KTH – KUNGLIGA TEKNISKA HÖGSKOLAN

THESIS WORK IN SUSTAINABLE SERVICE DESIGN

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Abstract

The city of Stockholm is experiencing an extremely quick development from the points of view of the urban expansion, the increasing number of inhabitants that demand to live here and the infrastructures that need to be built. The situation is particularly challenging for Stockholm and constitutes a great opportunity for city to compete with other regions and capital cities to attract investments and visitors. To be successful in this competition, Stockholm has decided to focus on the creation of an environmental profile that will make it the world's most attractive and advanced region in the field (RUFS, 2010). The recent development of the Stockholm Royal Seaport district finds its place in the frame of the sustainable direction the city aims to follow.

The goal of the project is to develop a new, modern and environmentally friendly district from the re evaluation of an ex industrial area in the North part of the city. The sustainability nature of this project is declined in many different measures that will be applied, including the energetic requirements of buildings, waste management system and transportation logistic.

This report focuses on the last topic presented, the logistic of transportation in the area, and aims at proving suggestions for its application. The methodology applied is based on the analysis of the previous experiences of other European cities of Bercelona, Graz, Göteborg, Ravenna, Linköping and Stockholm and on the reviews of the measures adopted in these cases. A deeper analysis of the case study of Hammarby Sjöstad has been presented as an experience that, because of its features, is closer to the specific situation of the Stockholm Royal Seaport. The analysis of the stakeholders involved, of the frame of the situation and the interview with a person form the city council have been tools of valid help to define the current state of the developments in the district.

Previous experiences in the field of multiple approach to the issue of transportation logistic and specifically in the field of clean vehicles as well as some unusual suggestions have been analysed and some interesting points have been outlined and used as valuable support for the definition of the final proposal.

Considering the analysis carried and after having set the criteria that could drive a decision, a project proposal has been made. This includes the establishment of a Logistic Centre (LC) that would handle the management of the transportation of building materials as well as the transportation of goods to, from and within the area. The location has been chosen assuming that the area is accessible and available for the construction of this infrastructure. The types of goods delivered have been classified into three categories and a suitable mean of transportation has been assigned to each of them, mainly focusing on the use of clean vehicles. The positioning of the waste sorting station in the same location as the LC has been suggested in order to encourage the cooperation between the two buildings and the Combined Heat and Power (CHP) that will be built there with the purpose of creating a sort of logistic area were all the traffic linked with the transportation of materials and goods is concentrated, thus reducing the congestion in other parts of the district.

Aims and goals of the report

The project aims at defining new ways of handling the transportation and distribution of goods to be applied first in the specific area of Hjorthagen and then in all the district of Stockholm Royal Seaport.

From the analysis of case studies of previous experiences of this sort and of the problems linked to them, many different reflections are made. There are basically two ways the issue has been handled so far: what we will call the “traditional way” where every delivery company works on its own and the “environmentally friendly” one, where a Logistic Centre has been establish to coordinate the transportation of goods within a certain area.

The aim of this project is to find out if there is a third way (or a fourth or fifth) to deal with this issue and, if so, to define it.

The purpose of this report is to create questions and doubts about the current situation and try to suggest or at least visualize a possible (or maybe impossible and visionary) solution for them, in order to improve the present reality and promote further reflections on the subject.

Introduction

The city of Stockholm faced a great growth in the past few years and is planning to grow further.

By 2030 the population of Stockholm is expected to grow to almost 1 million, 3.5 millions if considering the Stockholm-Mälaren region (Stockholms Stad, 2011). More people will require more houses, more goods, more infrastructure, more services and a better co-ordination of them. A larger population also results in a higher consume of energy and production of waste. The city of Stockholm needs to face this problem and wants to do it maintaining the environmentally friendly trend that has made her the first European city to be awarded with the European Green Capital Award in 2010 (European Commission, 2010). In order to achieve the goal of designing the structure of the region to host a greater population combining technology and environmental awareness, the city developed in 2010 a regional development plan, RUFS, whose aim is to predict, plan and present how the Stockholm region would look like in 2050 (RUFS, 2010).

The goals for the region are; to be accessible, to be a leading growth region, have a good living environment and being resource efficient.

In order to achieve them, the plan highlights six different strategies:

- Increase sustainable capacity and quality within education, transport and the housing sector: build up a more efficient system of transportation that includes also connections between different types of transport, reduce dependence on fossil fuels, increase the quality of education and build new accommodations to make the region more attractive.

- Develop ideas and the capacity for renewal: Stockholm region must be more open to external ideas and impulses and develop an international profile.

- Safeguard values for future needs: energy consumption must be reduced and switched over to new renewable sources (RUFS 2010), the cooperation between business, research and universities is essential to reach this goal.

- Further develop a dense, multi-centre region: the development of the city of Stockholm and of its infrastructure will lead to the creation of a network between the major cities in Eastern Central Sweden.

- Strengthen cohesion and Liberate life chances (RUFS, 2010): the cohesion between different areas is obtained through better transportation and the segregation of immigrants is to be avoided.

The planned outcome of the development and application of these six strategies is for Stockholm to become the world's most popular region (RUFS, 2010).

The challenge is particularly ambitious and it also includes some more goals the city planned to achieve, such as becoming fossil fuel-free by 2050 and reduce emissions of CO_2e to 3 tonnes per resident per year by 2015 (Stockholms Stad, 2009).

As seen from the analysis of the RUFS plan, the key directions towards which the city of Stockholm and the whole region intend to move are modernity and environmental consciousness.

Is exactly in this frame that the Stockholm Royal Seaport project finds its place.

The Stockholm Royal Seaport project

The Stockholm Royal Seaport (SRS) project is the greatest urban development the city of Stockholm is facing at the moment.
The overall goal is to revalue a disused area in the north part of Stockholm, Norra Djurgårdsstaden, and build a 236 hectares sustainable urban district that will be able to host 10.000 homes, 30.000 new work places and 600.000 m2 of commercial space. The area will be linked with the rest of the city through the already existing metro line, buses and walking path. It also includes the area of the proper port and cruise terminal.
When the project will be completed, SRS will be the second "green" district in Stockholm after Hammarby Sjöstad configuring the capital of Sweden as a leading entity in the sustainable city planning world.
The general guidelines cited in the RUFS plan are reflected in the goals stated for the SRS project: being fossil fuel free and Climate+ by 2030; reduce CO_{2e} to 1.5 ton per person by 2020 and adapt itself to a changed climate (Stockholm Royal Seaport presentation report, 2010).
The focus of the project is on sustainable development and the collaboration between the city, the users, the academia and the industry (Stockholms Stad, 2010).
The theme of sustainability is considered in many of its facets: climate, ecological, social and economic sustainability; and the measures designed to achieve these goals cover topics from sustainable energy system to sustainable lifestyle.
These measures and guidelines will be discussed and examined later on in the report.
The building process has been divided basically into four phases: first of all the construction of the infrastructure, then housing and commercial buildings, Lifestyles and in the end Business.
The works are planned to start from the north part of the area, called Hjorthagen, and this first phase will constitute a sort of trial to see how the planned development are working out.
It is exactly on the analysis of this first area that this report focuses on.

