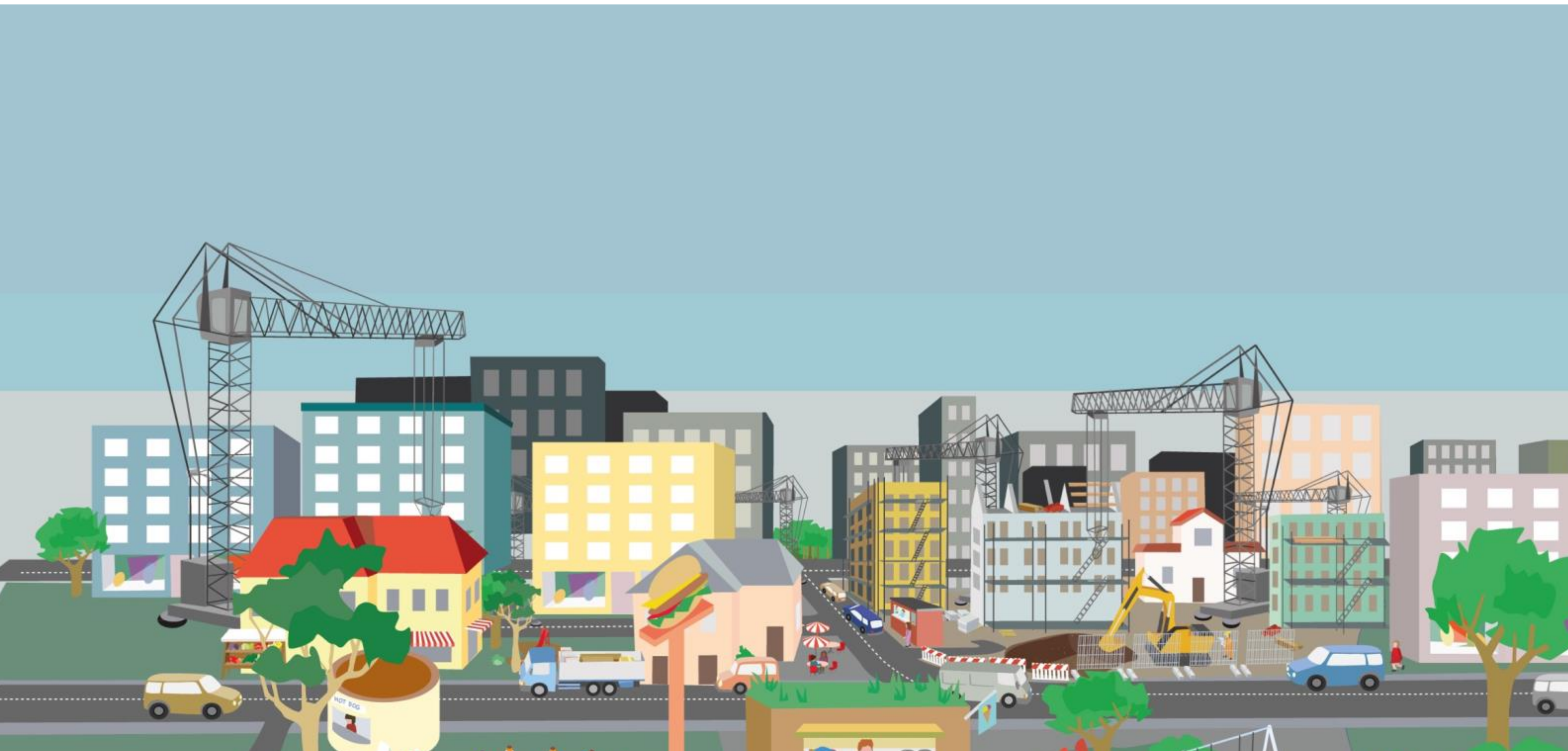
WP1: Construction logistics scenarios and stakeholder involvement

Deliverable 1.2: Application of scenarios of construction logistics

October 2021



Document change record			
Version	Date	Status	Modified by
0.1	21.9.2021	Case studies from Belgium	Nicolas Brusselae, VUB
0.1	27.9.2021	Case studies from Sweden	Anna Fredriksson and Mats Janné, LiU
0.1	8.10.2021	Case studies from Norway, 1st version of D1.2 based on inputs from Belgium, Norway and Sweden	Selamawit Mamo Fufa, SINTEF
1	13.10.2021	Final version	Anna Fredriksson, LiU

