Review of challenges for sustainable goods logistics and delivery solutions in urban outskirts

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List of abbreviations

15mC	15-minute City
B2C	Business-to-consumer
BCT	Behaviour change technique
CO_2	Carbon Dioxide
DUT	Driving Urban Transitions
EU	European Union
ID	Identity document

Table of contents

List of Figures

Administrative information

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Purpose of the document

As a preliminary work for the implementation of the planned pilot projects in the SuCoLo project, this document describes the challenges of fostering sustainable logistics solutions in European urban outskirts. General challenges and limitations are identified. Subsequently, the challenges specific to the pilot cities in Leipzig (Germany), Merano (Italy) and Salzburg (Austria) are substantiated. These delineated challenges will be made aware by the SuCoLo project consortium and be best overcome during the planning and implementation of barrier-free and accessible pick-up stations connecting social meeting points and emission-reduced cargo bike delivery in the outskirts of the pilot cities, along with inclusive and effective BCTs on e-commerce sites to promote sustainable goods delivery and pick-up options.

Recognizing challenges is the initial stride toward surmounting them and achieving a constructive transformation in connecting urban outskirts. Given the hurdles at hand, the SuCoLo project endeavours to address them in future actions through custom, collaboratively developed solutions.

Executive Summary

The sustainable delivery of goods in urban outskirts is still a challenge for both city infrastructure planning and delivery companies. The purpose of this paper is to capture these challenges and limitations in general and to elaborate them specifically for the SuCoLo pilot cities. Therefore, inclusive and environmentally friendly approaches also play an important role. Promoting sustainable logistics solutions for urban outskirts requires, for example, barrier-free web shops, suitable locations for picking up goods, and good road conditions for the safe use of cargo bikes by deliverers. These aspects are studied, particularly in terms of inclusion and accessibility. The challenges faced by people with disabilities are diverse and important to be taken into careful consideration to include all residents of the outskirts. Therefore, finding a suitable location for the pick-up stations and their accessibility is a first important point. The challenges of making deliveries with cargo bikes will also be examined. There are infrastructural as well as structural limitations, such as bad road conditions, route planning unsuitable for cargo bikes, limited load volume or bad weather conditions, which influence the use of cargo bikes. Moreover, these general challenges are complemented by the local, contextual challenges of different urban outskirt areas:

- In the pilot areas in the city of Leipzig (DE), the challenges for the delivery of cargo bikes and the establishment of a local pick-up station are addressed regarding road infrastructure, poor road conditions, the age structure of the population, population density, inaccessibility and other social aspects.
- In the pilot areas in the city of Merano (IT), different challenges impact the implementation of the cargo bikes; namely, a lack of shops that offer online shopping, a lack of suitable bicycle couriers, fragmented bike paths, a hilly terrain, narrow city streets, car conflicts in the outskirts of Merano, finding suitable pickup box locations, low security measures of costly shared cargo bikes, complex coordination with city authorities, and doubts concerning the uptake of SuCoLo-procured cargo bikes after the project duration.
- In the Salzburg (AT) pilot, posed challenges include the fact that there are only a few cargo bike couriers offering delivery via cargo bikes, an inexistence of micro-hubs, underrepresented areas for cargo bike sharing, and non-inclusive cargo bike sharing options for those with disabilities.

This analysis shows that in addition to the general challenges for sustainable goods logistics and delivery solutions in urban outskirts, local and contextual factors of different urban outskirt regions must be considered. Specifically, in the SuCoLo pilot cities, several challenges must be overcome, and respective SuCoLo solutions explored through the implementation of real pilots in Leipzig, Merano and Salzburg. Such challenges are delineated in this document.

1. Introduction and motivation

In the last years, some mid-sized European cities have continued to grow, and more living space is needed. As a result, outlying suburban areas are becoming more and more attractive places to live. City centers are emerging as popular shopping and meeting places. In recent years, the concept of the 15-minute City (15mC) has become increasingly important in the planning of urban transport infrastructure in terms of environmental protection, especially the reduction of emissions from urban logistics (Dybdalen & Ryeng, 2022). Due to their geographical location, residents of suburban areas often rely on emissions-producing means of transportation such as cars or motorbikes. As a result, people living in the suburbs can be expected to produce more greenhouse gas emissions in their daily lives than people living close to the city center (Dybdalen & Ryeng, 2022). However, European cities are increasingly using and promoting sustainable and environmentally friendly logistics and retail concepts, such as CO2-neutral delivery by using local micro-hubs and cargo bikes (Elbert & Friedrich, 2020). Therefore, the project SuCoLo is exploring a viable and sustainable delivery of goods, from the first step of ordering online to delivery and finally to local pick-up stations or from local cargo bicycle couriers in European urban outskirts. Due to urbanization and a growing trend towards online shopping, delivery traffic in cities is increasing and is becoming an important starting point for achieving climate targets. The adoption of micro-hubs and cargo bike delivery may also be influenced by user acceptance. For this reason, it is necessary to investigate whether an easily accessible (barrier-free) and inclusive community center for residents can increase the usage effect of sustainable urban logistics, and thus, in the long term reduce emissions in the suburbs. Infrastructural, logistical, and social limitations need to be addressed and overcome. Therefore, this paper focuses on the challenges on sustainable goods logistics and delivery solutions in urban outskirts, along with a contextual glimpse into SuCoLo's pilot cities in Salzburg (AT), Merano (IT), and Leipzig (DE).

2. Challenges of fostering sustainable logistics in urban outskirts

The following sections outline the challenges of promoting and executing sustainable logistics in urban outskirts, specifically with perspective of promoting sustainable delivery options on e-commerce sites, pick-up stations and cargo bike delivery - along. Thereafter, special emphasis is placed on the relevance and integration of accessibility aspects. Lastly, the pilot cities of Leipzig (DE), Merano (IT), and Salzburg (AT) delineate in detail the specific challenges of promoting sustainable urban logistics in their localities.