Hjorthagen

The area of Hjorthagen is extended from Lidingövägen up to the north edge of Norra Djurgårdsstaden and constitute the first development area of the whole project.
The area is surrounded by the park of Norra Djurgården on one side, by the sea on the other ad is well connected both to the island of Lidingö and the city centre by two main roads: Lidingövägen and Gasverksvägen. The area around the metro station of Ropsten hosts also the tram station, the train station and the bus station.
The actual situation of the streets organisation reflects the old function of the area. To allocate buildings meant to host houses and offices, the road system will be reviewed and integrated.

The interview with Daniel Carlsson-Mård, Public Relations Officer of the City of Stockholm regarding the Stockholm Royal Seaport project, has been of valid help to the effort of defining the current situation of the development in the area.
The content of the interview is presented here below and divided into the topics discussed.

The population of the area

The project of the Stockholm Royal Seaport is divided into several areas that correspond to the different phases of construction development. The first one is, indeed, the area of Hjorthagen; while the second is, unlike what one could reasonably assume, the southern area that is not directly connected with Hjorthagen. The development of the areas in between these two will follow. The reason of this order of development is that the first two areas are the residential ones and will be followed by the construction of the working areas located in the central part of the site.
The total number of people moving in the apartments will be 15000, and the first inhabitants will already move in in September 2012. The idea of the planners is to have a different types of people living in the area in order to create a mixed society. To reach this goal, a good variety of types of houses have been designed: apartments most likely to be hired by students, apartments to buy, apartments to rent and so on. There is not, however, any kind of social housing project.

The buildings
The buildings have been designed by almost 25 architects that often worked in parallel, in order to cooperate to the creation of an harmonic environment while providing variation. The hight of the buildings built along the waterfront will vary from 3 to 7 floors, while the buildings running up to Hjorthagsberget will be slightly higher. The area will have semi-open blocks overlooking the water and the Royal National City Park (Stockholms Stad, 2012).
The model of organization of buildings is the same followed in Hammarby Sjöstad with apartments from the first floor up and retails on the ground floor.
Each building has to respect what Carlsson-Mård defined as Green Factor, that refers both to a certain attitude towards environmentally friendly solution and to the colour green itself, denoting the effort to provide as many green areas as possible. Some buildings will therefore be equipped with gardens or common areas on the roof whereas others will have the already included structure to grown one's own herb on the balcony.
The question of what kind of shops will be placed in the area arose from the observation of what happened and is still happening in Hammarby Sjöstad, referring to the proliferation of flower shops among all the other types of store, with the consequent disappointment from the inhabitants.
As Carlsson-Mård pointed out, the city can not decide which shops will be allocate in the area, or at least can not do it in details. It can, however, provide guidelines for the developers in charged of the construction of the buildings. Since the number of developers is quite high (ten), the city makes sure there is a profitable dialogue between them, to ensure a difference in the types of shops that will be installed; everything else is basically up to the constructors.
The city can however positively interfere with the complete freedom given to developers by suggesting specific retails for specific areas (such as cafés and restaurants around a square or along the waterfront) or by imposing the presence of a certain kind of shop because that particular area needs that function, such as the imposition of having a grocery store in a defined building.

The collection of waste
The waste will be collected through an underground vacuum system, like the one already established in Hammarby Sjöstad. However, a development in this system will be applied: a waste grinder will be established in every kitchen for the disposal of food waste that will be then used for the production of Bio Gas. All the waste will be pumped to a specific building, whose location has not been defined yet, and from there it will be collected by trucks and delivered to different waste management plants.
The idea of creating a system for the local handling and use of food waste produced in the area (through activities like the production of compost to be reused in local common gardens, for example) has not been developed yet, but is an option for the future.

The society living in the area
Analysing the case study of Hammarby Sjöstad it was possible to notice how the society living there is passive in a certain sort of way, due to the nature of the district they live in. Someone is, in fact, already considered environmentally conscious just because he/she has moved there: no further action is required by him/her but throwing the waste in the correct pipe. The system takes care of all the rest. The society that wants to be encouraged in the Stockholm Royal Seaport area will be more active in this sense? The answer was reasonably negative. No one can tell the people how to behave, not even the city. However, the city can make sure its inhabitants have the best solutions to chose. In particular, concerning this area, the city's objective is to ensure a good communication of the solution that the facilities in the area and in the apartments provide. Opening invitations for information meetings together with the constructors in order to learn about the area and its environmental profile, and the distribution to new inhabitants of a information package, move towards this goal. The effort of the city is to provide the best solutions available at the moment on the market while keeping them flexible, so that they can be changed and always be the best ones.

The communication lines
There will be only one main road going through the area and it will be enough large to host a dedicated line to buses. There will be, by the end of the project, two bus lines whose introduction will follow the moving in of new inhabitants.

A railway tram will be introduced later on and will be installed in the eastern part of the area.
Ropsten metro station will still be a crucial point for the commuter traffic.
Carpools services, walking and biking lines will be introduced, aligning the area to the guidelines of the new master plan for the city of Stockholm that aims at making it a walk able city.
The aim is to provide as many alternatives as possible to the use of private cars, that must become the last option available. In this sense goes the decision of allowing no more than 0.5 parking slot to each apartment.

The distribution of goods
The city has not developed any specific plan for the management of the distribution of goods in the area. Many Research&Development projects have been, however, financed to study smart ways of transportation and use of energy.
The role of the city is to provide the infrastructures, such as roads, but it is not possible to control how they are used. There is an environmental programme written by the city stating that is recommended that every delivery company has an environmentally friendly profile of thinking that can mean, for example, to use bio fuels or electricity to power trucks instead of gasoline.
However, the city has not the authority to stop a delivery truck if it uses a particularly polluting fuel.
In order to facilitate and encourage the use of electrical vehicles, charging stations have been installed into garages and will soon be installed in the streets.

The Logistic Centre
A Logistic Centre will be established for the management and handling of the distribution of building materials through the area in order to reduce the number of trucks entering the site.
Once the construction operations will be done, the Logistic Centre will not be any longer used.
There is not any plan, at the moment, considering the possibility of using the Logistic Centre for the handling of goods.

Follow up and evaluation
Considering the experience of Hammarby Sjöstad, some of the characteristics of this project were considered useful to be imitated, such as the organization of the planning structure, the use of an underground vacuum system for the collection of waste and the establishment of a Logistic Centre for the management of the transportation of building materials. However, some weak points of the Hammarby Sjöstad project have been analysed in order not to repeat them. This refers mainly to the evaluation problems that were encountered during the follow up of the HS development and that will be discussed later on in this report when presenting the HS Experience. The city, for the SRS project aims at establishing a system for the continuous evaluation of the progresses.