MIMIC Deliverable 2.1

Version: 1.0

Date: 20211013

Responsible partner: LiU+SINTEF

Authors: Anna Fredriksson, Linköping University, Mats Janné, Linköping University, Selamawit Mamo Fufa, Sintef, Christoffer Venås, Omsorgsbygg, Nicolas Brusselaers, Vrije Universiteit Brussel

Contributors: Koen Mommens, Vrije Universiteit Brussel

Table of contents

1. Introduction

The purpose of MIMIC – *Minimizing impact of construction material flows in cities: Innovation co-creation* project is to demonstrate how Smart Governance concepts can be used as an aid in the construction and city planning processes to facilitate and support logistics to, from and on urban construction sites to improve mobility and reduce congestion within cities and thereby reduce the negative impact of construction sites on the surrounding community.

The MIMIC project integrates research within construction logistics, construction management, city logistics, sustainability, and optimization of flows, with the goal of developing the Smart Governance Concept 2.0. This concept provides the implementation partners (Cities and companies in the construction process and supply chain) with a structure of tools organized into a supportive platform for construction logistics issues in the urban development decision and procurement processes (D4.2 and D4.3). The tools help to increase the knowledge of construction logistics (D1.3), collecting stakeholder needs and criteria of construction logistics scenarios (D1.1, D1.2 and D1.4), and to evaluate the impact of construction logistics solutions on different stakeholders (D2.2, D2.3, D3.1, D3.2 and D3.3).

This deliverable *D1.2 Evaluations of construction logistics scenarios at implementation partners is part of WP1 Construction logistics scenarios and stakeholder involvement* in the MIMIC project. The aim of D1.2 is to provide a catalogue of case studies from Belgium, Sweden and Norway (Tabel 1), each providing an insight to construction logistics activities, impacts and learnings.

Tabel 1. List of case studies

Country	Case study
Belgium	Brussels Construction Consolidation Centre (BCCC)
	City Campus Anderlecht
Norway	Lia nursery school (Lia barnehage)
	Olav Vs Street (Olav Vs gate)
	Oslo emergency ward (Oslo storbylegevakt)
	Tåsen nursing home (Tåsenhjemmet)
Sweden	Stockholm Royal Seaport (SRS)
	City of Uppsala
	Älvstranden AB – Construction logistics strategy
	Älvsborgs sjukhus (Borås)
	Helsingborgs lasarett (Helsingborg)

2. Case studies from Belgium

Project name	**Brussels Construction Consolidation Centre (BCCC)**  *Figure. Brussels Construction Consolidation Centre with deliveries of construction materials by barge at the Port of Brussels. Illustration: ShipIt © 2020.*
Project type, size and time frame	The Brussels Construction Consolidation Centre aims to provide Brussels construction sites with a logistical platform for the consolidation of material deliveries. This project aims to test the operation of such a construction consolidation centre, but also its digital solution, while measuring the societal impacts. The BCCC has been operational since the end of 2019 and experiments have been conducted with different partners such as material suppliers and contractors.
Project location	The BCCC is located at the Port of Brussels (Belgium), hence offering transhipment possibilities and construction material deliveries through the inland waterways arriving at the heart of Brussels. From there, the last mile is covered by HDV in a consolidated and optimized way.
Constructi on logistics	The experimentation of the consolidation centre initially focused on the transport of palletizable materials (concrete blocks, insulation, facade bricks, bags of plates, etc.). Although the focus was initially on supplying large construction sites in the Brussels Region, the practice highlighted the multitude of situations to which the BCCC was able to respond. First, in terms of clients, this type of solution could be just as relevant for material suppliers (to improve their services), for construction companies (to set up specific logistics for one or more sites) and for real estate developers (e.g. to facilitate the reuse of materials). From an operational point of view, a whole series of experiments could then be tested: deliveries to large building sites; consolidated deliveries to several large sites; deliveries to infrastructure sites; deliveries of prefabricated elements; provision of storage space managed by a company itself; reverse logistics, remassification and material re-use; deliveries to smaller sites using vans and/or cargo bikes; etc.
Impact and learnings	In just over a year, 21 barges have come to supply the centre with various materials, each barge corresponding to 50 fewer lorries on the roads. The BCCC shows that the modal shift from road to inland waterway transport significantly reduces overall transport external costs. The environmental costs that could be avoided by using alternative modes of transport, taking trucks from the road and avoiding half-empty trucks delivering to site, are obvious if the manufacturing company is located close to the waterway. It is worth pointing out that this last condition restricts IWT of construction materials to companies who are initially