2.1 Challenges of promoting sustainable delivery options on e-commerce sites

In this section, the challenges of promoting sustainable delivery options on e-commerce sites via behaviour change techniques (BCTs) are delineated, with a focus on regulatory challenges, technological challenges, and business-related challenges.

2.1.1. Practical challenges of implementing BCTs to encourage sustainable delivery and pick-up options

As it stands, research studies on sustainable consumer consumption have employed a focus on sustainable product attributes, in place of other services, such as delivery and logistics (Frick & Matthies, 2020). Moreover, the use of consumer-facing BCTs to choose a preferred option is more mature in the application area of sustainable food choices (Berger et al., 2020) or sustainable clothing choices (Mirbabaie et al., 2021) compared to sustainable delivery choices. As it stands, when encouraging sustainable delivery options for consumers, the opportunity for online shoppers to select the most eco-friendly choice is frequently overlooked (Buldeo Rai et al., 2021), and consumers are often unaware of how sustainable e-commerce distribution actually is (Sallnäs & Björklund, 2020).

Moreover, the e-commerce market is characterized by a rise in free shipping, especially by large companies, which can lead to competitive pressures to implement other forms of shipping (Jones et al., 2019). This leads to retailers being cautious when promoting sustainable, yet less desirable delivery options (3-day delivery to batch packages, delivery to pick-up stations) with the fear to lose competitive advantage in customer retention and attraction (Barker & Brau, 2020). Furthermore, retailers do not want to risk cart abandonment, and thus, the displaying of sustainable delivery options must be thoughtfully carried out and not too complex in order to not disturb the consumer journey (Sallnäs & Björklund, 2020).

Figure 1 A digital nudge encouraging a consumer to choose a sustainable delivery option (Source: Green Nudges, https://www.green-nudges.com/greener-shipping/)

2.1.2. Technological challenges of implementing BCTs to encourage sustainable delivery and pick-up options

The technological implementation of sustainably labelled delivery options is not a new idea, seeing as Amazon Technologies Inc. has already filed a patent for a computer-implemented method to support consumers in making packaging and shipping decisions by providing environmental impact information as early as 2009 (Amazon Technologies Inc, 2009). Moreover, an analysis of the top 65 e-commerce sites in the German market by net revenue demonstrated that some – albeit a few – retailers have already implemented BCTs on their website to encourage consumer to choose sustainable modes of delivery (for more information

about these cases, please refer to SuCoLo D3.1 *Scientific publication of reviewed behaviour change techniques for sustainable logistics*.

However, technological obstacles still hinder the implementation of such BCTs. Currently, there is a lack of proper CO_2 emissions communication concerning different delivery transport methods (Tölke & McKinnon, 2021). Moreover, the adoption of CO_2 accounting and communication in freight transport remains generally low, particularly among SME couriers, where only a small fraction (25%) of them can calculate emissions related to transport on a per-delivery basis (Tölke & McKinnon, 2021). Although various CO_2 calculators exist, they often require heavy amounts of data, and its use is intricate. Due to this, CO_2 emissions are more easily and typically computed at a collective company level (Dubisz et al., 2022; Tölke & McKinnon, 2021). These general computations often have applications for carbon offsetting programs, while they are rarely used in the application on e-commerce sites to inform buyers of the environmental impacts when displaying the choice of different delivery methods. In order to carry this out in actuality, logistics companies play a large role in the process to properly inform the e-commerce sites and consumers which delivery options are sustainable by integrating such data (Petersson, 2022).

2.1.3. Regulatory challenges of implementing BCTs to encourage sustainable delivery and pick-up options

Additionally, the execution of involving BCTs for sustainable delivery and pick-up options must be compliant with various legislation. For example, in 2023, the European Commission adopted a proposal for a Directive on Green Claims that aims to combat greenwashing by making green claims reliable, comparable and verifiable across the EU (European Commission, n.d.), with a complementing proposal for a Directive on empowering consumers in the green transition. The directive is based on an ex-ante verification principle, meaning, explicit environmental claims and environmental labels must be verified by third-party independent experts before being published. The directive has been discussed by the European Council on 17 June 2024 and is expected to be negotiated with the European Parliament in the new legislative cycle (Council of the EU, 2024). This directive, if implemented in law, can have ramifications when it comes to B2C communication of environmental impact information, and thus, the promotion sustainable delivery options a more intricate task.

2.1.4. Inclusion/accessibility challenges in online shopping

People with disabilities can face significant challenges when they want to use online shopping. There are various challenges in the field of cognition:

- **Visual Impairments:** Complex layouts, poor color contrast, lack of alternative text descriptions for images (alt text) can make navigation and understanding product information difficult. Screen readers might not be able to interpret the information correctly.
- **Hearing Impairments:** Reliance on product videos with no captions excludes those who are deaf or hard of hearing. Important information only available through audio alerts or sound effects.

- **Motor Skill Limitations:** Complicated checkout forms with small buttons or requiring precise mouse control can be frustrating for people with limited dexterity. Difficulty navigating with a keyboard can be another barrier.
- **Cognitive Differences:** Confusing information architecture, overly technical language, or lack of clear instructions can make it hard for people with cognitive disabilities to complete purchases.
- **Lack of Accessibility Features:** Features like audio descriptions, closed captions on videos, or keyboard accessibility tools might be missing, hindering the shopping experience.

Additionally, a sizable challenge is to find an accessible payment solution, which includes special features for the mentioned difficulties. Furthermore, when attempting to promote sustainable delivery and pick-up options on online shops via BCTs, these very accessibility challenges also apply and must be taken into account.

2.2 Challenges of promoting sustainable delivery via use of pick-up stations in urban outskirts

In this section, the challenges of locating pick-up stations and providing inclusive and barrier-free access is described.

