

Survey of Smart City Trends in the West: Transit-oriented Development and Mobility-as-a-Service

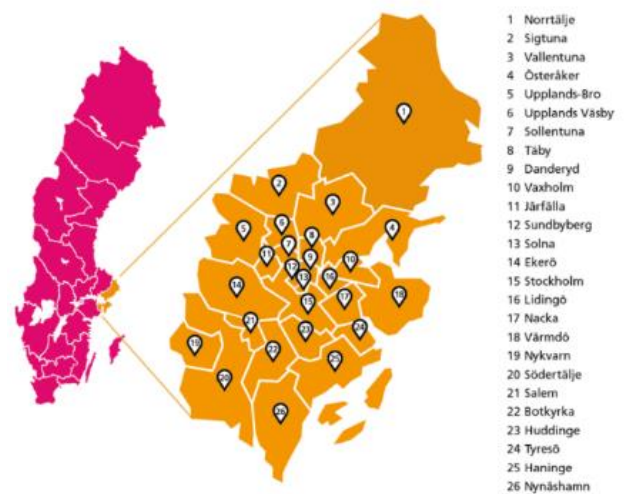
Part 2: Case Study 1- Stockholm, Sweden

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1. Overview of TOD and its Relationship with MaaS

In Sweden, most city land is owned by local governments, so it can be said that when it comes to urban planning and transportation infrastructure, local government plays a leading role. In legal terms, urban development has essentially been under the jurisdiction of local governments since 1987, and the involvement of the national government has been only in an advisory role and not legally binding. For this reason, development plans for wide areas such as counties and regions are rarely formed and implemented.

On the other hand, the metropolitan area of Stockholm is an exception. There, a plan for the entire metropolitan area was drafted primarily by the Region Stockholm Assembly and is being implemented. For context, the Stockholm metropolitan area is made up of 26 municipalities, each of which has its own assembly and exercises strong autonomy, despite belonging to the Region Assembly. Because of this, large-scale projects that have a wide impact on local residents—such as plans to expand the subway network—need coordination and cooperation between municipalities through the Region Assembly.



Source: Region Stockholm website¹

[Fig. 1] Municipalities belonging to the Region Stockholm Assembly

In addition, all the major public transportation systems (subway, commuter rail, bus, tram, LRT) are together run by the Stockholm Region Public Transport Administration (hereinafter referred to as SL (Storstockholms Lokaltrafik)) under the umbrella of the Region Assembly. Taking advantage of this situation, SL has already introduced a special payment system, an IC card called "SL Access card" which will work for the different modes of transportation which are all in the same network across the sprawling metropolitan area.² The technological transition from cash and magnetic-read tickets to contactless payments using IC cards has been completed, and for the first time, the technology has been applied so comprehensively that even visitors needing single-use tickets are using it.³ For single-use tickets, there is also a purchase option with a

smartphone app, and users can enter by showing the screen display to the driver or station staff, or in some cases, simply by holding the screen up to the smartphone readers equipped at the subway/railway stations and some buses.⁴ In addition to credit cards, if you are a Swedish resident, you can choose to pay automatically from your bank account.

In this way, Stockholm has a foundation in which urban functionality has been centered on public transportation even before terms such as TOD and MaaS emerged. Furthermore, in recent years, the Region Assembly has gained international recognition for its achievement of forming a city while staying consistent with its vision of an environmentally-friendly and sustainable city centered on the use of public transportation operated by SL. In particular, by connecting cities with public transportation and other mobility services, the regulations mandating the number of parking spots in housing developments will be mitigated, motivating developers and encouraging active development.⁵ It can be said that the method of "flexible and green parking permits" was innovative.⁶ In addition, when the city starts developing land owned by the city, there is a joint governance system in which the city entrusts the operation to the private sector by inviting the participation of many private developers and allowing them to freely come up with ideas and implement them. This also applies to the operation of public transportation: SL outsources the operation of almost all transportation to other companies, and there aren't any transportation modes it operates on its own.

However, with regard to MaaS, SL—which has advanced initiatives like integrated payment systems—at the end of the day is a public institution under the Region Assembly, and there is no indication that it will involve other service providers to form and lead MaaS. (The idea is to have the emerging services introduced and operated by startup companies connect to their own transportation systems, which will lead to an increase in the number of passengers and fare revenue). Instead, international and start-up companies from all over the world, attracted by the relatively flexible regulatory system and the great adaptability of emerging technologies, are competing to

take the lead as a mobility platform. Examples include the car-sharing service "Volvo Mobility," operated by the German automobile company Volvo, and "Aimo," introduced by the Sumitomo Corporation of Japan.