With the help of the information gathered during the interview, it is possible to draw a realistic picture of what the status of the development of the Stockholm Royal Seaport is at the moment.
As often happens, despite all the preliminary planning, due to the difficulty of finding a suitable solution for all the stakeholders involved, there is a deadline within which the construction must start and when the project is finally being realized not all the problems have been solved. Concerning the specific situation of SRS the locations of the Logistic Centre and the Waste Collection centre are still undefined. If, on one side, a solution is desirable to be found soon, on the other side this moment of uncertainness can be considered a good opportunity to study the evolving of the area in its preliminary stage and regard this as a sort of experiment in order to be able to find better solutions to be applied to the whole project.
Unlike what happened with the development of the project in Hammarby Sjöstad, during which the environmental program came late in the planning process of the area, resulting in contradictions between different goals (KTH, 2009), for the Stockholm Royal Seaport the environmental perspective is present since the beginning. Moreover, again in comparison with the experience of Hammarby Sjöstad, in the SRS project the involvement of the city is strong, efficient and cooperative and aims at supporting the project and encouraging cooperation between different stakeholders involved.
There is also a strong effort from the city to improve the follow up and evaluation process to be always on track and continuously evaluate progresses of each project.

Once the framework of the situation has been defined, it is useful to have a look at other examples of transportation management systems. In this report we will focus on some examples of different measures applied in various cities around Europe considered as case studies and will try to draw some conclusions and relate them to the specific situation of the Stockholm Royal Seaport.

Case studies

As mentioned in the Aims and objectives, there are basically two ways of handling the transportation system within an area: the traditional way (that in this case corresponds to the zero scenario) and the new way, where a Logistic Centre (LC) is established. The last one is included in the concept of City Logistic that aims at mitigate the negative impact of urban freight transport, support a lively city centre and improve quality of life for residents (Karlsson; Lundgren; Abrahamsson, 2011) while optimising the logistics and transport activities by private companies in urban areas (Taniguchi et al, 2001).
The topic is of major interest for every not necessarily big city, especially for those that have an historical centre that typically is the core of the city, attracting a large number of citizens and tourists that need to move through narrow streets. The importance of the city logistic design has increased during the last years together with the ever greater attention for environmental issues, such as the reduction of the CO_2e emissions.
As both an incentive and a result of the described situation, the European Commission has launched several large project whose objectives are mainly to create more efficient urban goods transport systems, considering new vehicle, safety, e-commerce, urban freight platforms etc. (Karlsson; Lundgren; Abrahamsson, 2011). Many different City Logistic Demonstration Projects (CLDPs) have been developed by different countries with the purpose to develop concepts and evaluate methods for implementation and specific objectives such as economics, environmental and congestion reduction (Karlsson; Lundgren; Abrahamsson, 2011).
More than the analysis of the CL projects launched by the European Commission, is more useful for our project to focus on their specific application through CLDPs; the background they act on, their application and the results achieved.
We will briefly consider seven different examples and then focus on the last one regarding the historical area of Stockholm, Gamla Stan.

- **Barcelona:** The focus for the Municipality of the city was on minimising congestion, especially in the city centre where surveys have proven more than 100.000 un/loading operations per day. The objectives of the project were to improve Municipality management of vehicle circulation, reduce delivery time and costs and develop mechanism to self-finance the successful scheme elements.

The measures taken were: allocation of one lane to bus priority during peak hours and to goods deliveries during between peak hours; night-time delivery; web information exchange of 8 supermarket operators and 3 distribution companies to avoid hotspots; temporary loading/unloading spaces with special regulations restricting.
The results were many and positive and lead to: reduction of travel time; less illegal parking; demonstration of possibility of quiet delivery during night with a large lorry that, with 2trips/weeks at night can save 7 trips using smaller lorries during daytime.
(Karlsson; Lundgren; Abrahamsson, 2011).

- **Graz:** The CLDP had to face the particular characteristics of the city, such as the presence of an historic centre with many pedestrians, speed limit of 30km in city areas and a rising car use due to people moving to the city outskirt.
  The objectives were to reduce congestion and emissions; especially reduce the number of partly loaded trucks going in the city and thereby reduce noise, fine dust, emissions, congestion and costs. The collaboration between the project management, a forwarder (ITG) and the biggest shopping centre of the city (K&Ö) proved to be essential for the good result of the project.
  The results consisted of reducing by half the number of delivering vehicles in the area thus implying cost and environmental savings.

(Karlsson; Lundgren; Abrahamsson, 2011).

- **GÖteborg 1:** The application of a CLDP had to consider the geographical situation of the city for the river divides it into a northern and a southern part. The objective was to reduce congestion in the city centre caused mainly by heavy duty vehicles; reduce emissions, pollutants and noise level from lorries.
  Measures taken included the use of CNG (compressed natural gas) vehicles thus decreasing emissions.
  (Karlsson; Lundgren; Abrahamsson, 2011).

- **GÖteborg 2:** The objective was to investigate the possibility of further development of Environmental Zone by testing load factor restrictions and incentive system for transporters fulfilling requirements. Incentives, open to all transporters on a voluntary basis, to stimulate increased load factor and use of clean vehicles was implemented.
  As a result, the load factor was not accomplished due to difficulties in measuring and reporting; moreover voluntary participation was, and it usually is, hardly effective.
  (Karlsson; Lundgren; Abrahamsson, 2011).

- **Ravenna:** The city had started a program of economic incentives to stimulate the growth of CNG and installed ITS systems to monitor and control urban traffic. The objective was to reduce congestion and emissions.
  Measures taken included restrictions and consolidation services provided by a private company and incentives from the Municipality to increasing load factors and cleaner vehicles by regulating access.
  The results were positive and included more efficient flow.
  (Karlsson; Lundgren; Abrahamsson, 2011).

- **Linköping:** The overall objective of the CLDP was to reduce the number of trucks in the city centre, characterized by old buildings and narrow streets and to evaluate the economic prerequisites for a consolidation concept.
  The measure taken was to involve a transport provider and three forwarder agents to coordinate deliveries of parcels and packages to the city centre by consolidation at a urban distribution terminal.
  As a result, the number of vehicles and total driving distance decreased; moreover the economical evaluation showed the concept was profitable.
  (Karlsson; Lundgren; Abrahamsson, 2011).