2.2.1. Challenge of finding a suitable location

When choosing a location for a local pick-up station in an urban outskirt, it is important to ensure that it is not too far away for both deliverers and residents, nor does it require a motorized vehicle to get there. It should be possible for the population to use it in everyday life as they pass by, so that no further effort is required (Sheth et al., 2019). However, it should only be large enough for citizens to come by bicycle or on foot. The pick-up station should not be located on private property, but instead should be on public land that is freely accessible. On the other hand, the pick-up stations should be adequately protected against vandalism. Overall, pick-up stations are best located in high-density areas where the potential demand for deliveries is greater. Notwithstanding, pick-up station locations must comply with cities' land-use plans and ordinances. For example, certain areas must be reserved as green spaces (Leonardi et al., 2012).

2.2.3. Challenge of inclusion / barrier-free accessibility

Pick-up station locations must be accessible to *all* people, especially for families with small children and pushchairs, senior citizens and people with disabilities. In addition to the needs of people with walking disabilities, the locations must also meet the needs of people with other impairments, such as sensory disabilities (visual impairments, hearing impairments) or learning and comprehension difficulties. To ensure full accessibility and usability of a pick-up station, architectural accessibility must be provided. This includes the presence of ramps, elevators, and accessible restrooms. The environment also plays an important role, e.g.,

transport connections, acoustic and visual signaling systems or possible seating areas. The urban environment, such as sidewalks, road junctions, points of interest for older people, families and people with disabilities, must be taken into account. It is also important for accessibility by bicycle, e.g. the accessibility of bicycle paths (distances, gradients, etc.). For this reason, a comprehensive and very complex survey and assessment must be carried out concerning a possible location for a pick-up station.

2.3 Challenges of promoting sustainable delivery via use of cargo bike delivery in urban outskirts

The use of cargo bikes for urban logistics can pose many different challenges. This chapter identifies infrastructure and delivery process challenges, as well as appropriate delivery models for cargo bikes for people with mobility impairments.

2.3.1. Challenge of infrastructure

Often, there is a lack of bike lane infrastructure for cargo bikes on the outskirts of cities, which can make delivery with cargo bikes difficult. In the absence of bike lanes, bike delivery persons must compete with cars on the same route. This can lead to inconvenience or even dangerous situations on the road (Leonardi et al., 2012). In addition, some cargo bikes are wider and significantly heavier than regular bikes, so they take up more space and are not as small when they are parked on the sidewalk. Another example is that pedestrian crossings are usually too short to be used by cargo bikes, so they cannot be used to cross busy streets in stages (Engelhardt et al., 2023). As a result, ordinary bike lanes can become very narrow and may not be used. To add to this, the bad condition of back roads or cobblestones is an infrastructural challenge. Due to this, the goods being transported (e.g., crates of vegetables) suffer on longer trips because the cargo bikes have less suspension. This can easily result in brown spots on fruit or vegetables. In addition, multi-track cargo bikes have major problems with curbs, and the presence of bollards/poles can be problematic in traffic. Even small bumps on uneven or cobbled roads can affect the stability of the cargo bike by shifting the centre of gravity (Kapp, 2021). The so-called "green wave" – the coordination of a sequence of traffic lights to be consecutively green – is usually designed for vehicles going over 50 km/h, i.e., for motorized vehicles, and therefore, a cargo bike delivery takes more time because it must stop frequently at red lights. Compared to vehicles with a larger load volume and a higher top speed, cargo bikes have disadvantages in terms of logistical efficiency. As a result, multiple micro-hubs are typically operated, requiring more careful and precise logistical planning (Sheth et al., 2019).

2.3.2. Challenge of delivery

To make delivery via cargo bikes efficient, a digital route planning system is required that is customized for cargo bike providers, as the delivery of cargo bikes has different requirements than motorized vehicles. It's not just a matter of planning the most efficient route. It's also a challenge for suppliers to make sure all the parcels fit in the limited space (Engelhardt et al., 2023; Naumov & Pawluś, 2021). This creates another problem when the recipient is not at

home and the courier is unable to deliver the goods. The courier will then have to take the parcel back to the hub and deliver it the next day if there is no opportunity to give it to a neighbour or leave it at a pick-up station. Thus, coordinating with customers and meeting delivery dates is another challenge when delivering via cargo bikes (Leonardi et al., 2012).

Another challenge is that logistics centres are usually located in the outskirts of cities or even close to freeways, and the distance from one outskirt to another can be very long. Currently, micro-hubs which would support the delivery in smaller delivery areas rarely exist in urban outskirts (Sheth et al., 2019).

Another factor to consider are the weather conditions. Heavy rain or snow may increase the risk of accidents for cargo bike deliveries and slow down the vehicles. Therefore, fewer deliveries can be made under these conditions (Dybdalen & Ryeng, 2022).

2.3.3. Inclusion/accessibility challenges and considerations[1]

A major challenge regarding the personal mobility of people with walking disabilities is the provision of suitable aids. For people in wheelchairs, simply switching from a personal wheelchair to an inclusive cargo bike or other aid could cause major difficulties or even be impractical without personal assistance.

Since there is no meaningful inclusive cargo bike solution for people in a wheelchair, as with their personal mobility aid they, so to speak, are already "fit to ride on wheels", it is recommended to use an electric instead of a traditional cargo bike – the purchase of an equivalent solution in the form of a motorized towing device.

In this regard, there are many different models with different advantages and disadvantages. An overview of suitable mobility aids for people in wheelchairs in the targeted 15-minute city is needed. A corresponding recommendation for the purchase of an equivalent alternative solution to the cargo bike as suitable aid for transporting goods is required.

