Sustainable Processes on the Last Mile—Case Study Within the Project ‘NaCl’

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Abstract Today the proportion of customers who prefer buying online increases in many product categories. The rising proportion of online orders and the associated returns have a significant effect on the existing logistics system. The city centers in particular are severely affected by the resulting traffic on the last mile with emissions, noise and traffic jams. In addition to these effects, the increasing pressure on performance and costs has a negative impact on the drivers employed by logistics service providers. The last mile, however, offers great potential for sustainable logistics processes. This article uses the sustainable crowd logistics project NaCl to show possible processes for last mile logistics.

Keywords Sustainability · SusCRM · Last mile logistics · Logistics process · Crowd logistics · Bundling
1 Introduction

The following definition by Gevaers et al. reflects the today’s situation in urban logistics: ‘The last mile is currently regarded as one of the more expensive, least efficient and most polluting sections of the entire supply chain’ [1]. Within the supply chain management, the last mile is understood to be the overcoming from the transport hub to the final destination. At this part of the supply chain the customers experience directly the aspects of service provided by the courier, express and parcel (CEP) service provider. Therefor the logistics companies are in charge of satisfying the customers’ demands to stay competitive.

An innovative approach for overcoming the last mile are on-demand platforms which are providing effective solutions for modern urban logistics. As the traffic worldwide is increasing rapidly [2] city logistics is facing various challenges on the economical, ecological and social level.

The stationary retail is losing more and more market shares to the e-commerce but as it has the advantage of customer proximity. This potential should be used by taking it into account in urban logistics.

While great challenges can be found within the last mile logistics, a lot of chances can be identified for the logistics companies. To face the challenges and benefit from the chances, the actual situation of the CEP-sector has to be analyzed with focus on different aspects and innovative solutions have to be developed. To follow a sustainable approach, it is important to examine solutions under the already mentioned aspects of ecology, economy and society and to combine them in one solution system while at the same time it has to be ensured that the requirements of the customers and furthermore, those of a sustainable last mile logistics are fulfilled.

2 Fundamentals and Innovations

2.1 State of the Art and Challenges

Nowadays it can be observed that consumers tend to buy products online. Studies from 2017, however, show that German consumer still prefer buying most products in the stationary retail, but at the same time these studies set out that a rapid change in the buying behavior in the direction of online trading can be seen. The proportion of customers who preferred buying stationary decreased in all product categories examined between 2016 and 2017, for example, the category electronics and computers lost 10% while the leading stationary shopping channel foods lost 5% [3].

The choice of shopping channel depends on the type of product, but it was forecasted that in 2020 every fifth purchase will be made online [4]. Many returns are associated with many orders and demand logistics to develop innovative approaches.

These developments lead to big challenges for logistics, especially on the last mile. In the year 2021 it is expected, that there will be a transport volume of 4.15
billion packages in the German market, which is meant to be handled by the already overstrained CEP-sector [5]. The increasing traffic load resulting from the rising number of shipments leads to traffic jams and environmental pollution, especially within the inner-city traffic. The last mile causes friction, because it is not only an obstacle to traffic but also has a negative impact on the quality of life and air. With 18.2 percent (166 Mio. T CO₂-equivalent) in 2016 traffic is the third largest cause of emissions in Germany [6] and has a huge negative impact on the environment.

There is great potential, especially on the last mile, to make supply chains more environmentally friendly in order to meet the general demand for sustainability in the economy and society and to improve the image of the industry. The use of electromobility instead of fuel-operated vehicles has positive effects on emissions, as it is locally emission-free. While the EU’s climate protection targets call for an emissions reduction of 40 percent by 2030 [7], at the same time, surveys show that for example consumers like to be more environmentally friendly and ethical through the economic acting of brands [8].

Just like consumer behavior, this shows that incentives have to be created so that consumers can and are willing to participate in a more sustainable delivery process. Providers of logistics services have to act in order to meet the demands of the consumers as those are the ones that define the requirements. It must therefore be ensured that the supply chain is designed on the basis of the endpoints (the requirements of the customers). According to studies from 2017, the most important delivery criteria are free shipping, the possibility of tracking the shipment and satisfaction with the delivery service [9].