	located close to an inland waterway axis. Also, its end destination (i.e., the construction site) should be located close to a transhipment point (such as a CCC), allowing to reduce overall costs and generating enough volume to be bundled on barge (for neighbouring construction sites). It is thus not always feasible to ship (all types of) materials through water. Although trucks are still top of mind in Belgium, initiatives guide construction sites in identifying suppliers close to waterways, and how to include clauses into tender documents and asking for options for environment-friendly solutions. In this way, these services aim to provide a transparent view on (a) the total logistics cost and (b) the service levels of using the waterways. The construction logistics decision-making, comparing different logistics solutions and taking into consideration all points of view, should be conducted in order to evaluate both the cost perspective and the added value services that e.g., a CCC can provide, as to highlight potential benefits and drawbacks to construction sites and the different actor groups.

Project name	**City Campus Anderlecht**  *Figure. City Campus construction site simulation. Illustration: Van Roey Vastgoed © 2019.*
Project type, size and time frame	The pilot site is the mixed ‘City Campus’ project, which will ultimately result in a 17,600 m² site for an SME park for agri-food companies and social and student residences.
Project location	Anderlecht (Brussels), Belgium. The site is located within the Brussels Outer Ring (R0) and the BCR and is considered as a typical ‘large’ construction project in Brussels, with a strong output value upon completion. The municipality in which the site is located, has a population density of 6,394.34 inhabitants/km^2 and a total population of 108,940 inhabitants. The location offers a variety of relevant and potential transport accessibility entries and exits: the area is in proximity of major road axes such as the R0 ring of Brussels and the E19 highway as well as the main navigable inland waterway axes of the Brussels-Charleroi Canal and the Willebroekse Vaart. The neighbourhood offers a rich diversity in vicinal stakeholders, including a shopping centre, a higher-education college and various local businesses. The construction traffic have a dedicated entrance and exits through the site, through which the vehicles can unload materials on an on-site delivery way. Each work and unloading space opens onto the public square and is accessible to freight traffic along a courtyard that is largely covered with a noise-reducing porch in order to limit the inconvenience for the surrounding houses.
Construction logistics	‘City Campus’ is organized in association with the public–private partnership between owner and city development agency CityDev and main building contractor Van Roey Vastgoed.
Impact and learnings	Construction logistics analyses are be based on OBU (on-board unit) data of +3,5 T trucks, providing a better understanding on the amount and type of flows generated in practice by construction works, and toquantify the impact of these flows on urban sustainability. This allowed to assess the impact on economic, social and environmental sustainability (with specific focus on congestion, emissions and safety) of construction freight flows from origin to destination. This analysis also allowed for the development of a collaborative Stakeholder Framework for construction logistics.

3. Case studies from Norway

Project name	**Lia nursery school (Lia barnehage)**  *Figure. Lia nursery construction site. Illustration: SINTEF © 2017.*
Project type, size and ambition	Lia nursery school, with a total heated floor area of 1600 m^{2}. It is the first fossil free nursery school in Norway and certified as BREEAM very good.
Time frame	Construction period from April 2016 - November 2017
Project location	Harald Sohlbergs vei 19, Oslo, Norway
Construction logistics	The construction logistic was planned in the early project phase. The location of the construction site, which was next to school and it's urban setting with lack of storage, leads to detail planning of deliveries and logistics to, within and from construction site. Use of prefabricated solutions (for walls, floors, and ceilings) and locally sourced elements (concrete) were considered to reduce construction period, transport frequency and associated waste and emissions.
Impact and learnings	More time and resources spent in the early planning phase, environmental requirements or targets included in the early procurement process and close dialogue with actors involved throughout the project period enabled to achieve the project ambitions. Lack of electric machineries at the time and other unforeseen challenges, such as machineries delivered with tank filled by diesel even if it was planned to use biodiesel, pointed out the importance of sharing knowledge and experience and considering external factors in the early planning phase.