To guarantee a safe and inclusive experience for *all* (families, elderly people, people with disabilities…) some important issues need to be considered, which are listed below:

Stability and safety:

- Some people have balance problems, or may not be used to cycle with the weight of the packages and the ground might not be always even so that a solution with tree tires is recommended.
- Users ride on roads and cycle paths, which makes it necessary to wear a helmet
- On the road, fast reacting is necessary therefore the device should have powerful brakes to ensure a safe drive
- Some people do not have the necessary strength in their hands, therefore we have to consider solutions for a secure brake system also for them

[1] For more information, please consult: FVG accessibile - Linee guida per la predisposizione del piano di eliminazione delle barriere architettoniche (PEBA) - https://accessibile.regione.fvg.it/portaleimmersive/documenti/56_LINEEGUIDAREDAZIONEPEBA2024.pdf

- Getting on and off from the bike might be already a challenge for some people, therefore a low centre of gravity is necessary and improves manoeuvrability.
- Some users might be mothers or fathers and transport also their child/children so we must individuate a family solution

Comfort and adaptability:

- Easy to use: for the bike rental station but also for the final user
- Since every user has a different body, different needs and we want to meet the largest possible group of users it is important to have ergonomic and adjustable seats and adjustable handlebars to allow a comfortable riding position. Furthermore, the frame should be stable to handle also the weight of heavy loads or overweight people
- Cycling uphill and especially with large and heavy loads could get exhausting, therefore assisted pedals and a motorised/electric bike have to be considered
- Taking off the hands to change gears is dangerous and should not be necessary. A secure solution for gear shifting should be considered.
- Wheelchairs have different sizes and weights, one challenge is to find the vehicle which can accommodate different sizes and allow an easy attachment
- Wheelchairs entering a vehicle or bicycle must be possible without steps or difference in high to the ground, it may be necessary to provide tools to facilitate the access
- The unevenness of terrain can cause vibrations which may be disturbing or even dangerous for some users, a valid suspension system has to be considered

Other options:

- Meteorological conditions have to be considered with a sun and rain protection
- To improve security front and rear lights must be considered, since they improve visibility especially in winter when it is dark at 5PM.
- Comfortable items for transporting personal luggage or shopping goods must be defined
- Since the user will stop at the destination to load and unload the bike, and especially in urban areas theft of bicycles is a big problem, a security system should be considered to guarantee a safe stop and give an additional theft security.

Necessary guidelines and rules:

- General rules of use need to be defined and diffused
- With any kind of bicycle or other vehicle, there could be unforeseen emergencies, for this case it is necessary to develop guidelines and emergency procedures for users and assistance staff. For people with mobility problems these procedures are even more important.

There are different types of cargo bikes suitable for people with disabilities, each with its own characteristics and uses. Unfortunately, there are none which a person in a wheelchair can use in autonomy and that are easily adaptable to different types of people. That is why instead of a cargo bike, it is recommended a corresponding motorised aid for wheelchair users like for example an accessible scooter or specific aid like Triride (https://www.trirideitalia.com/en-gb)

with luggage rack for manual wheelchairs, providing users with mobility impairments the best possible mobility in the 15-minute city.

Another major challenge is the barrier-free positioning and logistical integration of the chosen inclusive aid into the fleet of regular cargo bikes. In this regard, it must be clarified in what form the accessible cargo bike can be reserved and rent. In this respect, it must be clarified in what form the accessible cargo bike can be reserved and rented and whether this can/will be possible via a shared platform. It may also be necessary to provide the planned motorized aid together with an adapted wheelchair and only lend it out as a package, because this modern traction device can only be attached to different wheelchairs using various adapter parts.

Figure 2 Example of an accessible traction device for people with disabilities

The physical placement must also be clarified and should fulfil the requirement of easy and barrier-free accessibility. In this context, a location near the station (mobility centre) with a barrier-free access route (cycle path) to the city centre and pick-up stations should be identified. In addition to pure storage, the location should also have a charging facility (power connection) to recharge the battery of the accessible cargobike. Notwithstanding, before the barrier-free cargobike (Triride or similar) can be handed over to the users for independent use, a brief introduction to the safe use of the device is necessary, which must be carried out in person.

2.4 Pilot city-specific challenges

In addition to the aforementioned challenges above, the three European pilot cities in the SuCoLo project – Leipzig (Germany), Merano (Italy) and Salzburg (Austria) – face locally-

specific challenges with regard to the modalities mentioned above. In this section, the challenges of the local pilot cities' context are made more specific.

2.4.1 Leipzig

The pilot of Leipzig is focusing on the marked green suburban areas of Lützschena-Stahmeln (number 82) and Hartmannsdorf-Knautnaundorf (number 55), see Figure 3. These areas are particularly suitable for this study because they have lower levels of public transport use due to inconvenient schedules, often no stops in the immediate neighborhood, a large elderly population, and significant gaps in the bicycle network. Therefore, shopping in these regions is done primarily by car in big shopping centers or in the city center of Leipzig (Amt für Statistik und Wahlen, 2019). In the two outlying areas surveyed, the car is generally the fastest way to go shopping and to work (Amt für Statistik und Wahlen, 2022).

Figure 3 City districts of Leipzig (Stadt Leipzig, n.d.-d)

The population density in these two urban outskirts is very low. In comparison, there are 2,702 residents per square meter in the district of Connewitz, number 41 (Stadt Leipzig, n.d.-a), whereas only 255 people per square meter live in Lützschena-Stahmeln (Stadt Leipzig, n.d.-c) and 85 people per square meter in Hartmannsdorf-Knautnaundorf (Stadt Leipzig, n.d.-b). In the Connewitz district, there are many single households in a small area, whereas in Lützschena-Stahmeln and Hartmannsdorf-Knautnaundorf, most households consist of three or more people (Stadt Leipzig, n.d.-a, n.d.-c, n.d.-b). For a parcel delivery service, this means that significantly more distance has to be covered and the parcel may not be delivered and

has to be returned to the delivery stock. In turn, this results in increased costs for the delivery companies.