On the one hand the demand of public institutions and the customers for more sustainability are driving the industry to act more environmentally friendly, but on the other hand the consumers ask for free shipment and great service. Solutions have to be found to make the partly contrary goals compatible. The use of bundling, e.g., has the potential to realize the demand for cheap and at the same time sustainable delivery.

While sustainability is discussed on the level of ecology, it also has to be focused on the social aspects of sustainability. Several start-ups and companies today offer various solutions to meet the demand for flexible and cheap deliveries but at the same time those approaches often are missing social aspects such as fair payment, job stability and health insurance. Furthermore, these approaches have a destructive effect on the existing logistics labor market, since they often follow a crowd logistics approach that results in disruptive consequences for the logistics industry. Uber freight, for example, is a freight-on-demand service which takes over the brokerage part of the freight forwarder and in this way has the potential to make big changes in the traditional business model by replacing the freight forwarders with data and algorithms. As no human interaction would be needed anymore in this process design, it doesn’t meet the requirements of social sustainability within the last mile. Moreover, this kind of process leads to a higher pressure on the transport prices and thereby boosts wage dumping.
2.2 Innovations

Innovative logistic business models on the last mile are facing various partly conditional challenges and need to combine the aspects of the three dimensions of sustainability within one approach. On the ecological level those are environmentally and climate friendly transport and logistics processes, on the economical level profit and growth and on the social level fair payment, job stability and social security.

2.2.1 Electromobility

The integration of electromobility by the use of, for example, electric cargo bikes not just has positive effects on the carbon-dioxide footprint but at the same time helps improving the image of the companies using it. In combination with the use of micro depots as an intermediate between the depots of the CEP-companies and the cargo bikes, the disadvantages of the light electric vehicle (LEV), such as low loading capacity and driving range can be compensated. According to studies of the project ‘Cycle-Logistics’ it was demonstrated that cargo bikes have a huge potential to tackle these challenges as they can improve the image and general levels of cycling, replace over 50% of urban transport-related trips, as well as enhance air quality, safety levels, and life quality of urban areas. At present, however, this innovative solution is not fully deployed in any European cities’ [10]. The studies of the project ‘Ich entlaste Städte’ shows that more and more companies tend to use cargo bikes to replace fuel-operated driving systems on the last mile. The initiative lends cargo bikes to companies for a euro a day for up to three months of testing. While and after the testing phase the companies are surveyed and after testing every fifth user bought an own cargo bike or considered buying one in the future [11].

2.2.2 Bundling

Furthermore, approaches such as bundling can lead to positive effects on sustainability dimensions of the last mile.

Bundling, in this context, refers to bundling of different products (newspapers, parcels, delivery services) as well as bundling of services for different clients (local retailers, GLS, publishers etc.). Furthermore, delivery and collection can be bundled in one tour, in which the term “pickup and delivery” is also used. Several aspects including disposition, tour planning, the staff and the delivery vehicles are to be considered in the process of bundling.

Ecological benefits due to the higher utilization of loading capacities and reduction of distances can result from bundling of transport in different ways. Moreover, on the economic level it can lead to time savings and cost reductions. As the better utilization of capacities takes advantages of economies of scale by dividing fix costs by more units, at the same time it furthers reduction in overall costs, environmental
pollution and traffic congestion. With smaller shipment volumes, the costs per unit for bundling can be higher than for direct transport, since bundled transport leads to detours to different shipping and receiving points and causes additional downtime. In general, bundling has a positive effect on logistical sustainability and leads to improvements on economics, ecology and transport levels [12, 13].

For bundling, some product groups request special treatment, as for example some products are perishable or need special cooling, and the bundling results in longer transport times. Greater attention should be paid to the complexity of this instrument, and dynamic route planning must be geared to this. Uncertainties should be taken into account to route planning, so that planning steps must be continuously updated [14].

