the “sustainability model” sends a sustainable proposal to willing consumers. Willing consumers will respond to the proposal and give their feedback within a period 2weeks.
6. LMD sends the feedback to a data analytics object to be analyzed, as a response data analytics object will provide a segmentation of feedback according to similarity or preference.
7. If not willing option, data analytics will provide a list of non-willing consumers to LMD.
8. LMD will request a protective model to object “sustainability model” to recognize and protect non-willing consumers.
9. The object “sustainability model” will propose a constraint-based model to non-willing consumers.
10. LMD will create a final model made of willing consumers’ feedback.
11. The object “Final sustainability LMD model” will send it to actor “willing consumers” as a response, willing consumer will send their level of satisfaction to LMD.
12. The object “Final sustainability LMD model” will send it to actor “non-willing consumers”, as a response, willing consumers will send their level of satisfaction or not to LMD.

The primary purpose is to make the output sustainable, by enabling consumer’s engagement using social media data analytics as a tool for the purpose to reduce Co2 emission in last mile delivery. To achieve that goal, the proposal is displayed in a manner where firstly, Logistic firms runs a digital campaign with a purpose to create a sustainable last mile delivery network in cooperation with customers, sending environmental messages, posting e.g., # go green, #carbon footprint etc., and customers who are all part of the analysis are considered. Using a dataset from “Feld forum Ruhr” company, a specific set of customers are segregated based on the type of activities they are involved in on social media or the responses to the digital campaign they provide. A data analytics method is used to extract the data to achieve the objective to obtain two types of

customers: the willing customers type who volunteer to participate in the digital campaign and the non-willing customer group.

Then, possible scenarios are analyzed and will be proposed to customers. The proposed scenarios are decided with respect to the logistic site considering what and which type of scenarios are realistic. Upon choosing from the logistic site a sustainable matrix theory will be developed and delivered to both groups. different sustainable options will be presented to the willing customer group, and they will have the power to rate the options given, even be able to create their own sustainable options according to their perspectives. The same action will be applied to the non-willing customer group, instead a constraint-based model will be proposed to them, so that this group will be protected and put in consideration their values. A period of 2 weeks will be given to the customers to give their feedback (comment, rating, observation, opinion, reaction, creation etc.). The feedback will be analyzed by data analytics tools from there a final model will be developed and delivered again to both specific sets of consumers. This time they will be given 2 weeks to evaluate the final sustainable models and express their satisfaction.

4 Evaluation and analysis

4.1 Implementation phase Methodology

In the implementation phase, the strategy involves using qualitative and quantitative methodology. The first-round qualitative methodology will be used because the focus is on collecting and analyzing customers' feedback as the objectives are exploratory. Plus, to segment the customers into different groups and address individual customers based on natural behaviors to avoid including pre-conceived notions and assumptions by only focusing on aggregated data. Qualitative online surveys will be conducted. Questions will be presented to participants in written format via market research platforms, alongside quantitative survey questions on the same topic. Participants are required to respond to questions in text (in detail) to clarify their perspective or experience, which prompts a diversity of responses. Additionally, Online surveys will collect a significant number of responses compared to face-to-face and phone survey approaches. The second round

will be a full quantitative methodology as the objectives are confirmatory; the target is to measure how satisfied the participants are. In that matter, Python will be used for the data analysis part. A few steps will be implied to analyze survey data. First, data preparation will be done. Using Code to analyze the survey data, it is needed to get it in the form of a .csv file. Spider anaconda tool will be used for coding as it is quick to set up and very convenient. Panda was used to import csv file into spider anaconda environment.

4.2 Experiment design

The paper has adopted an Online survey to reach many participants regardless of geographical location in a shorter time. Moreover, it is convenient in economic, environmental, and safety terms, as there is no need to print countless papers or postages, plus no additional transportation costs or face-to-face interviews with covid-19 pandemic restrictions. For efficiency, it will enable testing each choice set equally and randomly across the sample. The online platform google forms online survey was utilized to create the necessary survey due to its considerably customizable capabilities.

As part of a survey, more than 6,000 participants were contacted, through market research (Feldforum Ruhr), usually answering questions in return for payment. Three hundred sixty subjects were prepared to complete the questionnaire and give their opinions for free. Participants are professionals in different domains; some work in logistic companies such as DHL and Helmes. Participants came from all over Germany (within 16 federal states). For that reason, the surveys were conducted in the German language.