Personal contact outside the core family is particularly widespread in large cities, where more than 50% of the population often lives in single-person households. People between the ages of 75 and 90 would particularly like to have more contact with their peers. These encounters take place in public spaces (e.g. cafes, parks, seating areas, open courtyards) at neighborhood festivals or projects. According to the survey, people prefer to meet in their own neighborhoods (Amt für Statistik und Wahlen, 2022). However, many public facilities, such as the district library in Lützschena-Stahmeln, are generally not wheelchair accessible and therefore it is not possible for everyone to use these social meetup points (Wheelmap.org, n.d.), as can be seen in Figure 4 below:

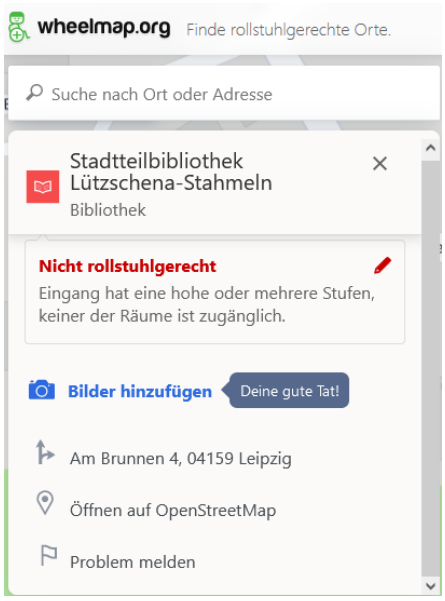

Figure 4 No wheelchair access to the library in Lützschena-Stahmeln (Wheelmap.org, n.d.)

Furthermore, in the age group between 75 and 90, only 60% of Leipzig residents have internet access (Amt für Statistik und Wahlen, 2022). This becomes a problem if a pick-up station can only be accessed through a smartphone app. This excludes non-users, especially the elderly, or makes them dependent on assistance from others.

As mentioned above, public transportation in Lützschena-Stahmeln and Hartmannsdorf-Knautnaundorf is not always barrier-free accessible. In fact, Hartmannsdorf-Knautnaundorf is only connected by bus, and it is necessary to change to the tram to get to other parts of the city. As an alternative, the Leipziger Verkehrsbetriebe in Hartmannsdorf-Knautnaundorf offer an on-call taxi called Flexa that can pick up passengers at certain stops and take them to the nearest public transport stop. This on-call taxi can be ordered by phone or via a smartphone app (Leipziger Verkehrsbetriebe, n.d.). In addition, there are only a small number of stops for public transportation, which makes it very difficult for people with walking disabilities to use and excludes smartphone non-users.

Fulmo Kurierunion is one of two local bike couriers in Leipzig that offer deliveries to the city's outskirts. They use cargo bikes and bicycles with trailers for delivery in combination with several mico-hubs in the city. They have to deal with the poor condition of the roads and the lack of bicycle lanes, or lanes that are too narrow in the suburban areas. The regional web shop "Locally Happy" offers delivery of goods with Fulmo from the city center to all districts of Leipzig (Locally Happy, n.d.). The goods on offer also include fragile items such as porcelain or glass containers, which must be handled with particular care when delivering with cargo bikes because of the poor side road conditions. Fulmo recently also offers a cargo bike rental service for citizens which is called Velobility (Fulmo, n.d.). The cargo bikes can be rented at collection points in the city center via an app (see Figure 5) but must be returned to the same points. Before a cargo bike can be rented, the user must be registered manually with proof of ID and a deposit (amount of money) must be paid.

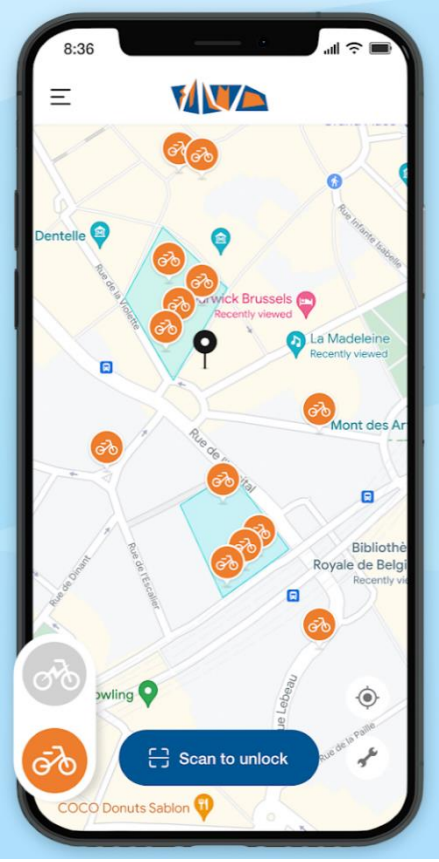

Figure 5 FULMO Velobility app (Sentinel nv., n.d.)

Furthermore, the city of Leipzig is struggling to solve structural problems in bike road traffic, such as missing or very poorly maintained bike lanes in side streets, narrow bike lane widths or traffic islands for cargo bikes, cobblestone streets, dangerous tram tracks, inappropriate traffic signal timing, and insufficient structural distance from trams or car lanes.

2.4.2 Merano

In the city of Merano, Italy, the vast majority of deliveries are made by car and motorbike. There is only one bike courier (FIX) (https://www.fix-merano.it/) who recently started in close cooperation with eight shops to deliver groceries and books by cargo bike. Neither the publicly owned postal service nor the city of Merano's cleaning services are using cargo bikes for their activities. Moreover, there is no system for citizens to rent publicly owned cargo bikes.