Dynamic data are, e.g.:

- **Customers**: Not all customers are available at the time of planning, as some of the customers or orders only become known as the tours are executed.
- **Service Time**: Customer events can extend the service time.
- **Delivery time window**: Customer can extend, shorten or shift the delivery time window.
- **Capacities**: Available capacities can vary, e.g., because of defective vehicles or sick employees.
- **Travel times**: Different travel times to consider at different times of the day, but also unexpected events such as accidents, weather conditions, etc.

To implement dynamic route planning innovative information technology is needed, while it has to be defined which data is required as input. Out of the input a certain output in shape of a planned route is generated with the help of an algorithm [15]. Inputs such as: Customer data, order data, driver data, vehicle data, stroke data, traffic information, distance matrix, product group etc. are needed for the data processing and the algorithm. The algorithm includes restrictions, input parameters, optimization objectives and secondary real-time data processing that is based on position data (geofencing), quantity (volume) update, tour control and changes in generation or distribution plans [15, 16].

### 2.2.3 Crowd Logistics

Crowd logistics leads back to the term crowdsourcing as a neologism of the terms “crowd” and “outsourcing”, where “crowd” is defined as the mass of people or potential labor force, and “outsourcing” is the relocation of processes, functions, and duties to third parties [17].

Mehmann et al. define the term as follows: “Crowd-logistics refers to the outsourcing of logistics services to a large number of actors, whereby coordination is supported by a technical infrastructure. Crowd-logistics aims to achieve an economic benefit for all participants and shareholders” [17].

The technical infrastructure is usually used as a communication medium, such as a platform, which can be accessed in different ways (mobile phone, web browser
The platform handles demand and supply for transport services, management processes and invoice processing.

On economical perspectives, benefits of crowd logistics are achieved from the Sharing Economy paradigm, a concept in which increased prosperity results from sharing goods or services between market participants. According to Mehmann et al. [17] crowd logistics enables new ways in logistics services and the improvement of existing logistics services in terms of volume, speed, and flexibility, which leads to win-win economic effects for all stakeholders. This can lead to significant growth of productivity on the last mile, for example. Recipients could be able to receive more convenient and flexible logistics services, while suppliers obtain economic benefits. The potential of crowd logistics can be observed in several successful companies, such as the Taxi Service Uber and its freight-on-demand platform Uber Freights. Certainly, it is increasingly seen that existing labor market models are leading to disadvantages of employees, especially when it comes to the low-wage sector, as the crowd logistics [18].

Problems in this context are fake self-employment, falling wage levels, shifting responsibilities and resources to the employee, as well as softening of the protection against dismissal etc.

Looking at social potentials of crowd logistics, it could be used not to replace the existing workforce but to support it in high phases and has the great potential to strengthen the over-the-counter retail by integrating them into the crowd logistics approach and bring them back some of their market shares.

In summary, it can be stated that crowd logistics models have high economic potentials but are also fraught with risks. An essential focus for companies should be to develop competitiveness but at the same time being employee-friendly based on the crowd approach in terms of social sustainability [16, 19].

### 2.2.4 Sustainable Customer Relationship Management (SusCRM)

Sustainability in CRM is discussed from several different aspects to date. As this approach features the notion of CRM, which focuses on customer relationship management or relationship marketing strategies, and the term ‘sustainable’. SusCRM can be understood as any CRM methodology which supports a continuous development of inter-business and customer relation while matching ecological, social and economic values for involved parties and as well relevant third parties. However, sustainability is growing more and more in importance in general within CRM research due to the immediate and direct impact on humanity from several perspectives that influences most meaningful things to mankind like, for example, life or a planet to live that has no substitution. Sustainability tends to be the main topic as it emphasizes since there would be missing essential parts of social and associated economic life without a viable environment. According to this, sustainability is an instrument of CRM supporting the process of identification, differentiation, interaction, and customization for customer clusters of current business cases. One of the key achievements of a successful CRM strategy is the creation of loyal customer
groups for a sustainable business model. SusCRM strategies can lead to determine sustainability values and targets as key differentiators among customers and on the other hand present a designed CRM process which increases loyalty to the core value in a specific reward-based concept, which motivates its audiences to act more sustainable through the business model [16, 20].