- **Stockholm:** The area considered is the historical centre of the old town of Gamla Stan characterized by old buildings, narrow streets, a large number of shops and restaurants and a large number of tourists. Some other issues had to be considered while analysing the area, for example the restaurants and cafés required frequent deliveries but could afford only a very little space for storage, the old buildings could be damaged by vibrations that shake the area and the pollution can erode their decorations and the level of noise has to be kept low. Other issues to be considered were the large number of private cars and the restriction on traffic between 6a.m. and 11a.m. The situation before the application of the CLDP showed several small delivery companies not cooperating with each other thus causing unnecessary driving and congestion in the area. The suppliers could be divided into two groups: suppliers with their own distribution solution and transporters which distributes for others (Trendsetter, 2005).
  The objective was to reduce the traffic congestion due to the many trucks entering the area for deliveries, reduce emissions and noise level.
  The measure applied was to create a Logistic Centre just outside the Old Town, storing there all the goods that needed to be delivered, hire a unique company to get in charged to delivery every type of goods in the area by a clean vehicle.
  Home 2 You was the company chosen and the Logistic Centre has been established in Söder Mälarstrand, very close to Gamla Stan and a bio-gas fuelled vehicle has been used for deliveries. The Centre provides co-tranport goods within Old Town, on-time delivery, co-

ordinated deliveries and reduces driving in the way that is most optimal at each moment. The main goal achieved was to reduce the number of small deliveries to the Old Town with 17% (Trendsetter, 2005).

The main problems encountered during the project include the possibility of handling food together with other goods, coordination of food and empty returns, lack of customer demand and involvement, lack of interest from the different bodies of the town and their lack of flexibility when testing new techniques and logistics, the high initial costs and the difficult coordination between different stakeholders involved (Trendsetter, 2005).

From the analysis of the case studies presented, some reflections reveal positive and negative aspects as well as general guidelines that can be useful when applied to our project.
As an example, the different measures applied have to be considered in relation to the specific area they deal with: city characteristics (historical centres or not), size, areas, density, geography (presence of hills, rivers..) and infrastructure.
Most of the projects presented involve a combination of measures, such as clean vehicles use, implementation of transportation system and new logistic concepts (Karlsson; Lundgren; Abrahamsson, 2011). This way of operating is probably the most effective one since the combination of different measures enables us to approach the problem from different points of view at different scales; the clean vehicles regard the single delivery company whereas the logistic design involves all the area / the city.
The common objective for all the projects is to decrease traffic congestion and reduce emissions from transportation, to achieve it many different measures have been used, some of which can inspire our analysis.
For example, establishing night-time deliveries has proved to be particularly effective in Barcelona and can be considered as an applicable solution to our case. While probably establishing a dedicated lane during peak hours is not a reasonable solution, the web communication is a point that needs to be stressed and invested on, in order to better coordinate all the system and allow simultaneous exchange of information.
The cases of Graz, Ravenna and Linköping are good examples of how the coordination and co-operation between the stakeholders involved and the participation of the city government is essential to the project.
The Göteborg experience is extremely interesting for the use of CNG vehicles, which are certainly of valid inspiration for our project, but also for the failure of the load factor incentive showing that the voluntary basis is without any doubt a path that can be followed, but that also includes many risks.
More time has been spent describing Stockholm Old Town case because it summarizes, in a certain sort of way, all the problems that can be encountered, such as the geography of the area, disposition of houses and streets, nature of shops, stakeholders involved etc. and because the reality of this small area can be closer to the one we are about to analyse.
The creation of a Logistic Centre located just outside the area is one of the most interesting solutions from the point of view of the Logistic Organisation.
It avoids unnecessary delivery traffic in the area, optimize the transportation thus reducing traffic and emissions. It involves, however some problems, such as the possibility of store food, the necessity of having a permanent crew that takes care of it, the necessity of including in the operation all the companies that delivers in the area, or at least most of them, in order to get as much as possible out of the project.

There is another project that is probably the closest to SRS situation, and that is the case of Hammarby Sjöstad. A specific section of the report has been dedicated to this example, in order to deeply examine it and be able to compare its features with the current situation of Stockholm Royal Seaport.

Hammarby Sjöstad experience

Hammarby Sjöstad is one of the most recently built areas in Stockholm with the main feature of being a sustainable district. The construction began in 2001 and by 2015 the project will be completed and the district will host a total of 35.000 people living and working in the area (Stockholms Stad, 2007). The environmental perspective that has stimulated the realisation of the project is expressed in different elements, starting from the sustainable materials used for the construction of the buildings, the use of renewable energetic sources combined with high energy consumption efficiency of buildings, the focus on public transport to reduce personal ways of transportation, advanced technologies for the management of water use and treatment of sewage, and the underground vacuum system used for waste collection (Stockholms Stad, 2007). According to this sustainable way of thinking, during the construction period a Logistic Centre for the management of transportation of building materials has been established: the purpose was to coordinate the ingoing and outgoing movements of trucks from the area in order to optimize them and reduce traffic congestion in the area, improve the quality of life for the inhabitants and reduce the emissions. The idea has proved to be particularly effective and successful: the number of trips in the area has been reduce within approximately 20 trips per day; the number of kilometres driven by vehicles has been reduced by 38 Km per day; the number of small deliveries to the site has been reduced with 80% through co-transportation; the congestion in the area has decreased; and the reduced amount of energy used and the reduction of emissions have created a better living and working environment (Trendsetter, 2006).

The Logistic Centre has been used only for the management of the transportation of building material. However, another LC has been established in the area to manage the transportation of on-line purchased goods. This Logistic Centre was set up by the City of Stockholm in 2003 with the purpose of coordinating transports to district residents, schools, municipal service units, private companies and restaurants in order to reduce CO_2 emissions and improve the quality of life in the neighbourhood. The company Home Department AB has been assigned as the operator of the centres and provides deliveries of on-line goods, dry cleaning services and distribution of food and beverages (ManagEnergy, 2003).

Given certain assumptions, including the interest of future inhabitants of the area to have home delivered on line purchased goods, a simulation of the project was made in order to picture four different scenarios (each one for a different share of on-line shopping: 0%, 10%, 25%, and 50%) for the environmental impacts of transportation of goods in the district. The results were encouraging the adoption of this solution, since energy use, CO2 and NOX emission were showed to be reduce within 7-8%. Moreover, surveys carried among the citizens of the area demonstrated the interest both of inhabitants and store/restaurants owners to use the LC for coordinating transportation of on-line purchased goods. The LC was then established. The main characteristic of this system was that it worked through an on-line service: the citizens, after paying a monthly fee to Home Department AB, could access to the web site of the company and make their order. The company managing the LC had settled agreements with 15 shops in the district. The company picked up the goods from the shops and, through electrical vehicles, delivered them door to door (ManagEnergy, 2003).

Despite the good and promising premises, the project did not gained the expected success: the LC was (in 2003), in fact, used only by 1% of all residents in the area. The reasons for this failure can be traced back in the economic situation: the price of living in Hammarby Sjöstad is already particularly high; besides Sweden is going through an economical recession period and many of the shops that used to provide a on-line shopping service, do not any longer offer this service (ManagEnergy, 2003).