Thanks to the DUT Project SuColo, Merano wants to enhance both B2C cargo bike delivery and the possibility of citizens to rent a cargo bike as part of the local existing bike sharing system. Especially with regard to the delivery aspect, Merano is aware of facing several challenges. In Merano, there is only one bike courier and only a small amount of shops that have an online shop. Consequently, there is a lack of online shops utilizing sustainable delivery options via local bike couriers. This shortage hinders the testing of the developed BCTs aimed at promoting sustainable delivery choices in online shops. Additionally, there are several geographical and organizational challenges. These challenges include fragmented bike paths, differences in elevation, and narrow streets in the city centre. Outside the city centre, there is conflict with automobiles, whereas within the historic centre, the conflict is primarily with pedestrians. Additionally, finding suitable locations for pickup boxes and ensuring connectivity to peripheral areas is a challenge. One major pick-up station will be placed in front of a new cultural centre in the “Via Bersaglio” Street. The challenge involves a planned doubling of train frequency in the near future. Consequently, the above-ground level crossing, which connects this pickup station with the city centre, is expected to be closed for approximately 20-30 minutes per hour during the day time.

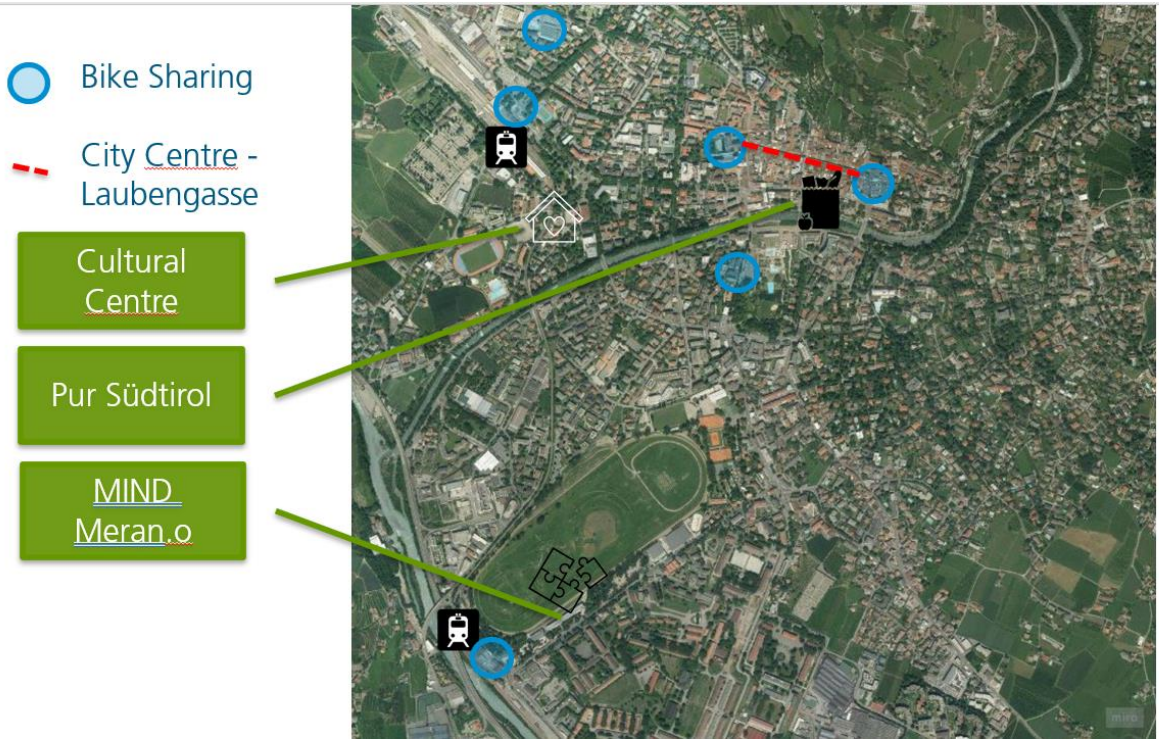

Figure 6 Placement of SuCoLo solutions in Merano. Source: Google Earth

With regard to the bike sharing of cargo bikes, the challenge will be integrating expensive bikes in the current system with almost no security parameters. To address the security issue of cargo bike theft and to alleviate the burden on the municipality, which has limited capacity to support the project, the Merano team has devised two parallel concepts. First, a few cargo bikes will be available for rent directly from shops, integrated into the digital sharing system. The challenge here is finding businesses willing to take responsibility for bringing the bikes inside at night and having the necessary space to store them. Second, the Merano team proposes placing one or two cargo bikes in bicycle boxes in suburban neighborhoods on public land. The challenge here is that construction measures are not worthwhile if the boxes are no longer in use after the project's end. Additionally, the Merano team is currently trying to convince the municipality to maintain these neighborhood cargo bikes permanently. Additionally, finding a suitable locking system is a major challenge, as the existing locking system for single boxes in the city is unsatisfactory, which would result in two separate systems: one for opening the cargo bike box and another for the cargo bike itself. Identifying a good technical solution for this poses a significant challenge.

Also, there are almost no data collection methods yet in place neither for the courier nor for the bike sharing to monitor bike journeys. Finally, the coordination with the city of Merano amidst changing contact persons and announcements proves to be a challenge when trying to implement new solutions. Lastly, the implementation process also faces long timelines.

An additional challenge besides the cargo bike sharing and the placement of the pick-up stations concerns a workshop on a last mile logistic hub. The city of Meran has requested a concept for a proper last-mile hub for major logistics companies like Amazon and DHL. The municipality was planned to place this station at the new train and since this is currently in the planning stages, they have asked the Merano team to develop a concept. To maximize benefits

for the municipality and its citizens from the SuColo project, the Merano team has considered organizing a workshop to gather information for a comprehensive concept, including participation from the follower cities. The challenge here is that the municipality frequently changes plans, and we are unsure whether the workshop will yield sufficient and useful information.

The pilot site of Merano includes specific social, inclusive and accessibility factors. Therefore, it is planned to include in the SuCoLo-offered cargo bike fleet also an inclusive option for people with disabilities/elderly people with mobility impairments. STA will buy several electric cargo bikes for transporting goods, and for this purpose, project partner IND proposes an inclusive three-wheeled and electric model according to the principle of *Universal Design* which suits the needs of most people, elderly citizens and families (with child seat).