3 Case Study Within the Project NaCl

3.1 Chances of NaCl-Approach

Within the “NaCl—Sustainable Crowd Logistics” project, an innovative and sustainable logistics system for last mile logistics was developed based on a crowd logistics approach. The project is currently planned in an inner-city test field in Bremerhaven shortly before being piloted.

Significant features of the designed logistics system are on the one hand the positive ecological effects using locally emission-free and traffic-sparing, electric cargo bikes. On the other hand, it has interesting economic potentials for the logistics service provider, as it is more elastic compared to conventional systems of CEP service providers based on combustion vehicles, especially in the personnel sector due to the lack of driving license and low qualification requirements.

The employment of student crowdworkers enables the delivery to be handled with maximum flexibility, as well as improving the working conditions of permanent parcel deliverers by taking over excessive parcel deliveries.

Another special feature of this project is that within the framework of a “combined delivery” the transports are bundled about both the delivered products and the logistics service providers commissioning them. As a result, logistics will be significantly more efficient and thus, more social and environmentally friendly. However, this makes the requirements on the system, both on an organizational and a technical level, more complex.

As part of the project approaches for Sustainability Customer Relationship Management (SusCRM) [20] were developed. These strengthen sustainability as a central marketing factor and exhibit gamified incentive systems for participation in a sustainable logistics system at the levels of logistics customer (B2B) and end customer (B2C) as well as at the employee level.

3.2 Conceptional Components

Partners of the project coordinated by the Bremerhaven University of Applied Sciences are the companies Rytle GmbH and the Weser Eilboten GmbH, an associated company of the Ditzen business group in Bremerhaven.
The logistics concept is based on the last mile logistics system of Rytle. This is a highly efficient system consisting of mobile hubs working as micro-depots, electric freight bicycles (MovR and Triliner) with an exchangeable transport box for the products to be delivered, and a digital infrastructure.

The digital infrastructure offers an innovative platform for networking between the software and hardware components involved in the logistics concept. Protected data on the products, customers and tour planning from the software of the logistics service provider Weser Eilboten are forwarded to the software of Rytle via this infrastructure. An optimized route planning for the last mile then is created for the crowdworker.

The main component is the driver app provided by Rytle, which was adapted for use by the crowdworkers as part of the NaCl project. The crowdworker is assigned to a cargo bike and a transport box via the app. It supports the crowdworkers in handling of transport and instructs them in the operating sequence of the customers. The driver app also supports pickup and delivery and the specification of customer time windows.

In addition to the driver app, the Rytle software also provides an app for business customers and end customers, in which shipments can be commissioned, tracked and evaluated. Additionally, to locking options for MovR, BOX and HUB, the app offers over 200 other use cases [21].

4 NaCl Model

For the implementation and testing of the NaCl model, a regionally based logistics service provider is required, who can take over capacities of other logistics service providers in addition to their own customer base. In order to be able to manage these additional tasks, crowdworkers will support the already existing staffing. A special feature of the pilot scenario is that the crowdworkers are mainly recruited from students of the Bremerhaven University of Applied Sciences. This focusing addresses a group that sets priority on a flexible working relationship, but at the same time is receptive to incentives through participation in an ecologically sensible system. It must be ensured that the permanent employees are working at 100% capacity and that the crowdworkers are only called in if there is an overload. Employees on vacation must be replaced, the Christmas business requires significantly more employees and cases of illness can be compensated. It is also possible to reduce overtime hours of the permanent staff quickly and easily. Consequently, this means a stable planning base for permanent employees with unlimited contracts and less stress.

