The Smart Sustainable Districts framework to improve mobility in cities: opportunities, tools and barriers

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1. Introduction

The Smart Sustainable Districts (SSD) project, promoted by the Politecnico di Milano and coordinated by Consorzio Poliedra starts from a reflection on the urgency of identifying effective actions for sustainable development, ecological transition, and the resilience of territorial and social systems at the local level.

Local administrations find themselves managing services and public spaces that is scarcely flexible, often outdated, with limited skills and resources at their disposal, and tools for collaborating with local players that are not fully operational.

In developing the SSD project, the Politecnico of Milano enhances and integrates its technical-scientific multidisciplinary competences, which allow it to address in a cross-sectoral way the theme and its declination in terms of technological, environmental, social, economic innovation and its experiences of planning and design in urban contexts, which suggest objectives of countering the dynamics of land and resource consumption (through the regeneration of disused or underutilised urban fabric) and of rebalancing inequalities and situations that lead to social and economic pressures. The outcome of this effort is reported in the "Smart Sustainable District White Paper", which describes principles, solutions, and tools for the concrete implementation of the SSD model in the urban context. Therefore, it aims to present a methodological and operational support toolbox to address the various phases of planning, design, implementation, monitoring, evaluation, and management of urban transformations in the SSD perspective, in support of public and private operators but also of the many other actors involved in these processes.

2. Smart Sustainable District (SSD) model

As stated in the previous paragraph, the term SSD model in what follows refers to a set of guidelines, proposals for actions and tools to address urban transformation at the local level in a smart and sustainable way.
The model is designed to be applied to a portion of the city corresponding to a district, a neighbourhood, a set of streets. It refers to an area with a variable geometry but with a dimension such that proximity relations and connections are established (or can be established) in both spatial and social terms based on proximity but also on shared values. However, before proceeding to the description of the structuring of the model, let us examine what the terms "smart", "sustainable" and "district" specifically mean.

Smart
The term "smart" indicates intelligence in the use of innovation to improve the district's overall performance and efficiency with respect to the various aspects of sustainability. It refers to the approach used in the development of the model: integrated, flexible, interdisciplinary, multi-scalar. In this way, smartness finds in the district the ideal laboratory for experimenting with innovative practices.

Sustainable
The district is connoted as "sustainable" with reference to all the social, environmental and economic aspects that contribute to the achievement and maintenance of conditions of quality of life of the community. Moreover, it refers also to a good environmental status referring to the mitigation/adaptation to climate change and to the conservation of natural capital, while creating equity and equal opportunities for its inhabitants.

District
The choice of the term and scale "district" is determined by the fact that it coincides with a dimension that can be governed by public decision-makers while maintaining a certain complexity with respect to overlapping thematic and relational aspects.

Moreover, the SSD project defines 11 "pillars", thematic areas with reference to which it proposes to connote urban districts from a smart and sustainable point of view and to define possible lines of work. They are:
A. Active and collaborative citizenship
B. Social inclusion and integration
C. Resilient service system
D. Quality public and private spaces
E. Environmental and landscape quality
F. Mobility
G. Energy
H. Financing models

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I. Business models
J. Local economies
K. Data management and utilisation.

For each pillar, "topics" are identified which detail the objectives, guidelines for new project actions, possible solutions and good practices. The contents of the topics are derived from skills and experiences gained within the "Politecnico System" and emerged during the shared path that led to the White Paper.
In the end, an in-depth analysis of the mobility pillar (network integration, last mile logistics, mobility management actions, innovative systems and sharing mobility) is described in the following paragraphs.

3. Network Integration (infrastructure and services)

The objective of this strategy is the integration between different mobility services both at urban and metropolitan scale. In particular, the network integration wants to enhance the intermodality of the district mobility system. The aim is the connection between the modes of transport for internal SSD travels (e.g., bicycles, scooters) and those for supra-local scale travel (metro, rail, bus, car). In this way, favouring active mobility in accessing the modal interchanges of the SSD a modal diversion towards public transport could be achieved. Indeed, this modal shift might reduce car ownership, with the consequent reduction of land consumption for parking, through the introduction of policies limiting car use for local travel (within the SSD) to electric vehicles and in shared mode.

In order to implement integration between local and supra-local mobility service networks, solutions that could be put in place concern the planning of services and the design of interchanges. In particular, it might be useful an integrated scheduling between public services (in terms of timetables and fares), even if this is not the case in some urban areas (where, for example, bus, metro and rail do not have the same ticket). The element of innovation for a SSD could be the integration of public services with bike-sharing, car-sharing and other collective transport services through integrated fares and subscriptions.
As far as the design of interchanges is concerned, this should increasingly take into account criteria oriented towards intermodality and favouring pedestrians and other forms of active mobility (bicycle lanes) around stations (e.g. dedicated spaces for shared modes of transport or integrated design of interchange nodes).

To do this, competences for service design and operation control (in the planning and operational management phases) are needed. The actors to be involved are managers of public transport services, managers of sharing mobility services, municipal mobility offices and mobility agencies offices.