Here is an overview of the overall homogeneous socio-demographic data: According to gender, 56,5% of participants were female, and 43,5% were male. According to the work situation,71,5%work full-time and 28,5% part-time. Age ranges from 17-25 was 4.5%, 26-35 was 18.8%, 36-45 was 22.7%, 46-55 was 23.5%, 56-65 was 21.3%, 66+ was only 9.2%. In household situations, only 2,8% have more than 4 people in their household, while 65,3% have 1-2 persons and 31,9% has 3 to 4 persons. According to the Living situation: 82,7% are Urban residents while only 17,3 are rural residents. About their interest in the environment, only 0,6% are not interested while 66,9% are extremely interested. Active

on social media: 50% prefer to use Facebook, 43,8% use Instagram, 12,6% Linkedin, Twitter 11%, and 26% use as well other social media platforms not listed above. Subjects were asked to complete a questionnaire via Feldforum Ruhr's platforms.

The survey's questions were structured into multiple choice questions, checkbox questions, and answer text. Five sustainable options were presented with their description, advantages and disadvantages, and their respective questions. Participants should answer the questions and write their opinions about their preferred sustainable option. Participants could give their opinion on more than one sustainable option. Also, with the following questions in each case, a detail of a selected option could be determined. Towards the end of the questionnaire, participants were asked to specify a preference for each option presented. Adherence to a ranking order was not mandatory. For example, rank one could be given to all options. Note that the five sustainable options were the result of various previous research. The sustainable options and their questions were presented as follows:

4.2.1 Option1: "The use of only one delivery person" (Incharge, 2021)

Description: Here, one company collects all packages from different logistics companies and delivers them to customers.

The advantages:

- The customer receives all the parcels once a day at a certain time and does not have to open to the messenger several times a day.
- The company uses electric vehicles, which reduce noise, emissions and dirt.
- Traffic and its congestion in the city center are reduced.
- Diesel driving bans are alleviated.
- Traffic safety will increase.

Disadvantage:

The additional fee incurred (currently, businesspeople in downtown Düsseldorf pay an additional 1.- Euro per package). The participants were asked how much per package they will be able to pay, between no further fee up to more than 2€. At the end of this

question, participants were asked if they have any additions or suggestions regarding the option above.

4.2.2 Option 2: “The use of autonomous robots”

Description: Electrically powered ground vehicles enable parcel delivery, without a delivery person. This could save a lot of cost as a statement made by Hermes Supervisory Board Chairman Schibur "70 percent of Hermes costs are due to personnel" and "The delivery from the distribution center to the front door alone, i.e. the last mile, accounts for 50 percent of expenses." (handelsblattt, 2018).

- The autonomous delivery robots (SADRs). These are pedestrian-sized robots that only use sidewalks or pedestrian paths.
- The street robots (RADRs). Here, autonomous delivery is done with driverless vehicles that share the road with conventional vehicles.

The Advantages:

- Carbon dioxide emissions are significantly reduced because of the electric motors. Cost savings because no or fewer technologies are needed for drivers, can lead to lower prices. (No additional cost of labor which lead to lower price)

Disadvantages:

- Not complete pedestrian safety.
- Additional sidewalk congestion at the beginning of the still new technology.
- Downtown traffic is not that relieved.

Participants were asked, what would the cost savings be used for? Between 1.to lower the prices for parcel delivery, 2.to co-finance environmental projects at home and abroad, 3.to support educational offers for precarious workers.

At the end of this question, participants were asked if they have any additions or suggestions regarding the option above.

4.2.3 Option 3: “The use of drones”

Description: The drones will deliver the packages.

The advantages:

- Cost savings through driverless technologies.
- Less traffic and congestion in the city.
- Reduction of Co2.

The disadvantages:

- Drones can only transport packages up to about two kilos.
- Human labor is replaced by robots.

Participants were asked, what would the cost savings be used for? Between 1.to lower the prices for parcel delivery, 2.to co-finance environmental projects at home and abroad, 3.to support educational offers for precarious workers. Additional question was "does the maximum package weight of 2kg plays a role for you?" participants should choose between 1.no, because my packages never weigh that much. 2.no, I take the weight into account when ordering. 3.yes, but this type of delivery is still in its infancy. 4. Yes that's why heavy parcels must be able to be transported. At the end of this question, participants were asked if they have any additions or suggestions regarding the option above.

4.2.4 Option 4: "The use of pack stations"

Description: Packages are delivered on foot or by bicycle from post office boxes, lockers in shopping centers, Train stations, or from a local store itself.

The advantages:

- Carbon dioxide emissions are significantly reduced.
- Traffic and its congestion in downtown areas are reduced.

Disadvantage:

- If one uses vehicles with combustion engines, the advantages are reversed.

Participants were asked: "there are exceptions that cause you to pick up the parcels by car (combustion engine)". And participants should choose between 1. Yes, in bad weather. 2. Yes, if the package is too heavy. 3. Yes, when I am pressed by time. 4. No, I will go without the car when I pick it up. At the end of this question, participants were asked if they have any additions or suggestions regarding the option above.