Project name	**Olav Vs Street (Olav Vs gate)**  *Figure. Olav Vs Street construction site. Illustration: SINTEF © 2019.*
Project type, size and ambition	Olav Vs Street is the first emission free construction site in Norway. It is 180m long pedestrian street upgrading project aiming to create a new city space with no traffic. The upper section of the street was transformed to pedestrian street by moving the taxi stand. The street is widened in the lower section by replacing parking spaces with good delivery bays and disability parking and leaving the remaining space for relocated taxi stand with charging stations for electric taxis.
Time frame	September 2019 - December 2020
Project location	Oslo city centre
Construction logistics	The project started with a dialogue with manufacturers and suppliers of machineries and equipment on available electric construction machinery and local grid operators to ensure sufficient power supply to construction site. There have been limited electric machineries available at the time. The project entered an agreement with rental service to secure supply of electric machineries.
Impact and learnings	Use of electric construction machineries was estimated to enable saving 35 000 litres of diesel and 92 500 kgCO_2eq. The construction site also facilitated noise reduction which contributed to improved health and safety of the workers. The city of Oslo plays major role by challenging the market on providing emission free solutions and also support the process by providing free electricity during the construction period. Early planning and good dialogue with market on available emission free technologies and infrastructure enable to realise emission free construction site. The lesson from the project also shows the need for training of construction workers on use of new emission free technologies.

Project name	**Oslo emergency ward (Oslo storbylegevakt)**  *Figure. Olav Vs Street construction site. Illustration: Oslo Munucipality*
Project type, size and ambition	The new emergency ward is an on-going project with a total area of 25 000m^2. The project aimed to fulfil passive house standard and to be certified with BREEAM excellent.
Time frame	Demolition in 2019, construction 2020-2023
Project location	Trondheimsveien 235, Oslo, Norway
Construction logistics	Digital scheduling, planning system for transports and (material) deliveries and time restrictions for intermediate storage on site (max. 14 days) is considered. This means that progress of the construction is planned in 14 days intervals, and just-in-time deliveries as the main strategy. The use of crane truck is paid directly by the subcontractors, penalizing such use of internal transport, whilst incentivized direct delivery from the delivery vehicle. Delivery vehicles has direct arrival from the highway with an own construction road to avoid traffic in the neighborhood, and deliveries are time restricted (through the booking system). Almost 130 000 m^3 of excavated mass has been transported from the site. Some had been brought by barge as filling masses in the seaside, with Fjordbyen as a new residential neighbourhood, thus avoiding app. 40 km of road transport.
Impact and learnings	Good planning of logistic activities and importance of electrification of construction process. With lots of mass transport, the choice of means of transport has also significant impact. Choice of material, including use of low carbon concrete and reuse of hollow concrete slab elements from from the old, decommissioned Government Quarter, has been used in order to reduce the carbon footprint of the building.

Project name	**Tåsen nursing home (Tåsenhjemmet)**  *Figure. Tåsen nursing home. Illustration: Arkitema Arkitekter*
Project type, size and ambition	Tåsen nursing home for elderly is on-going four floor project with a total gross floor area of 14 500m^2 for 135 residents and a day center for residents and outside users. The project includes demolition of an existing nursing home and constructing a new one with an ambition to be the first energy plus house nursing home in cross-laminated timber in Norway. It is FutureBuilt model project and aimed to be certified as BREEAM outstanding.
Time frame	Construction period from 2021–2023
Project location	Pastor Fangens vei 26 - 28, 0854 Oslo Nordre Aker, Oslo, Norway
Construction logistics	Selection of construction materials, use of prefabricated wood elements such as cross laminated timber (CLT), is considered as a solution to reduce construction time, transport and on- site logistics need, and associated waste and GHG emissions. Possibilities of having large storage areas and coordination with material suppliers for just -in time deliveries with large vehicles, using full capacities and optimization packaging have been planned to be considered. All the masses from the demolition work are planned to be used in the project to reduce the mass transport. Walking and cycling routes, access to public transport and charging possibilities are also discussed to reduce transport intensity within the construction site. The project was on hold due to complaints from neighbors, prolonging the zoning process and affecting the size of the building and available green space around the nursing home.
Impact and learnings	Fossil free as minimum requirements and use of emission free solutions for construction site activities as award criteria in procurement procedure, and certification schemes such as BREEAM identified as main drivers to consider different measures. The project is a good example how public procurers take risk and push the limits to move away from traditional way of construction by setting ambitious but achievable requirements. The lesson from the project shows the need for involvement of citizens in the early planning phase of the project to avoid conflict of interest.