Currently, in the Stockholm metropolitan area, the subscription-type MaaS service UbiGo, which was developed with the support of the national government and the EU, is being used as a MaaS. The city of Stockholm, the public transportation network SL, as well as private car rental, carpooling, car sharing and bike sharing operators are all taking part in this. Especially for SL, there is an intention to increase the number of users by participating in UbiGo, and the results are beginning to appear: one-third of UbiGo users answered that they started using public transportation more than they did before.⁷

The results of UbiGo (which started being used in 2019) from the initial pilot project to its introduction show that, at least in the Stockholm metropolitan area, the existing TOD is evolving as a transportation hub by incorporating emerging technologies and services developed and introduced for the realization of MaaS and compensating for its own shortcomings. For example, since the phase of the pilot project, when service was provided by UbiGo, the above-mentioned measures to ease the regulation on the number of parking spots (flexible and green parking permits) were applied, and the regulation on land use and city planning was also applied, reflecting the existence of MaaS.

2. History and Background of TOD at the National and Local Level

Over the past 50 years, Stockholm has strategically promoted urban planning in the Greater Stockholm region and developed a radial rail and transportation system that extends from the city center to the suburbs, reducing the number of commuters and residents dependent on cars. In the past, satellite cities called "Strings of Pearls" have been developed along the axes of these transportation networks. The recent re-evaluation of TOD in Sweden is linked to the idea of environmental city development, which is partly due to the promotion of development called Green TOD.⁸

Stockholm was also awarded the first European Green Capital Award for by the European Commission in 2010. Prior to this award, the 2005 plan for reducing emissions aimed to reduce per capita gas emissions from the European average of 10 tons, to 3 tons by 2015. They sought to do this by taking various measures for urban environments, starting with traffic, and other measures such as waste disposal and eco-friendly construction. In particular, the city is making efforts to improve the convenience and attractiveness of public transportation, and the utilization rate of public transportation in Stockholm is nearly double that of it in Berlin and London. In addition, its carbon emissions are the lowest when compared to other cities where railways are well developed, such as New York and Tokyo.

Satellite cities such as Vällingby⁹ and Kista¹⁰ were developed as suburban grasslands from the 1950s to 1980s and were the first-generation TODs in Stockholm. However, in recent years, TOD has been done in abandoned industrial areas (brownfields) near the city center, and Hammarby Sjöstad (hereinafter referred to as Hammarby), which will be introduced in the following sections, is among them. Hammarby, which began construction in 1994 and gradually opened in 2004, has attracted worldwide attention as a sustainable development project. New development projects are still underway, reflecting the success and lessons learned from the project.

3. Example of Exemplary TOD: Hammarby Sjöstad

This section will feature the Hammarby Sjöstad district, located in the southeastern part of Sweden's capital, Stockholm, as a good example of attracting MaaS. The district has adopted TOD with an emphasis on Green Urbanism and is regarded as a successful example of an environmental city. It has a thorough urban circulatory environment system with water purification, waste treatment, and eco-power generation in the district. It has also received attention as an example of significantly reducing both car usage and carbon dioxide emissions.

In addition, the Hammarby Sjöstad area was selected as the first place to introduce UbiGo ahead of any other area

in the city, and the eyes of those responsible for the introduction and operation of MaaS are focused on public transportation. It can be said that this is an example of an attractive TOD with both a residential and commercial concentration.

Green Urbanism, which aims at creating a sustainable society in harmony with nature, has been gaining popularity mainly in Europe and North America in recent years as a concept for creating a compact city that incorporates countermeasures to climate change.¹¹ The movement leading to Green Urbanism, which incorporates the coexistence of the elements of nature and reducing waste and greenhouse gases into urban development, has been supported since the 1990s concept of a sustainable society, with terms like "Ecological City" and "Green City." In recent years, Green Urbanism, which has been favored in Europe, has been a comprehensive city planning concept that is focusing more on climate change countermeasures, as well as landscapes and sidewalks that incorporate nature for the overall health of humans (well-being). Many of the communities that have been promoting Green Urbanism in recent years have set the goal of becoming carbon neutral.

In addition to this, Green TOD regards transportation as a more effective means of dealing with energy and environmental problems, and integrates the above-mentioned Green Urbanism and the concept of TOD, thus making a stronger TOD for environmental concerns.¹² The efforts of Green TOD include: increasing the development density to promote the use of transportation, saving the cost of heating and cooling, promoting transportation other than gasoline vehicles, and converting mixed land and parking lots with poor drainage into community gardens. Examples of Green TODs have been found in urban renewal projects in Sweden, Germany and Australia, and the implementation of Green TODs can reduce carbon dioxide emissions by 35% compared to conventional development.