The main feature of the project of Hammarby Sjöstad is the holistic view that was applied to its development including the urban planning, the management of waste, water and energy use, and the logistic of transportation. This holistic perspective lead to the creation of platforms where it was possible to discuss the developments of the program and to shape the so called Hammarby Model. An important entity in the promotion of this model is the information house called GlashusEtt that works as information both for tourists and for inhabitants of the area (KTH, 2009).

The main problem highlighted from the analysis of the results achieved by Hammarby Sjöstad are the difficulties encountered in the practical realization of the environmental goals stated and the evaluation process. As mentioned before, the environmental perspective came late in the planning

process of Hammarby Sjöstad thus resulting in the creation of some contradictions in the project. The lack of clarity in the statement of the agreements between the City of Stockholm and building contractors prevent the situation from improving. Moreover, the lack of decisions regarding how the project should have been followed up, together with the lack of systematic gathering of data and results have made the evaluation process particularly hard (KTH, 2009).

The experience of Hammarby Sjöstad is a valuable example and many lessons can be learn from it, as mentioned in the conclusions of the ManagEnergy report used as a reference.
In the first place, the analysis and prediction on how the hypothetical Logistic Centre system will work is necessary and must be confirmed by other means, such as surveys among the targeted customers. A reasonable number of citizens and shops that will take part in the project is vital for the survival and good efficiency of the service.
Moreover, the system requires a well carried planning, supervision and management, in order to best exploit its potential. Participation and support from the city government are also essential elements for the positive result of the project.
The example of the information point of GashusEtt is a valid model to be imitated. When building a new district or when simply presenting a system that is in some sort of ways different from what the users are used to, it is extremely important, for the success of the initiative, to ensure the complete comprehension of the project. In the case of Stockholm Royal Seaport the planned establishment of an information point like GlashusEtt will help the new inhabitants of the district to better understand the environment and the system that surrounds them.
The evaluation problem linked with Hammarby Sjöstad has been and still is the main flaw of the project. As mentioned during the presentation of the interview with Daniel Carlsson-Mård, the city has expressed a strong determination in the willing of continuously evaluate the results achieved by the developments in the SRS project.

Considering the different case studies presented and the specific experience of Hammarby Sjöstad, the choice of which of these measures proposed can be the best one to be applied to the specific situation of Stockholm Royal Seaport depends on the nature and configuration of the now developing district and is connected with the types of goods considered, the positions of different stakeholders, the types of buildings, roads, geographical environment and in general with the goals we want to achieve.
It is, therefore, at this point useful to define the frame of the situation for the Hjorthagen area.

Frame of the situation

Stakeholders

The main stakeholders involved in the decision of improving the management of the transportation of goods are:

- The city of Stockholm; whose interest is to develop a new district at the forefront of environmental consciousness and to maintain its reputation of green city. The main idea is to follow the path traced by the experience of Hammarby Sjöstad and go beyond it, further improving the system. The focus is on the reduction of traffic congestion, emissions, noise and pollution in the area. The aim is to create a holistic system in the name of sustainability; system of which the logistic of the transportation of goods is a relevant part. The city aims at keeping the price of such an initiative as low as possible, thus providing the necessary investments on R&D projects to develop the best possible solutions. The focus on the optimization of roads transportation and the effort of improving the biking lines and walkable connections with the city are topics of first importance for the Municipal Government. Reaching this goal will contribute to the improvement of the image of Stockholm as green and modern city, and goes in the direction of making it the world's most attractive urban region.

- The shops that will be located in the area; their focus is on the price of the deliveries, on their punctuality, on the integrity of the delivered product and on the possibility/need to have daily delivered goods. The shops can be roughly divided into food shops and other kind of stores. The first category needs goods to be delivered daily and to be kept fresh. The second category

includes any other type of goods that do not need to be stored in fridges. They focus on the price of the deliveries and on the advantages they can receive from changing their usual system. Their participation and interest in the project can vary according to their level of information about the initiative. In case of shops from which the goods are delivered to customers (both, shops and customers, living in the SRS area) the participation of stores in the project can depend on the types of customer they serve and on their expectations and needs.

– The inhabitants of the area; their focus is on the reduction of traffic both for the safety of people living in the district and for the reduction of congestion during rush hours. Other important issues for the inhabitants of SRS are the reduction of the noise caused by trucks delivering goods and the reduction of the pollution in the area. They want, of course, the deliveries of their goods to be on time. They are interested in being actively involved in the environmentally friendly system established in the district, but only if the infrastructures to benefit from them are well organized and easy to use: leaving the participation entirely to self initiative will be an unsuccessful action. A thoughtful and effective information system must be established.

– The delivering companies; whose focus is on the optimisation of their own transportation routes in order to be able to serve all the clients using as less resources and time as possible. The punctuality of the deliveries is both a focus for them and a requirement from their customers. Their interest is to satisfy as many citizens as possible, but in the beginning they focus on gaining a minimum number of clients to make their work worth it. Their interest is on the transportation rules of the area: if there are some restrictions or particular fees for some types of trucks, parking spots or dedicated lines and the facility of accessing the area. The economic side of the situation is for them of primary importance.

– The organisations that will be chosen to coordinate the project; they focus on the strategic planning of the organization of the deliveries and on the collaboration between the different delivering companies that will adopt their service. They are interested in the transportation system in the area and in the rules and restrictions linked to it. They also focus on the types of means of transportation that will be used. They are willing to take part in the project because of its importance and because it is a great advertising opportunity for them. The starting investment is for them of primary importance.

The above described situation shows a certain level of complexity in the decision making process: the stakeholders involved are many and with different interests. In order to guarantee the success of any kind of initiative that includes all the stakeholder, a profitable and serene dialogue must be established between all of them. This will be prove to be useful both for the development of the project and for the evaluation of the results as well as when managing problems.

Multiple approach

As outlined from the analysis of the general situation, there are many entities involved in the system and many goals to reach. In this case the word entities refers to all the parts that are included or will be affected by the project. We consider, as such entities and goals: the stakeholders, their interests, the general necessity of delivering goods, the willing to reduce emission, the traffic/congestion issue, the energy saving subject, the noise level reduction, the preservation of historical and natural areas.
The question is if all these issues can be approached and treated all together with a unique measure and, if so, which measure this is.
Since the situation has many aspects the suggested answer is, indeed, to work through a multiple approach in order to face the problem from different sides.
A multiple approach can, as an example, include measures like:

– creation of a Logistic Centre; this would help reducing the traffic in the area thus reducing emissions, noise level and risk of accidents
– use of clean vehicles; this would reduce the emissions of CO_{2e} and guarantee a better quality of air as well as produce a saving of energy

- create a good coordinating system; including on-time information exchange and SMS communication
- night-time deliveries; this measure will reduce daytime traffic congestion but it must be well organised in order not to create unbearable noise level during the night.