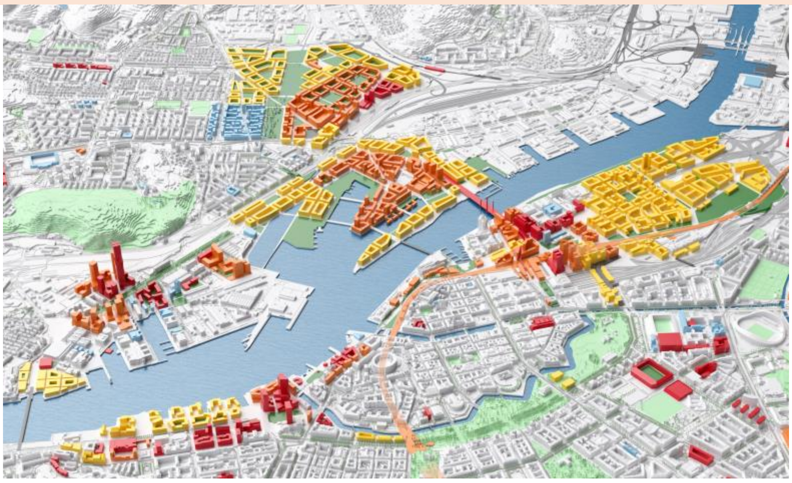
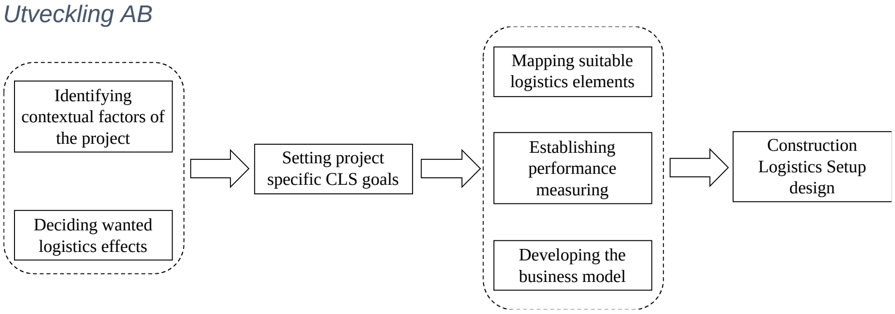
4. Case studies from Sweden

Project name	Stockholm Royal Seaport (SRS)  *Figure. The warehouse tent at CLS of SRS. Illustration: Mats Janné*
Project type, size and time frame	A former petrochemicals industrial area is being transformed into 12 000 new homes and 35 000 new workplaces. The total investment in this development project is approximately €2.2 billion. The first phase started in 2011 and the final phase is scheduled to be finished by 2030.
Project location	Stockholm, Sweden. Situated on the Baltic Sea shoreline and bordering the national city park and the city centre, the development area is limited in its access routes. As part of the Stockholm City Council's plan for a sustainable urban city, the SRS project is to be completed with minimum impact on the environment and surrounding residential and working areas.
Construction logistics	Accession to the CLC is mandatory for all projects in the SRS area, in accordance with the land allocation agreements with developers. The city has rules for how the CLC should be utilized by the projects, with the goal of minimizing construction freight transport in the SRS area and reducing disturbances to third parties in the vicinity. The SRS CLC is located close to the construction area and is based on a terminal and its operations, traffic piloting, education, and perimeter fencing and security. The *terminal structure* comprises 2200 m^2 climate-controlled terminal tent, 230 m^2 cold terminal tent, 1000 m^2 waste management area, 70 m^2 office space, and 3000 m^2 of outside space. The CLC is funded by a connection fee paid by developers as well as through service fees paid by the projects in SRS.. All services are stipulated in a price list available on the CLC's website.

Impact and learnings	Construction logistics is repeating the mistakes of its big brother, city logistics, in that it has common utilization challenges and follows the same way of designing CLC setups based on implementation drivers. By showing that there is a difference between implementation and utilization drivers and challenges, the implementation often stems from a goal of reducing disturbances to third parties, whereas the drive for utilizing a setup stems from a need to increase efficiency on site and reduce unnecessary logistics activities. Construction projects can apply two possible strategies for utilizing a CLC. Either they use the CLC as a consolidation point to allow different suppliers' materials flows to be delivered as consolidated deliveries to the construction site, or they can use the CLC as an external storage point to facilitate JIT deliveries to site. Furthermore, projects that formulated a logistics strategy were found to utilize the CLC more as part of their operations than those that came into SRS without formulating a logistics strategy. It is thus important to note that, when starting a construction project in an urban development area that has a construction logistics setup, part of the planning for that construction project must be to develop a strategy for how to work with that construction logistics setup. Further reading, Janné and Fredriksson, 2021, Construction logistics in urban development projects – Learning from, or repeating, past mistakes of city logistics?, International Journal of Logistics Management.