Even after the project-specific pilot interventions have been completed, there is another challenge that needs to be overcome, which should be organised as far out as possible before the electric mobility and transport aid is commissioned; namely, the future use of the purchased accessible cargo bike (Triride/Scooter). According to the Italian funding criteria, the costs for the purchase of equipment and fittings can only be claimed for the duration of the project and therefore only in accordance with the corresponding amortisation rates, after which other funding must be found to continue the initiative. Other public bodies (like for example the Kurverwaltung Meran or Südtirolrad) could possibly take on a financial sponsorship for the inclusive cargo bike in the city of Merano and make it available on loan to the local population and guests with mobility disabilities; for example, to go on accessible excursions and walks in the surrounding area. The necessary technical inspections and maintenance intervals could be carried out by the local provider of vehicles for people with disabilities (Handicar social cooperative) as part of a maintenance contract.

2.4.3 Salzburg

In the city of Salzburg, there is a lack of local cargo bike couriers. This is with the exception of DieBoten, which utilises bikes and cargo bikes to deliver letters and large objects. However, it is unclear to which degree they deliver in the outskirts of Salzburg (https://www.dieboten.at/). Additionally, LTS Transport is actively conducting last-mile delivery via electric cargo scooters in Salzburg, however, they do not utilize cargo bikes (Mrazek, 2023). Within the context of SuCoLo, the Salzburg pilot is faced with a lack of cargo bike couriers – and due to this, a lack of online shops which utilize the use of sustainable delivery options via a local bike courier – to test the developed BCTs to promote sustainable delivery choices on online shops. Fanny-Fresh online shop (https://www.fanny-fresh.com/) is an online shop operating in Salzburg, which delivers local fruits and vegetables exclusively via e-cargo bikes in Salzburg city. However, they are only offering one type of delivery option (e-cargo bike delivery), which makes the testing of BCTs for sustainable delivery options ineffective since there is not another delivery mode present to present beside it for the consumer. Additionally, to date, there are no micro-hubs present within the city limits of Salzburg, which also presents a challenge when the Salzburg research pilot conducts testing of BCTs for sustainable pick-up options on online shops.

In Salzburg, the renting of publicly owned cargo bikes by citizens is promoted via the “Radverteiler” programme, with many cargo bikes being available to rent in urban outskirts and different cargo bike models to suit diverse needs, e.g., families (Stadt Salzburg, n.d.). With 14 available cargo bikes, this service comes in handy for citizens to use a free service to transport large purchases without the use of a car. However, it can be perceived to be lacking in regard to accessibility and inclusion, as none of the offers currently available are well-suited for those with a handicap. Additionally, as seen in the picture below of cargo bike sharing locations in Salzburg and surrounding areas, some urban outskirt locations are still underserved with regard to cargo bike sharing.

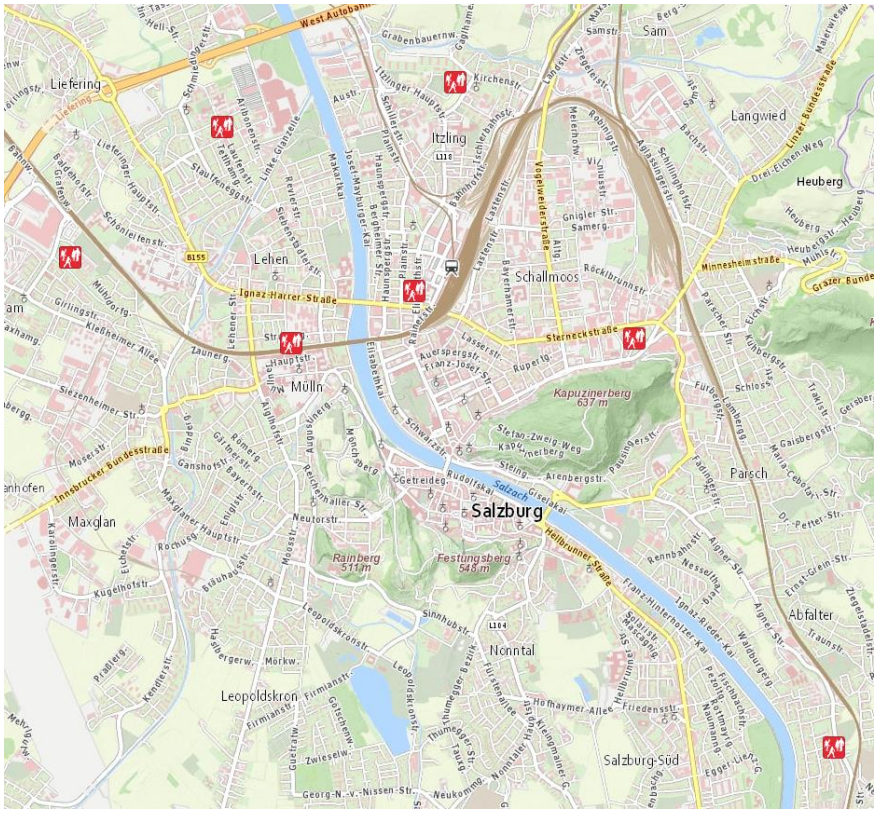

Figure 7 Cargo bike sharing station locations in Salzburg and surrounding area. Source: Stadt Salzburg

Regarding accessibility in Salzburg and its surrounding outskirts (to make walking or biking for deliveries or personal mobility to reach a pick-up station/micro-hub possible), the University of Salzburg has come out with a platform to assess the walkability and bikeability of streets (Z_GIS – University of Salzburg, n.d.). In the two pictures below, it can be seen that there is room for improvement concerning both the walkability and bikeability in both the city proper and in the outskirts (green = high walkability/bikeability, yellow = medium walkability/bikeability, red = low walkability/bikeability). However, Salzburg and its surrounding area is perceived as generally quite bikeable and walkable.