We have already analysed the pros and cons of the introduction of a Logistic System through the Gamla Stan experience example.
The topic of clean vehicle is extremely actual and it is worth seeing how this can be linked to our project. By the definition of clean vehicles, here we consider: electric vehicles, hybrid electric vehicles vehicle running on biodiesel, biogas and ethanol. All these types of clean vehicles were tested within the Trendsetter project. Within this project, the city of Stockholm has introduced 320 new clean vehicles in the city fleet and over 3000 in the private companies fleet (Trendsetter, 2006). The relevant data is that clean engines can be applied to heavy vehicles too, without affecting their performances: nine waste freighters and five trucks have been successfully taken into operation in Stockholm. For the effectiveness of the introduction of clean vehicles, side measures had to be taken in order to ease their adoption. For the city of Stockholm, exclusion from congestion charges, reduced parking fees and subsides for extra vehicle costs have been used as tools to promote the interest in clean vehicles (Trendsetter, 2006).
The evaluation of the adoptions by the city of Stockholm of clean vehicles in its fleet has showed positive results: the total energy consumption was reduced by 20%, the CO2, NOX, HC and CO emissions were reduced and the drivers were very satisfied of their experiences of driving clean vehicles (Trendsetter, 2006).
Bio gas fulled vehicles have been introduced in Stockholm for the collection of waste and the results were as successful as the one presented before: the drivers were extremely satisfied of the experience and happy of not having to bare any longer the nuisance from the exhaust diesel fumes. However, a lack in the biogas refuelling infrastructure has been an obstacle to further development of the project (Trendsetter, 2006).
In order to improve the knowledge and reduce uncertainty about the world of clean vehicles, the miljiofordon.se web site has been created: the initiative received an interesting feedback from the users, and the cities involved in the project (Stockholm, Malmö and Gothenburg) planned to keep it as a permanent service (Trendsetter, 2006).

The examples provided by the projects carried within the frame of Trendsetter offer a valid experience to be followed. The demonstration that clean technology can be applied not only to personal cars but also to heavy vehicles without affecting their performances, is an interesting data that can be applied to the Stockholm Royal Seaport project too.
The application of these premises to the specific SRS project will be illustrated later on in the report.
The strategy of applying clean powered engines to heavy vehicle is one of the many ways of approaching the transportation management problem. Another approach would be, instead of changing the type of power that runs a vehicle, reducing the total number of vehicles used for transportation. This goal can be reached by integrating different functions within the same vehicle: that is the aim that guided the HOST project presented her below.

The HOST example

A good example of multiple approach to the problem and integrated solution comes from the HOST (Human Oriented Sustainable Transport means) project experience.
Starting from the analysis of the current situation of transport means in cities and of the impact this activity has on the environment, the project aims at developing an innovative sustainable vehicle concept suitable for both passengers and goods (Frostell, Villatico, Alexanderson, Hultén, 2005).
The idea the project is based on is to create a unique Low Polluting Vehicle (LPV) that could solve many problems and complete different tasks by itself. The goal has been achieved by making the structure of the vehicle modular: different cabins suitable for different purposes are installed on the same chassis. This solution has the advantage to reduce the number of vehicles circulating on roads while reducing the costs of the LPV. The main four tasks HOST is conceived for are: nocturne collective taxi; daytime car sharing services; daytime freight collection and distribution; nocturne garbage collection thus being more suitable for the so called “municipal services” (Frostell, Villatico, Alexanderson, Hultén, 2005).
Moreover, concerning the clean power, HOST is equipped with an energy system based on a modular structure so that different modules, such as internal combustion engine (ICE) or fuel cells (FC), are inter-exchangeable. The vehicle has four wheel drive capability and, with the help of four electric motors, ensures stability, safety and good maneuvering capability in narrow streets (Frostell, Villatico, Alexanderson, Hultén, 2005).
The idea proves to be extremely interesting and appealing if we consider the effect of such a project: cost reduction due to the creation of a unique chassis instead of many different ones; reduction of occupied space due to the 24h period of use of the vehicle; reduction of waste material; increased life of vehicles due to the possibility of changing the constituent parts; traffic congestion reduction since only one vehicle is used for several services (Frostell, Villatico, Alexanderson, Hultén, 2005).
The two main features of the HOST project are the modularity of its components and reuse of a unique vehicle for different tasks.

The solution hypothesized by the HOST project would provide a good solution to the problem of better organising the transportation system of goods and people and of reducing emissions.
However, even thought it seems to be the best and easiest solution, it has to face some problems, as highlighted in the HOST User Needs Analysis (Frostell, Villatico, Alexanderson, Hultén, 2005). For example, even if HOST will solve many of the main issues concerning freight and human transport, it is however not actually seen as an applicable concept nowadays as it is for the future. Moreover it is absolutely necessary to create a functioning market for the vehicle including special road regulations, such as dedicated lanes and tax alleviations). On top of that, many interviewees emphasized the necessity of a strong society interaction, in order to make the project work.
In the end, the HOST project was never realized due to the difficulty of designing such a complex vehicle: the results from the engineering concept design revealed that the weight of the vehicle would have been too high, thus creating problems of handling.

The most interesting aspect of the project is the modular concept that forms its basis: this idea will solve the problem of transporting extremely different kinds of goods (such as food and waste) with the same transport mean, thus solving the problems highlighted in the previous analysis of the Gamla Stan case. Unfortunately, even though the HOST case has proved to be a valid example and starting point for new developments, there is no such a vehicle on the market at the moment.
However, what could be done in the absence of a modular vehicle, is to gather together the distribution of goods that require similar conditions of distribution.

Types of goods considered

The types of goods considered in our project vary from food to the on-line bought products.
The spectrum of the considered goods is very wide but they can be roughly divided into 3 categories according to the influence they have on the mean of transport:

- perishable goods that need daily delivery or a dedicated storage place
- fragile / heavy goods that requires particular attention when managed
- goods that do not need any specific kind of storage place or handling precaution

The first category refers mainly to food but also to flowers and maybe also to particular types of medicines. All of these items need to be stored in particular areas, mainly fridges.
This involves that, in case of the construction of a Logistic Centre, the building and the transport mean have to be equipped with the proper gear.
The food transportation issue is particularly complicated and poses different conditions and boundaries to the possibility of integrating transportation with other goods.
The second category refers to those goods that require attention when handled, such as glasses, vases, mirrors etc. and to those goods who are too heavy to be moved manually. These premises imply that these goods can not be transported with other ones that can damage them or, in the case of the heavy ones, that the transportation mean has to be equipped to handle them.
The third category includes any other good that does not require any particular attention when handled neither poses restrictions of any sort and can be joined with other goods during transportation.

The classification here presented will be useful later on in the project when defining a possible solution to the transport organization issue.
Before drawing the conclusions of the project, it is interesting to have a look and maybe get inspired by some visionary and unusual suggestions.