Project name	**City of Uppsala**  *Figure. The CLS of Uppsala. Illustration: Catharina Danckwardt-Liljeström*
Project type, size and time frame	The city of Uppsala is to build and densify several areas within the coming years. The areas are Rosendal, Ulleråker and Östra Sala Backe. To consolidate and control the flow to and from these areas, the city of Uppsala has procured a construction logistics setup (CLS).
Project location	The projects the CLS is to serve are located in the central parts of Uppsala. One of them are also close to the area from which the city gets its water.
Construction logistics	The goal with the CLS is to decrease the traffic through and within Uppsala and by this improve the living and working conditions in the areas. The CLS should also help to decrease the construction time and the material waste. The CLS consists of a terminal on the outskirts of Uppsala close to the E6 and a booking calender. The terminal offers consolidation and short time storage.

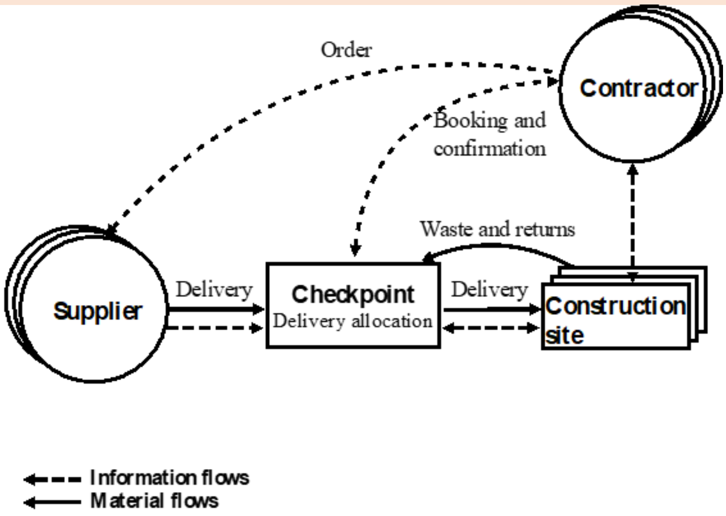
	The city of Uppsala has provided a location for the terminal and procured a third-party logistics provider to run the terminal.
Impact and learnings	The analysis showed that the municipality, the main contractors and the TPL provider all found the consolidation effect to be positive. Though, the acceptance and success of the solution will depend on some actions being taken regarding both the construction logistics solution and its governance as well as what type of performance it is expected to deliver. A CLS cannot be designed only as a transport solution, it has to be seen as a part of the material flow to the construction sites and thereby more operations related performance measures have to be considered. It is also hard to get acceptance among politicians of the cost to run a CLS.

Project name	**Älvstranden AB – Construction logistics strategy**  *Figure. Älvstadens development area, Gothenburg. Illustration: Älvstranden Utveckling AB*  *Figure. The CLS developing process part of the strategy. Illustration: Mats Janné*
Project type, size and time frame	A strategy for construction logistics in the projects developed and run by Älvstranden Utveckling AB. Älvstranden Utveckling AB is a developer owned by the municipality City of Gothenburg.
Project location	Älvstranden Utveckling AB is to develop the areas along the river Göta Älv in the center of Gothenburg. The work is to take place both on the north and south side. These areas are very central in the city and the city has already from the beginning a congestion problem, especially related to the transfer over the river.
Construction logistics	Älvstranden Utveckling AB have developed a construction logistics strategy based on their goals: 1) to decrease emissions during construction with 50% until 2021, where from construction logistics should contribute with 3-5% at least. 2) to improve mobility and attractiveness in their project areas during construction and minimize traffic disturbances in the city.
Impact and learnings	The strategy is to develop project specific construction logistics plans early in the development program. It should, when possible, be include in the land agreements and be followed up during the project. They present several earlier learnings to their project leaders and a portfolio of different services and when they are to be used. The strategy also includes what Älvstranden Utveckling AB calls “hygiene factors”, which are booking system, logistics coordinator, logistics adapted site plans including marked storage areas, short term

	storage, kitting, carrying, store on site, standardised etiquettes, follow up of performance and education.