4.2.5 Option 5: "accept longer waiting times"

Description: The service provider first collects parcels for your residential area and delivers them one or a few days later. The customer may receive a price or other benefit for the additional wait time.

The advantages:

- Carbon dioxide emissions are reduced.
- Traffic and its congestion downtown are reduced.

Disadvantage:

- Delivery is often delayed.

Participants were asked, what compensation do you expect from the service provider? Between 1. I do not expect anything, I only do it for the environment, 2. I am expecting a discount for the late deliveries, 3.i expect a price reduction in favor of environmental projects. Additional question was "if you are ready to wait, how long would you wait?" participants should choose between 1. max. one day, 2. Up to two days, 3. Up to three days, 4. Up to one week, 5. More than a week. At the end of this question, participants were asked if they have any additions or suggestions regarding the option above. After reviewing all the five sustainable options, participants had an opportunity to rate the options according to their preference from 1 as the best sustainable option and 5 as the worst. And participants were asked the reason behind their rating.

4.3 Result and discussions

4.3.1 The final ranking

- 1st place with 180 votes in 1st place received option 1, the use of only one delivery person
- 2nd place with 92 votes in 1st place went to option 4, the use of parcel stations
- 3rd place with 76 votes in 1st place received option 5, accepting longer waiting times
- 4th place with 27 votes in 1st place received option 3, use of drones
- 5th place with 21 votes in 1st place received option 2, use of autonomous (driverless) robots

The results show that the selection does have a very individual character. All options received votes for the first rank. So, there is no option that has no supporters. But there are favorites. And one that outshines all the others is Option 1 of course. But the differences diminish, when the 1st ranks, and the second ones are added and weigh them equally. The previous ranking remains, but the gaps become smaller.

- 259 (180 + 79) for 1st place the use of only one carrier
- 216 (92 + 124) for 2nd place use of packing stations
- 156 (80 + 76) for place accepting longer waiting times

Drones and autonomous robots remain behind in 4th place (69) and 5th place (67). The survey reveals that, even though, the majority of participants were skeptical about innovation using drones and autonomous robots. A group of participants who declare themselves as extremely interested in environment, interestingly they chose option 2 and 3 which use drones and autonomous.

After the analysis of these facts and participants' opinions, the paper proposes 3 models.

- Model 1: this model was a result of a combination of option1 (The use of only one delivery agent) + option 4 (The use of parcel station (parcel locker))

With this model 3 variants are conceivable. The deliverer always tries to meet the customer. If the recipient is not present, she/he puts the parcel in the parcel stations, from which the customer picks up his parcel later. The delivery person only delivers to the parcel station and there is no option to meet with the customer (contactless option). The delivery agent only delivers to the pick-up stations. However, if requested or if there are special circumstances (for example, the parcel exceeds a certain value or weight), he or she will call the customer directly. As a precondition: The parcel stations would have to be accessible quickly and in an environmentally friendly manner. Optimally within walking distance of the place of residence.

- Model 2: Combination of option1 "only one delivery person" + option5 "longer waiting times".

In this model, the assumption is that the parcel carrier first delivers parcels that the customer has marked as urgent in advance. In addition, or on other trips, he carries parcels that have been waiting for delivery for a longer time. There would be a need for separation into "urgent" and "can wait" actually exists because the messenger normally

has his vehicles filled with urgent packages. Additional trips ensure that not-so-urgent deliveries also reach the customer.

- Model 3: A combination of option4 "Parcel station" + option5 "longer waiting times"

Deliveries are made only to the Parcel station. First with urgent parcels, later with packages that can wait. As precondition, Packingstations of all suppliers would have to be quickly and environmentally accessible. Optimally within walking distance of the place of residence. The need for a separation into "urgent" and "can wait" exists because the messenger normally has his vehicles filled with urgent packages. Additional trips ensure that not-so-urgent deliveries also reach the customer.

The three final sustainable models were presented to participants, through the same channel (official website of Feldforum Ruhr) first was to assure that their opinions to mitigate Co2 emission in last-mile delivery were taken into account, and secondly, how satisfied they are with the results provided. The participants had to give scores to models on a scale of 1 to 10. 1 as not satisfied and 10 very satisfied with the model. To rate them properly the accumulation of the last 3 digitals was done to get a tangible comparison. Model 1 was the most favorite with 63,8%, model 2 was the second favorite with 21,7%, and lastly model 3 with 19,2%. It is abundantly clear the huge gap between model 1 and the rest. a gap of 42% has been proven. It is interesting that participants who were in favor of model 1 have their opinion on models 2 and 3. Even if the majority has chosen the model1, the participants who were in favor of model 2 were not at all interested in model 1, surprisingly were more attracted to model 3. Nevertheless, All the 3 Models had votes, and all of them should be considered and further research is needed. Below all five options are presented in detail.