Visionary suggestions

The solutions presented before are the most common ways of dealing with the problems, but there are some less known but extremely interesting suggestions coming from everyday people, such as the ones hosted in the DHL website page dedicated to the City Logistic Open Innovation Contest.
The aim of the contest is to identify and address cities' logistics needs through today's technological trends, and simultaneously (and by the same means) to develop solutions that will address tomorrow's challenges (www.citylogistics-ideacontest.com, 2011) and it is open to everyone. The contest is divided into three different categories: Improving City's Efficiency through Logistics Green City; Redefining Urban Environment; Digital logistics & IT Clouds.
There is a huge quantity of different ideas proposed in the contest ad it is not possible to mention all of them in this report.
However we identified five common trends that will be presented below.

- **Bicycles:** the possibility of using bicycles has been suggested by many participants as an alternative solution to trucks for the delivery of post and small packages. This way of transportation will reduce the emissions, the traffic congestion and the level of noise produced. In addition to that, the image of the district will look safer and cleaner.

It is, however, a solution that can not be easily applied to every city as in many of the biggest metropolis the bike circulation is extremely dangerous. To solve this problem, proper biking lanes should be introduced. Another con to this solution is that transportation by bike is not as quick as the one by trucks: some participants propose to give the customer the possibility to choose whether he wants his good to be delivered by truck or by bike and to offer him a sort of gift if he chooses the second one. The possibility for the customers to choose the way they want their goods to be delivered (that mainly depends on the urgency they need them) can help organising the delivery of packages into two different channels (trucks and bikes) and optimise both.

- **Computerized logistic system:** the importance of the necessity of having a well organized logistic system that co-ordinates all the different services related to it arouses from different proposal made by the participants of the contest. This measure will be

beneficial to the project (any project) by allowing the optimisation of the number, capacity, nature and location of facilities; the number, type and positioning of vehicles used to provide city logistic services; the allocation of specific demand points to facilities and vehicles within city logistic network (www.citylogistics-ideacontest.com, 2011).

- **Instantaneous communication:** many proposals regard the importance of using all the communication media available today to exchange information in real time. These include, of course, communication via SMS: this type of real time exchange of information can help co-ordinating all the different parts involved in the logistic system and can enable them to deal with unexpected problems, such as a sudden traffic jam or similar situation.

- **Interception of deliveries:** some of the most interesting ideas proposed consider the opportunity for the customer to intercept the delivery of his own good. This means that the user is notified with the exact position of his package, for example the position of the truck it is in, and can reach it if it is nearby instead of going home and waiting for the truck to arrive. The system enables also the customer to deliver a package he wants to send directly to a truck of the delivery company that is, at that time, near his office or house thus being closer to the user than the delivery company office. The notification system is thought to work via mobile phone and includes also a system for the payment of the delivery. The proposal is extremely interesting because it offers the opportunity for both the parts involved to save time, energy and resources. It requires, however very well designed communication and logistic systems since there is the possibility that the last-minute requests by customer to pick up the goods directly from trucks slow down the time schedule for the truck for door to door deliveries.

- **Robotic conveyor system:** a couple of proposals concern the possibility of installing in the city a robotic conveyor system that will be exclusively dedicated to the transportation of goods contained in small packages. This system will require the construction of a underground or elevated structure, similar to the ones imagined by the creator of the cartoon Futurama, Matt Groening. For its characteristics this suggestion is probably the most visionary one, but maybe this future is not too far behind. Effective improvements of the application of this system will be the drastic reduction of traffic due to transportation trucks, the decreasing in the level of emissions and noise level.

Considering the frame of the situation and the various kinds of case studies and suggestion presented, it is at this stage possible to filter the useful information that can be applied to the specific case of Stockholm Royal Seaport and develop a suitable proposal.

Criteria

Before defining the characteristics of the proposal, it is necessary to state the criteria chosen for the development of the project.
The main criterion is to find a solution to reduce the traffic in the area due to the transportation and delivery of goods executed mainly by trucks. The positive side effects of the reduction of traffic on tire will be: an improvement in the circulation of cars, especially during rush hours; higher level of safety in the neighbourhood; a reduction of noise smog and an improvement in the quality of the air, due to the reduction of emissions. As derived from the analysis of the case studies, the establishment of a Logistic Centre seems to be the most suitable solution for the specific situation of the Royal Seaport and it is, indeed, the solution chosen by the City.
This Logistic Centre must be equipped for serving different purposes at different times or at the same time. These include: the handling and management of transportation of building material, that is the initial reason of its establishment; and the possibility of adding the management of other types of goods.
The second criterion is the centred location of the Logistic Centre. In consideration of the geographical disposition of the Royal Seaport district that is developed in length rather than being compact, the central position of the LC is an essential requirement.
The position of the LC must be carefully decided and the proximity of road connections is an important factor for the decision of the positioning. Being efficiently connected with the main infrastructures can result in a better communication between the district, the city and the other areas where trucks come from.
Another criterion chosen is the importance of avoiding the interference with the green areas. The proposal will be much more valid if it uses the already existing ways of communication and respects the actual planning of the area instead of requiring the construction of supplementary infrastructures.
The solution proposed must take into account the directives of the development plan for Stockholm that aims at improving the biking and walking traffic. It would be therefore a great added value to include these ways of transportation in the project.
The last requirement for this project is the flexible nature of the proposed solution in order to ensure its transformation over times to adapt to changed and ever changing situations.

Proposal

As mentioned before when presenting the current situation, the city section in charged of following the development of the Royal Stockholm Seaport is looking for a location where to establish a Logistic Centre for the coordination of the management of transportation of building materials.
Once the construction works will be completed, the Logistic Centre will be dismantled.
Since the construction of the area will move from the northern to the southern part and then go back to the central one, the Logistic Centre must be located in a position that can prove to be suitable, in the first place, for the management of the transportation of building materials through the area that will undergo different phases of development interesting different parts of the construction site and, in the second place, for the management of the transportation of goods in the whole district.
Considering the provenance of goods mainly from the City area and from the northern traffic arteries and observing that these two ways converge where Lindigövägen meets Valhallavägen, it would be useful to locate the Logistic Centre close to Lindigövägen, in the area of Värtaverket. Moreover, this area will be bordered by the E4 European Highway that will be completed in 2015 and will connect the Stockholm Royal Seaport area with the Essingeleden highway (Stockholms Stad, 2012). The completion of Norra länken, the E20 European motorway, will connect SRS area with the northern part of the city, thus improving the communication with Kista Science City, Arlanda airport and Karolinska-Norra Station. Connection with the southern areas will be improved by a possible future eastern section of the Stockholm ring road. Moreover, the SRS district will be more efficiently connected with the islands of Lindigö and Djurgården by boat buses (Stockholms Stad, 2012).
This location will be therefore extremely convenient for it will ensure a good communication with the main transportation arteries and will avoid extra circulation of trucks around the area. Because

the construction works will last for many years through different phases and in different locations, a central position of the LC will be useful for all the steps of the building development.
The LC will be equipped with a certain number of trucks that will depart and come back to it in order to deliver goods around the district.
The location of the LC has been chosen assuming that the area of Värtaverket is accessible it is available for the positioning of a structure of this sort. Here, by 2020 the construction of the Combined Heat and Power (CHP) plant by Fortum will be completed (Stockholms Stad, 2012).
The combination of many different types of building (CHP plant, waste collection plant, LC) with different functions in the same area is an interesting solution to concentrate here the traffic going in and out of the area and will encourage cooperation between the entities involved in order to optimize the management of the transportation.