Project name	**Älvsborgs sjukhus (Borås)**  *Figure. Södra Älvsborgs Sjukhus. Illustration: Mats Janné*
Project type, size and time frame	It is a 5-year project to build and renovate the psychiatric ward, the infection clinic, and the medical laboratory of the hospital in a medium-sized city in mid Sweden.
Project location	All three wards and clinics are operational during construction, with the current medical laboratory scheduled for demolishing once the new laboratory is completed.
Construction logistics	The main contractors site manager demanded a CLS to ensure that material deliveries are running smoothly and in accordance with plans. The CLS is organizationally located under the main contractor and consists of a terminal, with additional services such as kitting, on-site materials handling, and a machine resource pool. Deliveries are carried out after call-offs, based on takt production. The main contractor has a dedicated logistics manager in the project, acting as the contact point between construction project and logistics provider. Terminal solution, ensure on-time deliveries and on-going operations on site, other services included are: on-site materials handling, Kitting, Machine resources, Routes within site and Education.
Impact and learnings	The goal of utilising a CLS to include more than just avoiding disturbances. The goal must also be to ensure that material deliveries and on-site logistics works within the hospital project and there is a continuous development process. First, there are many different stakeholders adding to the organizational complexity of the project. At the same time the structural complexity of operating a hospital while simultaneously building new parts or renovating it, means that there is also a big risk of physical disturbances within the hospital area. It is thus of utmost importance that any rules and regulations set by the CLS operator are adhered to and that the CLS operator has the mandate to enforce these rules. The CLS design must include measuring the

	overall performance of the CLS. The performance measuring must include the logistical efficiency of the solution, but also how well the CLS reduces disturbances and what the effect is on sustainability aspects.

Project name	Helsingborgs lasarett (Helsingborg)  *Figure. The physical and information flows in the CLS setup. Illustration: Mats Janné*
Project type, size and time frame	It is a 7-year project where the renovation of the main building is combined with the construction of new care buildings and parking garage. The hospital is operational during the renovation and new-build project.
Project location	The hospital is located in the middle of the city center adjacent to both residential, office, and school buildings.
Construction logistics	The regional council employed a construction management (CM) company to manage the site and the material and resource deliveries. The goal of the logistics solution is primarily to reduce impact on third-parties and to ensure that the hospital operates as normal. As the hospital is located in the busy city center, the CM company opted for a checkpoint solution with a planning system for all delivery bookings and waiting area for lorries outside of the city. The CM company is managing the site as well as all delivery activities and by being part of the project management and having their own budget, they are in a position where they can focus on managing relationships and ensuring that all stakeholders strive towards a common goal, but they also have mandate to enforce rules and regulations towards contractors, suppliers, and transport providers in the project. However, as their mandate is only for the project, there has been issues in coordinating regional and local council road and construction works adjacent to the hospital project with what happens on site.
Impact and learnings	The goal of utilising this CLS was primarily avoiding disturbances, i.e., ensuring that the hospital could be operational while the project was ongoing. This case shows that when introducing a CLS, it is important to consider where in the organizational hierarchy the CLS is located as this will signal actual and perceived mandate to enforce the regulations set for construction logistics within the construction project. Due to its position within the project organization and the dedicated own budget, the CM company had a comparatively easier journey to get all stakeholders onboard with the CLS. The main issues encountered in Helsingborg was that at the same time as the hospital project was running, the municipality had smaller infrastructure projects performed adjacent to this large-scale project and the access roads

	of the site. Ideally, the municipality would have postponed their infrastructure projects until the hospital project was completed. However, this is not always a possibility as at times, urgent repair work needs to be undertaken in the infrastructure. At these times, the CLS should be consulted to allow for discrepancies in access roads and routes to and from a construction project. However, this means that actors outside of the focal project needs to be included in the CLS design and to allow for these actors to be able to utilize and impact a CLS,

Acknowledgements

This project has received funding from the European Union’s H2020 research and innovation programme and is part of the research programme JPI Urban Europe with project number 438.15.403 (MIMIC). This project is subsidised by the Brussels Capital Region - Innoviris and the European Union and receives funding from the Swedish Governmental Agency for Innovation Systems (Vinnova), the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT) in the framework of the research programme "Stadt der Zukunft" and the Austrian Federal Ministry of Science, Research and Economy (BMWFW) and The Research Council of Norway.