4.3.2 Option1. “The use of only one delivery person”

With 180 votes in first place and only 19 in last place, the majority of respondents are in favour of this as a solution to reduce Co2 emissions. The majority of the participants had not yet heard of this model. When choosing this option, the question was also whether a fee should be charged for this additional service and, if so, how high it should be.

As shown in Figure 3, 18,9% are not willing to pay an additional fee. By delivering the parcels from DHL and Co only to the last mile delivery service, costs are saved. This financial advantage can be passed on to the last mile service provider. Thus, no additional costs added. Additional fees could be waived. But other proposals to avoid additional charges also seem worthy of closer consideration. Thus, one should be able to select this last supplier immediately when ordering goods. Or that delivery could remain free of charge if returns were generally subject to a charge. 247 people stated that they would be willing to pay a fee, 93 of them (22%) were even prepared to pay more than one euro per parcel. However, the willingness to pay more is not only due to environmental considerations. With or without an additional delivery fee, objections to electric vehicles were generally raised. In many cases, it was doubted that these actually avoid Co2, since the production and disposal of batteries pollute the environment too much. In addition, it was often not possible to ensure whether the electricity consumed by the electric vehicle is actually so-called "green" electricity. These critical voices were also heard for the following options 2 and Option 3.

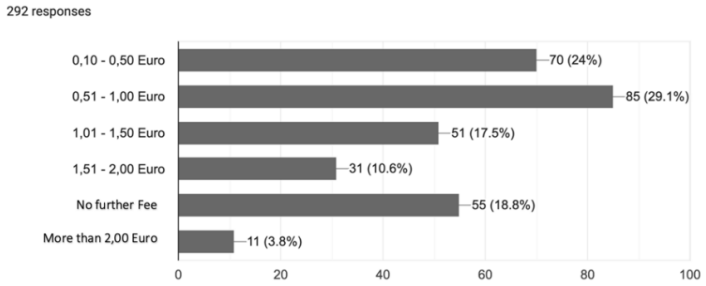

Figure 3: Ratings for extra cost per package

4.3.3 Option 2. “The use of autonomous robots”

With only 21 votes in first place and 120 in last place, the majority of respondents are against this solution. The choice of this option was also about the question of what the savings gained by eliminating high personnel costs would be used for. The assumption that personnel costs account for a significant share of parcel delivery is supported,

among other things, by a statement made by Hermes Supervisory Board Chairman Schibur "70 percent of Hermes costs are due to personnel" and "The delivery from the distribution center to the front door alone, i.e. the last mile, accounts for 50 percent of expenses." (handelsblattt, 2018). Figure 4 presents (1.to lower the prices for parcel delivery, 2.to co-finance environmental projects at home and abroad, 3.to support educational offers for precarious workers). While almost a third of the votes cast (48 people) see a direct cost benefit for themselves in the savings, more than half (57.6%) would prefer to spend the cost savings on environmental projects. As many as 40.5% of the votes were cast for the option of providing education for precarious workers. In many cases, an improved education first provides the opportunity to take up "better" employment and, associated with this, better pay. People who now make up the largest proportion of personnel in the "last mile business" could also benefit from this. From a social point of view, a vote for people and the environment. But surprisingly, not one person has commented in this direction. Instead, there are numerous messages against the use of robots. In many cases, a cost saving was also doubted, as the production and operation of the robotic elements also caused high costs.

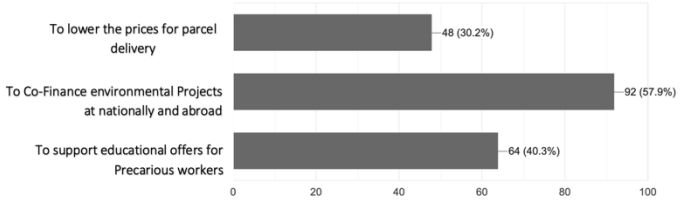

Figure 4: Ratings for the use of money saved for option 3"the use of autonomous robot"

4.3.4 Option 3: “The use of drones”

With only 27 votes in 1st place and 106 in last place, this solution option only reaches the penultimate 4th place. In choosing this option, the question was, just as in option 2, what the savings gained by eliminating high personnel costs would be used for (1.to lower the prices for parcel delivery, 2.to co-finance environmental projects at home and abroad,

3.to support educational offers for precarious workers.). Of course, drones are also robots. They differ from driverless robots only essentially in the type of traffic route. This led to the assumption that there would be little difference in the assessment compared to Option 2. In fact, the results were fairly identical on the question of the use of saved personnel costs. Almost exactly one-third of the votes cast (33.9%) saw the savings as a cost benefit to themselves. The vast majority, however, would prefer to spend financial resources on environmental projects and educational opportunities for precarious workers. A comparability of the comments made also emerged. With the exception of one ("a considerable relief for parcel deliveries"), all additional comments on the subject are negative. As shown in Figure 5, since drones can currently only carry weights of around 2 kg, there is also the question of whether that concern play any role for participant. Many doubts uncomplicated delivery in city centers, especially in large housing estates, apartment blocks and high-rise buildings. Others also think that the risk of accidents, which can also harm people, is a risk that should not be taken. The technical limitations also play a not insignificant role in the largely negative assessment of this option. The development of logistics drones is still in its infancy. The technology is not yet mature enough to allow quadcopters to carry heavy loads. The weight restriction also has an impact on the acceptance of drones.