The information of individual data streams, for example of tour planning, customer requirements, the specifications of the goods and the delivery route, must be managed transparently in one system (Fig. 1).

This project fixes that the crowdworkers will deliver entire boxes and moreover pickup and deliver parcels of the business customers of the regional stationary retail during the pilot phase.
In the area of SusCRM, the purely economic dimension of CRM is expanded to include an ecological and a social dimension in the sense of sustainability. Therefore, a SusCRM approach of the mobility domain is transferred and adapted. The main goal is the motivation especially of customers for a more sustainable consumption [20].

Various approaches will be pursued, for example, a consignment-related emission calculation is planned to compare air pollution on the last mile, which is on the one hand, based on the conventional delivery method using diesel internal combustion engines, and on the other hand, the load caused by the use of load bicycles. Also, concrete incentive systems are to be developed so that customers decide in favor of sustainable delivery, and students are encouraged to become part of this sustainable project. The focus here will be on social media and advertising campaigns as well as the university’s communication channels. The sustainability goals of the project are analyzed by means of an evaluation and acceptance among the population, permanent employees and crowdworkers is recorded.

4.1 Crowd Logistics and Work Situation

The NaCl model provides a staffing structure that consists in part of crowdworkers. The crowdworkers will only be mobilized in peak times when permanent staff capacities are exceeded. The goal is not to replace the current staff, the crowdworker should relieve the staff and thus generate a significant overall improvement of the work situation with less overtime and reduced stress situations. This leads to a higher level of motivation among the permanent employees and to less fluctuation. The usage of cargo bikes has a distinct advantage that driving does not require a driver’s license. The main drive of the crowdworker should not only be earning money but also to contribute to a cleaner environment. Delivering should be a flexible and lucrative part-time job for most drivers. Due to the bundling of different cargo and products and to the pickup and delivery of goods, the job confers more responsibility. The
bundling will also reduce the costs of the logistics service providers. The cost reduction and higher responsibility will lead to higher wages of the regular driving staff [16].

4.2 Logistical Processes

In this part, we will take a close look at the logistical processes of the NaCl model. The logistical processes describe the basic logistical process, the selection process to find a crowdworker, the delivery process from the driver’s perspective and the pickup and delivery process.

The general logistical process is shown in the following activity diagram (Fig. 2).

Fig. 2 General logistical process
Weser Eilboten GmbH creates its orders via an application and a software tool and merges them into a tour. If sufficient permanent staff is available, the tour will be delivered by them. Otherwise a crowdworker will be contacted to fulfill the orders. In this case one of the crowdworkers accepts the tour, which then is removed from the order pool. The delivery is made by cargo bike. The crowdworker picks up the cargo from a hub and delivers the goods [16].

In detail the crowdworker selection process “Finding crowdworker” is done through the Rytle app and is based on 3 criteria (Fig. 3).

1. Status:
   This means that only “standing by” crowdworkers receive a push notification. Standing by means that the crowdworker is logged into the driver app at the beginning of its standby time and switched to “active”.

2. Distance:
Crowdworkers who are located less than 250 m from the university should be given preference when placing orders. If no crowdworker is available in this radius, it will be expanded to up to five kilometers.

3. Available working hours:
Since student crowdworkers have a limited monthly working time, it is important to check whether the crowdworker assigned to the order does not exceed his workload.

If the crowdworker checked does not meet one of these criterias, another crowdworker will be checked after a delay of 15 min. This process is carried out in three iterations. If no crowdworker is found during this period, the delivery request returns to Weser Eilboten.

The delivery process from the driver’s perspective is shown in the next figure (Fig. 4). After accepting an order, the crowdworker goes to the cargo bike (MovR or Triliner), which is available on the university campus. The student then scans the MovR using the driver app, which assigns it to a MovR ID. The lock is opened via
Bluetooth so that the crowdworker can now drive to the HUB to load the parcel carrying box. There is also an optional cargo bike (Triliner) at the university for pickup and delivery orders from the regional retail. The correct BOX is scanned at the HUB, a BOX ID is assigned, and the BOX is attached to the MovR. The delivery begins, while the routing is done via the mobile application.