[Fig. 2] Green Urbanism and Green TOD

3.1. Project Background

Hammarby, (Lake Town), is located about 3 kilometers southeast of central Stockholm and was the site of an industrial and military barracks. In the early 1990s, when the city of Stockholm was planning to host the 2004 Summer Olympics, the theme was "environment", so it was decided to set up an Olympic Village with environmentally friendly housing in Hammarby. Ultimately, the city was not selected as the venue for the Olympics, but the city decided to go ahead with Hammarby's development site of 200hectare (of which 50ha is an aquatic environment such as lakes and marshes) as an eco-new town.¹³

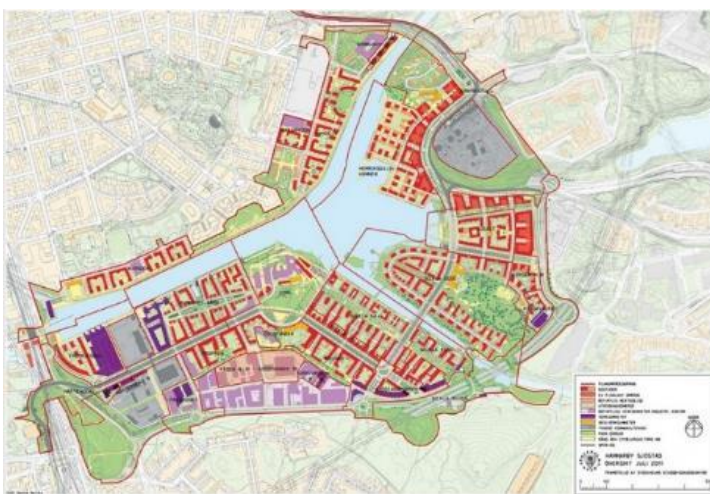
Hammarby is the largest urban redevelopment project in Stockholm, with 12,000 homes in 12 development areas, and about 20,000 inhabitants—35,000 if you include commuters. The construction started in 1994 and was divided into two parts. Starting in 2014, it opened in stages, and the main construction of the second phase was completed by 2016.¹⁴

include the improvement of the environment of the development site—which was an abandoned industrial area (brownfield), the promotion of public transportation, the promotion of recycling, the reduction of waste, and the reduction of water and energy consumption.

Hammarby's development goals strongly reflect the UN's "Agenda 21 Human Settlement Objective 7.5" philosophy adopted at the 1992 United Nations Global Summit. This is because the city of Stockholm obtained part of Hammarby's development funding from the Local Investment Program (LIP), which is a subsidy from the national government for local governments to promote sustainable environmental city development. As Sweden has adopted the United Nations' Sustainable Development Goals (and the Sustainable Development Goals adopted by the EU in response) at the national level, an obligatory condition for receiving LIP grants is that there be an element of "sustainability/environmental city" reflected in development.

The Swedish government has set strategic goals in the following areas related to the environment, society, economy, welfare, etc. in order to realize "sustainability" through the development of residential communities.

- Future
- Limitations on climate change
- Population and public health
- Social cohesion
- Welfare and security
- Employment
- Economic growth and competitiveness
- Community development



Source: Stockholm City Planning Administration

(Red is residential/commercial multipurpose architecture. Light blue is lake and other aquatic environment)

[Fig. 3] Development Map of Hammarby Sjöstad

3.2. Hammarby's Environmental Development Goals

The overall goal for Hammarby development was to make it an excellent urban area by cutting energy consumption in half, and reducing the environmental impact compared to conventional urban development. Other pillars of the development vision

In order to achieve these goals, Hammarby has adopted New Urbanism (promotion of community awareness, human scale, etc.), TOD (high-density development, promotion of public transportation, etc.) and Smart Growth (sprawl suppression, nature protection), to apply the urban development theory on which the development plan is based.

Large-scale developments need to meet different types of goals, including practical ones such as durability, energy

efficiency, and space efficiency, economic ones, or aesthetic ones such as building design. Moreover, if the environment is taken into consideration during development, the number of goals will increase, and there can be competing factors between those goals. Therefore, in order to prioritize the environmental goals in development, the Hammarby project team proceeded by using various tools such as policy guidance with detailed planning and procurement programs to plan, design and construct their development.

For example, as a tool to support the achievement of the overall goal of halving the environmental load of conventional development, Environmental Load Profiles (ELPs) have been developed according to spheres of people's activities. These include in homes (e.g. washing, cooking, etc.), in buildings (e.g. building materials, heating /cooling, commercial electricity consumption), in unconstructed real estate areas (e.g. materials, work machinery) and in common areas (e.g. traffic, distribution, mobility). By incorporating these environmental indicators to build a computer model and comparing the environmental load of Hammarby with a similarly scaled conventional development as a reference, the approximate environmental values for the development plan—such as CO2 emissions and water usage that can be treated by sewage facilities—were obtained.

The next report in this series will introduce specific details such as transportation planning, promotion system, and financing for this project.

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