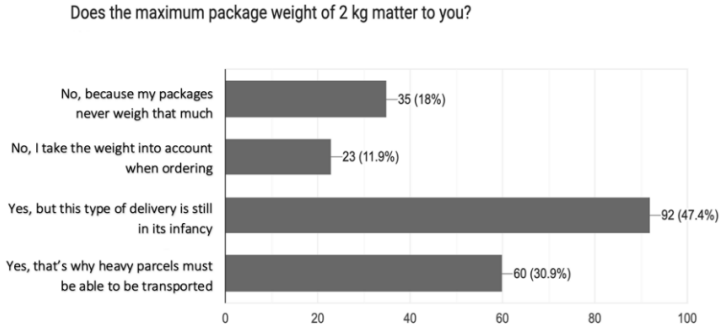

Figure 5: Ratings for the role of weight for option 4, "the use of drones "

4.3.5 Option 4: “The use of parcel station (parcel locker)”

With only 92 votes on rank 1 and only 30 on the last rank the Parcel station reaches rank 2 of the presented options. When choosing this option, the decisive factor is how you pick up your parcels from the Parcel station. In order to save CO2, one would have to forego the use of a vehicle with an internal combustion engine. As shown in Figure 6, Only 13.6% of all votes cast would consistently forego CO2. Weather conditions and time pressure are reasons why just under half of the vote-getters would use CO2 to get their parcel. ¾ of all votes, see no possibility of CO2 savings with heavy packages. The comments made on this are complex. But no additional environmental problem to pick up the parcel with the combustion engine see many under the following condition. Many complain that there are too few of these stations. Particularly in rural areas, people sometimes have to drive considerable distances to pick up their parcels.

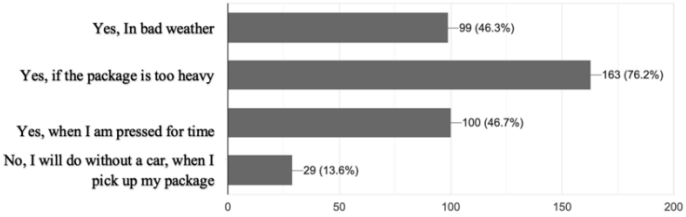

Figure 6: Rating for reasons to pick up the parcels by car (combustion engine)

4.3.6 Option 5: “accept longer waiting time”

With only 76 votes on rank 1 and 50 on the last rank the longer waiting times reach rank 2 of the presented options. When choosing this option, the decisive factor is how long you are willing to wait for your package to be delivered. Details of the answers can be found in Figure 7: (1. max. one day, 2. Up to two days, 3. Up to three days, 4. Up to one week, 5. More than a week). A maximum of 14% would wait a day, 33.6% would wait 2 days and just under 30% would even wait up to three days for their own package. Up to a week and beyond even more than 23 %.

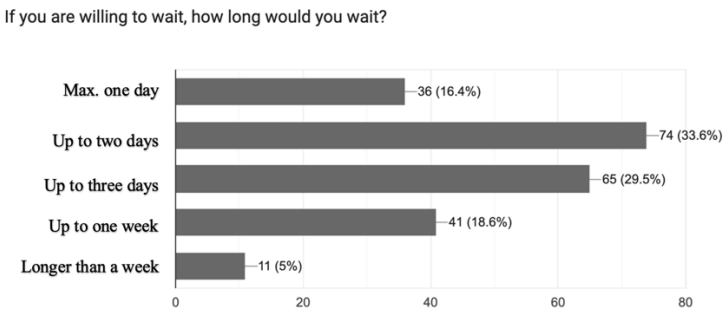

Figure 7: Rating for the waiting time

5 Conclusion

The purpose of this research was to identify effective strategies to engage consumers to participate in the creation of a sustainable last mile delivery network using social media and data analytics. Based on the analysis, it can be concluded that social media is a convenient way for a firm to carry out a sustainable campaign. Moreover, customers' opinions have been expressed through their perspectives. However, it is imperative to strengthen the cooperation of consumers and logistic firms in finding sustainable logistics innovation. Consumers' willingness is at their disposal. Unfortunately, they are not mostly updated with sustainable logistics innovation, which weakens consumers' opinions. The survey conducted in this research reveals that of the sustainable options presented to the participant, only a minor part is open-minded to using technologies such as drones and robots for the sake of the environment. While for others, it still sounds like science fiction. Even the models created from consumers' opinions show skepticism toward innovation. Seeing the immense challenges connected to last-mile delivery in the urban area shows a deep complexity that just one model cannot support a CO2-neutral solution for all stakeholders. Place of residence, living situation, age, mobility, social networking, shopping habits, and willingness to support sustainability are just a few examples that need to be considered in last-mile delivery. Moreover, due to consumers'