After the first delivery is done, the crowdworker takes a photo of the package and saves it in the driver app. Now the customer has to sign it. If the customer is not present, a notice saying “not picked up” must be stored in the app and the package is placed back in the BOX.

This process repeats until all goods have been delivered. As a last step, the crowdworker returns to the HUB, leaves the BOX and confirms this process in the driver app. The MovR must be driven back to the university, where it is parked and locked. At the end the crowdworker confirms the whole order and completes his working hours.

Another important process within the NaCl project is pickup and delivery for business customers (see Fig. 5). A B2B customer can request a pickup in the customer app. The RYTLE software then tries to assign this pickup to a crowdworker who is already on a delivery tour. He receives a push notification and can accept the pickup. Afterwards the pickup will be inserted into the route as a tour stop. If no driver is on the road or the crowdworkers on a tour do not accept the pickup, it will be sent as a new order to all active crowdworkers via push notification. If no crowdworker accepts the order (e.g. due to the time or a lecture), there is a possibility that a driver of Weser Eilboten takes over the delivery of the pickup. The regular driver also delivers the pickup by cargo bike.

4.3 SusCRM Approaches and Incentive Systems

Within the framework of the project, incentive systems for participation in the sustainable logistics concept have been developed. At the employee level several concepts of gamification have been modeled and incentive ideas for the acquisition of drivers. Within this topic the biggest incentive should be that the crowdworkers support an environmental project with their commitment. In addition, the salary is an important factor within the acquisition process. Important incentives for the student crowdworkers are the high flexibility of the job and the participation in an innovative and modern project. Finally, the lack of a driving license increases the elasticity of the crowd approach. Communication of the benefits and special features of the sustainability logistics system motivates the crowdworkers to be a part of the active “Rider-Community”.

Gamification is a concept in which game elements are integrated into non-game activities and applications. The goals of this transition are to influence user behavior and motivation. Also, loyalty is to be increased, guaranteeing the sustainability of the app [22]. Gamification can be used effectively, especially with apps whose basic tasks are monotonous and repetitive, and significantly improve commitment and
motivation. The process of implementing gamification elements can be subsumed into the points of challenge, reward, theme, and progress [16, 23].

For successful gamification within the framework of the NaCl project, several gamification ideas have been developed for the implementation in an app to encourage drivers to drive for a long time. At the same time, the incentive systems should increase the quality of the transport service. Within a level system of achievements, tasks and rewards experienced people shall be retained. Achievements are badges that are awarded to the driver after reaching specific milestones. Table 1 shows an example for this kind of gamification.
Table 1 Gamification system

| Achievement | Task                                                                 | Reward                      |
|-------------|----------------------------------------------------------------------|-----------------------------|
| Town expert | Have delivered a package in each district of Bremerhaven!           | Golden flag for bicycle     |
| Sportler    | Drive 200 km by bike!                                               | Race bar                    |
| Profi       | Reach level 12!                                                     | Golden App layout           |
| All for one! | Promote a friend for the App!                                       | Extra big bicycle bell      |

These competition-based incentives with city and district-specific rankings would be a useful indicator for drivers of how they perform compared to their colleagues.

At the customer level, an approach for a SusCRM was developed. To achieve a high level of efficiency of the SusCRM approaches, it is necessary to set up an own CRM system, which allows customer relationships to be managed and strategies to be quickly adapted or created. Different incentive systems must be implemented so that the customer pays attention to sustainability in his consumer behavior. In the SusCRM approach, the distinction is made between information-based, social, and reward-based incentives, as well as gamification-based incentives are possible [20].

Within the NaCl project, these approaches were transferred to the last-mile-delivery domain. Specific use cases are shown in the following diagram (Fig. 6).