Regarding the waste management, the City is still looking for a suitable location to establish the building where all the waste from the different pipes of the underground vacuum system will be collected. From this building, a number of trucks will depart to transport to different locations the waste.
It would be interesting to allocate this building in the same area as the LC, in order to concentrate here the traffic going in and out of the area.
Since for certain types of waste (such as exhausted oil or big pieces of furniture) there is not an organized collecting system, it is responsibility of the citizen to personally bring to the sorting station his waste. This system, far from being efficient and convenient, leads to the accumulation in our houses of old material that has the status of waste, for example old furniture or appliances.
If the site where all the waste from the underground vacuum system converge hosts the sorting station where these kind of special waste can be collected, it would improve the waste collecting service and the feasibility of its use by the citizens. If the sorting station is in the same neighbourhood as one's house, a person is more likely to be keen on separating special waste from the others and bringing them there. However, a further improvement is possible in this system. If we analyse the hypothesis of establishing a Logistic Centre from which only a restricted number of trucks depart for delivering the goods around the district, it is clear that these trucks, once completed the deliveries, will come back to the LC empty. The space that is, little by little, emptied after every delivery, can be occupied by the special waste mentioned before, according to the principle of giving away something useless when receiving something useful. The trucks, instead of coming back to the LC empty, could be used to transport the special waste from the citizens to the sorting station, that would be located in the same area.
This idea of assigning different functions to the same mean of transportation can be applied not only to the trucks transporting goods, but also to the ones in charged of the transportation of building materials: the trucks, on the way back to the Logistic centrer, could transport the waste coming from the construction site.

Since the waste management system will consist of an underground vacuum system, there will be no trucks transporting waste on the surface and there will be no need for them.
This consideration partially solves the problem presented before of including two different types of good transported in the same truck.
There will still be, however, trucks transporting waste out of the collection centre.
Analysing the categories of goods presented before that divided the goods considered in perishable, fragile/heavy and goods that do not need any particular place or handling precaution, it is possible to define the means of transportation that best suite their features.
The first two categories require the use of a truck for the transportation. The employment of an electrical vehicle for the purpose is a valid option: facilities for charging an electric vehicle will be, in fact, installed in the district.
The truck in charged of the transportation of perishable goods will be equipped with a fridge area where to store the food and the other types of goods that can be delivered with it.
Another truck will be used for the delivery of fragile/heavy goods and will be equipped with the necessary tools to take care of them. This could be the truck used for the collection of the special waste mentioned before. The use of clean powered heavy vehicles has proved to be efficient in previous experiences, as mentioned before, without reducing the level of performances of clean vehicles when compared to traditional ones.

The third category includes both goods contained in boxes and mail. For the first ones, it is possible to add them to the truck transporting the second type of goods, whereas for the delivery of the mail another mean of transportation can be used, such as the bicycle. Biking ways will be built around the district and will be connected to the city: the transportation by bike could therefore easily reach both the city and every corner of the Royal Seaport area.
Concerning the possibility of providing night time deliveries, this is certainly an option that can be considered in the aim of reducing congestion in the area. However, the district will be densely populated and nigh-time deliveries could cause more damages (because of the noise produced) than benefits: it is important to remember that the citizens' satisfaction and wellness is one the main requisite of the project.

The main points of the proposal are:

- the establishment of a Logistic Centre both for the management of the transportation of building materials and for the transportation of goods;
- the positioning of the waste sorting station in the same area as the LC;
- the interaction and cooperation between the LC, the waste sorting station and the CHP plant in order to coordinate the ingoing and outgoing traffic in the area;
- the use of clean vehicles for the transportation of goods and building materials;
- the adoption of two types of vehicles (one equipped with a fridge and one not) to best suit the requirements of the transportation of specific goods;
- the use, when possible, of bicycles for the transportation of mail and small packages;
- the introduction of the idea of a new concept of delivery meaning not only the consignment of something by the delivery company but including also the action of the citizen of giving away something that has become useless;
- the flexibility of this system in order for it to be adapt to future developments.

From the creation of a system of this sort, all the stakeholders involved will take advantage.
The new concept of the integration of many different functions in the same area and the cooperation that will be created between the different entities involved will be an interesting challenge but will also provide the city of Stockholm with an experience that can become a model for other cities to imitate. The cooperation between the managers of different companies involved in the project towards the improvement of the logistic of the transportation will be beneficial: for them in the first place, resulting in a reduction of expenses; for the citizens, due to the reduction of trucks driving around the district; and for the inhabitants and the city because of the consequent reduction of emissions, thus meeting the goals Stockholm has set for the future. The organization chosen to handle the transportation of goods from the LC to various locations around the district will benefit of its participation in this challenging and innovative projects, even though the initial investment costs will maybe be prohibitive. The shops that will receive the good delivered from the LC or that will use the LC transportation system to deliver goods to their customers will certainly benefit from the cooperation between them and the other shops in the area and from the possibility of using a local service instead of an external one: if the delivering company is, in fact, operating only in a restricting area, the risk of delays and problems with deliveries is reduced.
Essential conditions for the positive outcome of this project are the continuous and proficient dialogue between the different stakeholders involved, the level of information about the system provided to the citizens and the constant support by authorities, with the City Government in the first place.

Conclusions

The report presented is the result of a two months full immersion in the Stockholm Royal Seaport project. The time-frame was evidently too short to lead to the complete knowledge of the situation in order to present a detailed project proposal. However, the purpose of this research was to gather as much information as possible about the current situation without, however, getting lost in this process. One of the prerequisites we decided to set for this project was to deliberately remain at a certain level of “superficiality” to leave the decisional process as free as possible from the conventional way of operating and to be able to provide unusual suggestions accepting the risk for them to be considered visionary and inapplicable.

From the analysis of previous case studies, of the frame of the situation and the stakeholders involved, from the interview with a person from the City Council and from the reviews of different technologies available at the moment and methodologies nowadays applied, a project proposal was formulated. This suggestion was made as a consequence of different assumptions, such as the availability of the area where the LC could be placed. In the case these assumptions prove to be unreal, we consider the report still a valid help of future developments of cases like the one of Stockholm Royal Seaport.

This report, in the end, claimed to provide a humble suggestion for what could be done in the Stockholm Royal Seaport concerning the logistic of the transportation and found its place in the climate of indecision that seems to envelop the current situation regarding this topic.

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