safety concerns, direct contact with drones and autonomous delivery vehicles may remain problematic. Thus, acquiring the right decision assist innovative last-mile delivery concepts based on autonomous driving and consulting consumer engagement offers many interesting future research tasks. The results obtained from this research can be used to establish social media influences on customers to participate with the last mile delivery service providers through sustainability paradigms. As different strategies for engagement of customers are analyzed and investigated the important aspects for implementation and fulfilment of strategies can be used for more robust and successful marketing trends.

References

Abbasi, M. and Nilsson, F., 2016. Developing environmentally sustainable logistics: Exploring themes and challenges from a logistics service providers' perspective. Transportation Research Part D: Transport and Environment. Pergamon, 46, pp. 273–283. doi: 10.1016/J.TRD.2016.04.004.

Agle, B. R., Mitchell, R. K. and Sonnenfeld, J. A., 1999. Who matters to CEOs? An investigation of stakeholder attributes and salience, corporate performance, and CEO values, Academy of Management Journal. Academy of Management, 42(5), pp. 507–525. doi: 10.2307/256973.

Ahmadi, H., Nilashi, M. and Ibrahim, O., 2015. Organizational decision to adopt hospital information system: an empirical investigation in the case of Malaysian public hospitals. International journal of medical informatics. Int J Med Inform, 84(3), pp. 166–188. doi: 10.1016/J.IJMEDINF.2014.12.004.

Andersson, P. and Forslund, H., 2017. Developing an indicator framework for measuring sustainable logistics innovation in retail.. doi: 10.1108/MBE-04-2017-0017.

Awwad, M., Shekhar, A. and Iyer, A. S., 2018a. Sustainable Last-Mile logistics operation in the Era of E-commerce. Proceedings of the International Conference on Industrial Engineering and Operations Management, 2018(SEP), pp. 584–591.

Awwad, M., Shekhar, A. and Iyer, A. S., 2018b. Sustainable Last-Mile Logistics Operation in the Era of E-Commerce.

Bask, A. and Rajahonka, M., 2017. The role of environmental sustainability in the freight transport mode choice: A systematic literature review with focus on the EU. International Journal of Physical Distribution & Logistics Management. Emerald Publishing Limited, 47(7), pp. 560–602. doi: 10.1108/IJPDLM-03-2017-0127.

Björklund, M. and Forslund, H., 2018. 'Exploring the sustainable logistics innovation process. doi: 10.1108/IMDS-02-2017-0058.

Björklund Maria, Forslund, H., 2015. In search of sustainable logistics innovation. Available at: https://www.diva-

portal.org/smash/record.jsf?pid=diva2%3A810735&dswid=-10 (Accessed: 22 July 2021).

Boysen, N., Fedtke, S. and Schwerdfeger, S., 2020. Last-mile delivery concepts: a survey from an operational research perspective. OR Spectrum 2020 43:1. Springer, 43(1), pp. 1–58. doi: 10.1007/S00291-020-00607-8.

Boysen, N., de Koster, R. and Weidinger, F., 2019. Warehousing in the e-commerce era: A survey. European Journal of Operational Research. North-Holland, 277(2), pp. 396–411. doi: 10.1016/J.EJOR.2018.08.023.

Brockhaus, S., Kersten, W. and Knemeyer, A. M., 2013. Where Do We Go From Here? Progressing Sustainability Implementation Efforts Across Supply Chains. Journal of Business Logistics. John Wiley & Sons, Ltd, 34(2), pp. 167–182. doi: 10.1111/JBL.12017.

Bundesverfassungsgericht, 2021. Federal Constitutional Court - decisions - Constitutional complaints against the Climate Protection Act partially successful. Available at: https://www.bundesverfassungsgericht.de/SharedDocs/Entscheidungen/DE/2021/03/rs20210324_1bvr265618.html (Accessed: 6 July 2021).

Burkhardt, B., 2020. German Government Sets Out for More Sustainability - Lexology. Available at: https://www.lexology.com/library/detail.aspx?g=80e0136a-685b-43ea-a31b-628b26cc547a (Accessed: 16 July 2021).