Information-based incentives are all those incentives which lead to a change in the customer’s purchasing behavior by providing information to the customer. The pure providing of information is not enough for a change of behavior, so it must be complemented by attractive options and further incentives [20]. An app is intended to provide the customer (also the dispatcher) with information on the sustainability of the transport options.

Fig. 6 SusCRM approaches on the customer side
Table 2 Incentive systems and marketing of sustainable logistics

| Incentive system type            | Customer loyalty                                                                                     |
|---------------------------------|------------------------------------------------------------------------------------------------------|
| Information-based incentives    | • Re-use of packaging                                                                                 |
|                                 | • Hint to the number of articles in the shopping basket                                               |
|                                 | • Hint to sustainable delivery option                                                                 |
|                                 | • Proposals for more sustainable products (less carbon footprint, label “Fair Trade”)                |
| Gamification-based incentives   | • Carbon footprint comparison between the existing and a virtual shopping basket                      |
| Social incentives               | • Sustainability report of the own buyer behavior                                                     |
|                                 | • Share in social networks                                                                           |
| Reward-based incentives         | • Credit for no returns                                                                               |
|                                 | • Bonus for new customer acquisition                                                                  |
|                                 | • Selection delivery time and delivery site                                                          |
|                                 | • Successful delivery in the first delivery attempt                                                   |
|                                 | • Rebate system for new registration                                                                   |

With social incentives, the motivation for changing behavior arises from the expected reciprocity. This describes the human effort to increase his value in the community to satisfy the need for social attention [20].

Reward-based incentives involve material and immaterial incentives to influence the purchasing behavior of end customers. Material rewards can be divided into monetary rewards, such as credits and discounts, and non-monetary rewards, such as vouchers. Immateral rewards do not influence behavior through material value but relate more to social incentives [20]. Table 2 shows an overview about possible incentive systems for customers.

Furthermore, it is also possible to agree on virtual delivery points with the delivery and the customer’s location based on the current location of the cargo bike. This requires a high level of dynamic tour and route planning as well as communication with the customer. For the customer, the advantage is the saving of additional routes because he has to pick up his delivery at the post office in case of the unsuccessful delivery. The delivery also is faster. This offers the dispatcher economic and ecological advantages such as the reduction of journeys, the bundling of parcels, and the reduction of CO₂ emissions [16].

4.4 Pilot Phase

The project is about to start a three-month test phase. The pilot phase is used to test the concept of sustainable last-mile logistics using students as crowdworkers. The sustainable logistics solution will be tested in a defined delivery area in the center of Bremerhaven. Depending on the location of the business customers, the test field can be expanded flexibly during the pilot phase.
On the technical side, one MovR and two Triliner of Rytle will be used during the pilot phase. The driver app adapted to the project will be tested by the crowdworkers as well as the customer app that is only available to business customers in the event of pickup and delivery. The two applications may have to be adjusted during the test run if the new operating conditions require so. The pilot phase is documented via an evaluation study and the tour data will be monitored using the cargo bike telematics system.

Another important point during the pilot phase is the achievement of a high level of attention for the project. It must be examined how high the acceptance of the sustainable delivery method is according to the inhabitants of Bremerhaven. In order to be able to assess this, the customer is asked for a brief assessment of the project and the sustainable delivery as the goods are handed over. The NaCl website also provides evaluation options for end customers and business customers. A diary integrated into the project website about the progress of the pilot phase can create opportunities for participation in sustainable last mile logistics.

5 Conclusion and Future Outlook

In view of the diverse effects that on-demand platforms and increasing e-commerce have on last-mile logistics, the NaCl approach presented here can be a correct step towards an ecologically, socially and economically compatible logistics system.

In addition to reducing emissions and traffic jams in the city centers, relieving regular delivery drivers through well-paid student crowdworkers and bundling goods deliveries, the logistics system also has a positive impact on stationary retail businesses.

Particularly in view of crisis situations, such as those currently shaking the world (SARS-COVID-19), the sustainable logistics system offers stationary retail an alternative to realizing deliveries and disadvantaged people a chance to be supplied with important goods.

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