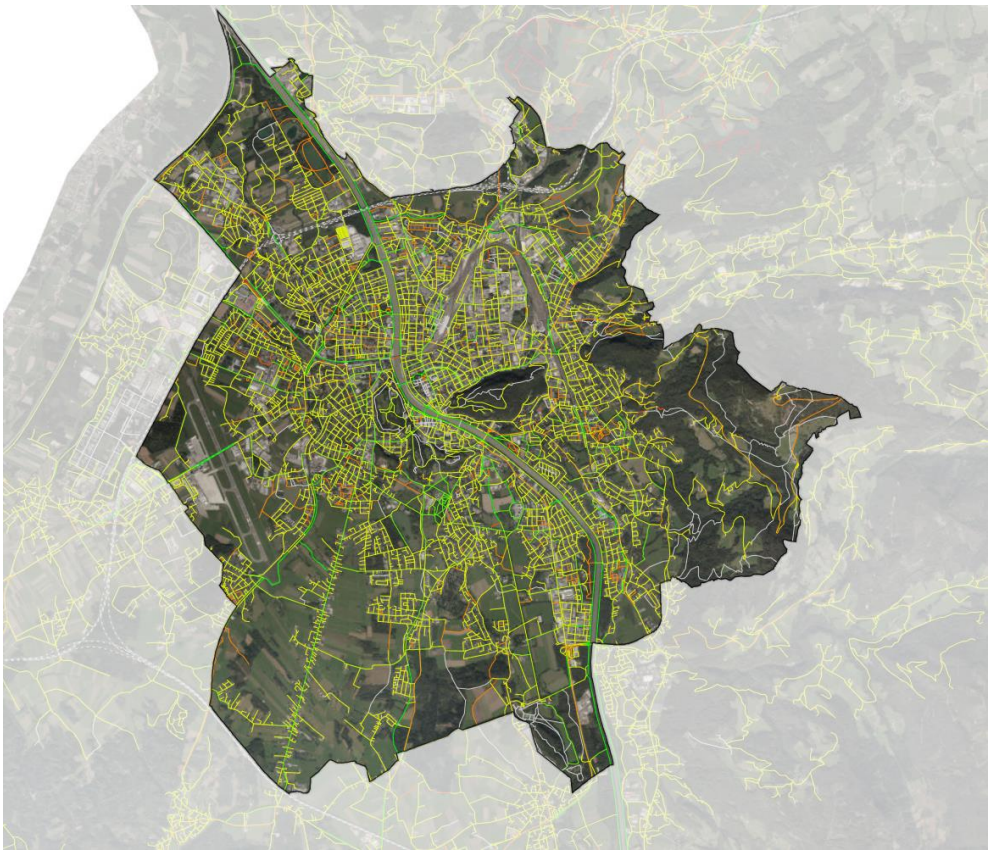

Figure 8 Bikeability index in Salzburg and surrounding area (Z_GIS – University of Salzburg, n.d.)

Figure 9 Walkability index in Salzburg and surrounding area (Z_GIS – University of Salzburg, n.d.)

3. Conclusion

As much as the implementation of sustainable and barrier-free logistics solutions for outskirts has been proclaimed as a goal of many European cities, there are many challenges and limitations in the implementation phases. Many factors must be considered, such as the existing urban infrastructure or the needs of the population. Starting from the ordering process to the collection at local pick-up stations, to the addition of cargo bike deliveries using micro-hubs and cargo bike rental stations for the citizens. Ultimately, solutions for pilot implementation can be found by defining the challenges of implementing sustainable logistics solutions for the outskirts.

In the mentioned outskirts of Leipzig, sustainable goods delivery and public transport connections can be optimized. The city of Leipzig offers great potential to address and help solve these named challenges. In collaboration with the Locally Happy web shop (Locally Happy, n.d.) and the bicycle courier service Fulmo (Fulmo, n.d.), the order process and delivery of goods by cargo bike and collection from local pick-up stations is being investigated in the project SuCoLo.

Concerning the piloting of SuCoLo solutions in Salzburg, the lack of potential pilot partners presents a challenge to test the developed BCTs for sustainable delivery and pick-up options on online shops. Nonetheless, a fitting solution to test and validate the developed BCTs will be undertaken. Salzburg stands to benefit from such SuCoLo solutions as it also has potential to give visibility to future initiatives that promote sustainable goods delivery and pick-up options.

In Meran, different challenges impact the implementation of the cargo bike delivery and haring system. Firstly, there is a lack of shops that offer an online shopping option, moreover there is only one local bike courier. Therefore, it won’t be easy to find partners that match the criteria. In addition to that, the city faces fragmented bike paths, elevation differences, and narrow streets in the center. Outside the city centre, bikes conflict with cars, while inside, they conflict with pedestrians. Additionally, finding suitable pickup box locations and ensuring connectivity to peripheral areas is challenging. Regarding cargo bike sharing, integrating costly bikes into the current system is challenging due to low security measures and the lack of data collection methods for monitoring bike journeys. Coordinating with the city authorities is also challenging due to frequent changes in contact persons and announcements. Lastly, there is uncertainty about the future use of the accessible cargo bike (Triride/accessible scooter for disabled people).

The challenges in connection with the inclusive accessibility of the pilot measures in SuCoLo are manifold: infrastructure, vehicles, services, information provision, participation. In addition to the barrier-free accessibility of the pilot structures, suitable alternatives must be found for the inclusive usability of the planned cargo bikes. And all services offered on site must meet this challenge. Last but not least, the aspect of accessibility must also be taken into account in the planned participatory project measures as well as in the dissemination of information and project communication, which represents a major challenge.

Awareness of challenges is the first step towards overcoming them and creating a positive change. In light of the challenges presented, the SuCoLo project aims to overcome these in forthcoming work via tailored, co-created solutions.

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