Chan, H. K., Wang, X., Lacka, E., and Zhang, M., 2016. A Mixed-Method Approach to Extracting the Value of Social Media Data, Production and Operations Management. John Wiley & Sons, Ltd, 25(3), pp. 568–583. doi: 10.1111/POMS.12390.

Collins, C. M., Steg, L. and Koning, M. A. S., 2007. Customers' Values, Beliefs on Sustainable Corporate Performance, and Buying Behavior. Psychology & Marketing, 24(6), pp. 555–577. doi: 10.1002/mar.20173.

Effing, R. and Spil, T. A. M., 2016. The social strategy cone: Towards a framework for evaluating social media strategies. International Journal of Information Management. Pergamon, 36(1), pp. 1–8. doi: 10.1016/J.IJINFOMGT.2015.07.009.

EU commission, 2021. Transport emissions | Climate Action. Available at: https://ec.europa.eu/clima/policies/transport_en#tab-0-1 (Accessed: 13 July 2021).

Gevaers, R., Van de Voorde, E. and Vanelslander, T., 2014. Cost Modelling and Simulation of Last-mile Characteristics in an Innovative B2C Supply Chain Environment with Implications on Urban Areas and Cities. Procedia - Social and Behavioral Sciences. Elsevier, 125, pp. 398–411. doi: 10.1016/J.SBSPRO.2014.01.1483.

Gevaers, R., Van De Voorde, E. and Vanelslander, T., 2009. CHARACTERISTICS OF INNOVATIONS IN LAST MILE LOGISTICS-USING BEST PRACTICES, CASE STUDIES AND MAKING THE LINK WITH GREEN AND SUSTAINABLE LOGISTICS'.

Hajli, M. N., 2014. A study of the impact of social media on consumers. International Journal of Market Research, 56. doi: 10.2501/IJMR-2014-025.

Handelsblattt, 2018. Hermes, DHL: In der Paketbranche sinken trotz Boom die Gewinne. Available at: https://www.handelsblatt.com/unternehmen/dienstleister/paketdienste-trotz-boom-bei-dhl-und-hermes-sinken-die-gewinne-was-hinter-dem-paket-paradox-steckt/22799070.html (Accessed: 8 August 2021).

Qaiser, F.H., Ahmed, K., Sykora, M., Choudhary, A. and Simpson, M. Decision support systems for sustainable logistics: a review and bibliometric analysis. Industrial Management & Data Systems. doi: 10.1108/IMDS-09-2016-0410.

He, W., Zhang, W., Tian, X., Tao, R. and Akula, V., 2019. Identifying customer knowledge on social media through data analytics. Journal of Enterprise Information Management. Emerald Group Publishing Ltd., 32(1), pp. 152–169. doi: 10.1108/JEIM-02-2018-0031.

Hillman, A. J. and Keim, G. D., 2001. SHAREHOLDER VALUE, STAKEHOLDER MANAGEMENT, AND SOCIAL ISSUES: WHAT'S THE BOTTOM LINE?, Strategic Management Journal Strat. Mgmt. J.

Howells, K. and Ertugan, A., 2017. Applying fuzzy logic for sentiment analysis of social media network data in marketing. Procedia Computer Science. Elsevier, 120, pp. 664–670. doi: 10.1016/J.PROCS.2017.11.293.

Hu, W., Dong, J., Hwang, B., Ren, R., and Chen, Z., 2019. A Scientometrics Review on City Logistics Literature: Research Trends, Advanced Theory and Practice. Sustainability 2019, Vol. 11, Page 2724. Multidisciplinary Digital Publishing Institute, 11(10), p. 2724. doi: 10.3390/SU11102724.

Incharge, 2021. incharge – Smarte Innenstadtlogistik. Available at: https://www.incharge.city/ (Accessed: 7 August 2021).

Iwan, S., Kijewska, K. and Lemke, J., 2016. Analysis of Parcel Lockers' Efficiency as the Last Mile Delivery Solution – The Results of the Research in Poland. Transportation Research Procedia. Elsevier, 12, pp. 644–655. doi: 10.1016/J.TRPRO.2016.02.018.

Olad, A. A. and Valilai, O. F., 2020. Using of Social Media Data Analytics for Applying Digital Twins in Product Development. in 2020 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), pp. 319–323. doi: 10.1109/IEEM45057.2020.9309834.

Olsson, J., Hellström, D. and Pålsson, H., 2019. Framework of last mile logistics research: A systematic review of the literature. Sustainability (Switzerland), 11(24), pp. 1–25. doi: 10.3390/su11247131.

Orji, I. J., 2019. Examining barriers to organizational change for sustainability and drivers of sustainable performance in the metal manufacturing industry. Resources, Conservation and Recycling. Elsevier, 140, pp. 102–114. doi: 10.1016/J.RESCONREC.2018.08.005.

Otto, A., Boysen, N., Scholl, A. and Walter, R., 2017. Ergonomic workplace design in the fast pick area. OR Spectrum 2017 39:4. Springer, 39(4), pp. 945–975. doi: 10.1007/S00291-017-0479-X.

Peterson, H., 2018. Amazon Delivery Drivers Reveal Claims of Disturbing Work Conditions, Insider. Available at: https://www.businessinsider.com/amazon-delivery-drivers-reveal-claims-of-disturbing-work-conditions-2018-8?r=DE&IR=T (Accessed: 22 July 2021).

Post DHL, D., 2018. A custom report compiled by Euromonitor International for Deutsche Post DHL Group In cooperation with'. Available at: www.euromonitor.com (Accessed: 18 July 2021).

Pourhejazy, P., Sarkis, J. and Zhu, Q., 2019. A fuzzy-based decision aid method for product deletion of fast moving consumer goods. Expert Systems with Applications. Pergamon, 119, pp. 272–288. doi: 10.1016/J.ESWA.2018.11.001.

Prodhon, C. and Prins, C., 2014. A survey of recent research on location-routing problems. European Journal of Operational Research. North-Holland, 238(1), pp. 1–17. doi: 10.1016/J.EJOR.2014.01.005.

Punakivi, M., Yrjölä, H. and Holmström, J., 2001. Solving the last mile issue: reception box or delivery box?. International Journal of Physical Distribution & Logistics Management. MCB UP Ltd, 31(6), pp. 427–439. doi: 10.1108/09600030110399423.

Sabine, C., 2014. The IPCC fifth assessment report. Carbon Management, 5(1), pp. 17–25. doi: 10.4155/CMT.13.80.

Sodachi, M., Sahraei, P. and Valilai, O. F., 2020. Public sustainable transportation planning with service level efficiency: Hamburg case study. in Proceedings of the Hamburg International Conference of Logistics (HICL). (Proceedings of the Hamburg International Conference of Logistics (HICL)), pp. 97–127. doi: 10.15480/882.3154.

Sodachi, M. and Valilai, O. F., 2021. Sustainable public transportation using markov chains: case study Hamburg public transportation. Hamburg International Conference of Logistics (HICL) 2021, pp. 97–134. doi: 10.15480/882.3998.

Stöckigt, G., Strube, R., Lubjuhn, S., and Brand, M., 2019. Assessment of Consumer Attitudes Toward Sustainability in Food Logistics and the Role of Shopping Behavior and Personal Characteristics. Innovative Logistics Services and Sustainable Lifestyles: Interdependencies, Transformation Strategies and Decision Making. Springer, Cham, pp. 87–104. doi: 10.1007/978-3-319-98467-4_4.

Trenberth, K. E., 2018. Climate change caused by human activities is happening and it already has major consequences. https://doi.org/10.1080/02646811.2018.1450895. Routledge, 36(4), pp. 463–481. doi: 10.1080/02646811.2018.1450895.

Tseng, M. L., 2017. Using social media and qualitative and quantitative information scales to benchmark corporate sustainability. Journal of Cleaner Production. Elsevier, 142, pp. 727–738. doi: 10.1016/J.JCLEPRO.2016.05.062.

Umweltbundesamt, 2021. Indicator: Greenhouse gas emissions | Umweltbundesamt. Available at: https://www.umweltbundesamt.de/en/data/environmental-indicators/indicator-greenhouse-gas-emissions#assessing-the-development (Accessed: 14 July 2021).

Wang, Z., Xu, G., Lin, R., Wang, H., and Ren, J. 2019. Energy performance contracting, risk factors, and policy implications: Identification and analysis of risks based on the best-worst network method. Energy. Elsevier Ltd, 170, pp. 1–13. doi: 10.1016/J.ENERGY.2018.12.140.

Waves, 2021. This is why logistics companies should know their carbon footprint | WAVES. Available at: https://waves.lu/know-the-carbon-footprint/ (Accessed: 17 July 2021).

Young, S. D., 2014. Behavioral insights on big data: using social media for predicting biomedical outcomes. Trends in Microbiology. Elsevier Current Trends, 22(11), pp. 601–602. doi: 10.1016/J.TIM.2014.08.004.

Zeng, D., Chen, H., Lusch, R. and Li, S., 2010. Social media analytics and intelligence. IEEE Intelligent Systems, 25(6), pp. 13–16. doi: 10.1109/MIS.2010.151.

Zhang, S., Li, C.K.M, Chan, H.K., Choy, H.K., and Wu, Z., 2015. Swarm intelligence applied in green logistics: A literature review. Engineering Applications of Artificial Intelligence. Pergamon, 37, pp. 154–169. doi: 10.1016/J.ENGAPPAI.2014.09.007.