In conclusion, in the next few lines some best practices are briefly described.

1) RFI - Stations Plan

RFI's (Rete Ferroviaria Italiana) station revamping projects has as objective the intermodality of the railway stations (e.g. integration between railway infrastructure and other modes of urban transport). Moreover, the revamping aims too the regeneration of spaces around stations to encourage pedestrians and the establishment of new activities and public services. Some examples: Milan Rogoredo junctions, Bergamo (https://www.rfi.it/it/stazioni/pagine-stazioni/stazioni-per-il-futuro-delle-citta/Un-nuovo-concept-per-le-nostre-stazioni.html).

2) EX-TRA - EXperimenting with city streets to TRAnsform urban mobility

EX-TRA is project that involved Politecnico di Milano with a focus on pedestrian accessibility and accessibility for weak users (i.e. elderly and disabled). The analysis at the territorial scale was conduct on the Nuclei di Identità Locale (NILs), which could be comparable to SSD (https://www.ex-tra-project.eu/).

3) Bay Area Rapid Transit (BART)

The San Francisco Bay Area Regional Transit (BART) has successfully applied the Transit Oriented Development model by building infrastructure to promote rail-road intermodality and developing new residential developments and neighbourhood services in station catchment areas. In some cases, these services have been tailored to the populations and ethnic groups living there in order to avoid gentrification. See for example the case of Fruitvale station (https://www.bart.gov/).

4. Last mile logistics

In the last decade, the growth of online shopping is increasing and changing the flow of goods through cities.

New distribution problems are being generated (small parcels to be delivered to dispersed destinations, demands for ultra-rapid deliveries...), which, if addressed with traditional solutions, can lead to inefficiency, increased traffic and emissions, and a deterioration in the liveability of cities.

Nowadays, there is an urgent need to develop and implement innovative urban logistics solutions that are able to tackle the changes taking place and manage these new flows of goods. The objective is to pursue and achieve sustainability, understood in its triple meaning: economic (reducing costs), environmental (reducing emissions and traffic) and social (reducing social inequalities).

Regarding purely transport solutions, logistics, and in particular last-mile logistics, could greatly benefit from all-electric means of transport. In particular, the benefit in terms of reducing pollutants, especially in urban areas, is considerable, in contrast to

conventional vehicles which, left running even during delivery operations, have efficiency/emission levels no longer in line with the objectives of the green deal. However, the availability of recharging points, in large cities no longer raises concerns about the use of such vehicles. In addition, the use of autonomous vehicles for the logistics of goods could make possible to carry out distribution while minimising the impact on human traffic.

Another possibility for future developments is the increasingly widespread use of drones. Indeed, drones represent a new trend in terms of last-mile delivery solutions, strongly driven by experiments by e-commerce giants. Important technical (limits in terms of load capacity, travel distances, charging times) and legal (air traffic management in urban areas, insurance) problems remain to be solved. Potentially, however, this solution makes it possible to minimise delivery times and distances (by bypassing houses, it is possible to move from any point to any other point following a straight line) and thus consumption. Finally, yet importantly, an important solution could be the use of cargo-bikes for last-mile deliveries. The effect is also positive for the community, as they help to relieve congestion during rush hours by taking a significant number of vehicles off the road. The main limitation of this solution, however, is its capacity limits, which do not make this type of vehicle suitable for transporting all kinds of goods.

However, in addition to transport solutions, there are those concerning the network design solution. One of the most common is the parcel locker. Parcel lockers are 'lockers' that allow the decoupling of the delivery phase by the logistics operator from the reception phase by the customer. The latter can pick up the parcel independently using a QR code, which opens the correct compartment. Among the main advantages of this solution are the increase in delivery density and the significant decrease in missed deliveries. Parcel lockers are typically located in busy public places (e.g. stations or supermarkets) or on busy streets. Another solution is the introduction of micro-hubs (real small warehouses), located in central city areas. These allow for an additional level of sorting and storage compared to warehouses located just outside the main city centres: goods that arrive in the neighbourhood and are temporarily stored in these micro-hubs can then be delivered by cargo-bike, on foot or scooter, significantly reducing the distance between these storage points and the destination.

In conclusion, in the next few lines some best practices are briefly described.

1) A significant example of goods delivery using autonomous and electric vehicles was implemented within the Urban Mobility KIC to minimise the risk of infection during the COVID-19 pandemic. The system is based on small autonomous platforms and is dedicated to people who are fragile and therefore more at risk in case of contagion. By means of an app, the user can shop at the supermarket near his or her home and can schedule the delivery (EIT Urban Mobility, 2021).

2) Also in the grocery sector (i.e. supermarket grocery delivery), many initiatives based on parcel locker delivery are playing an increasingly important role. These lockers, if located in areas not covered by physical outlets, enable operators to reach new customers, potentially increasing their market share.

3) Milan City Council's pilot project 'Zero emission urban goods transportation' is oriented, which proposes an active role for rail transport to bring goods into the city. Goods arrive in city centres at night, thus not influencing rail traffic, which is minimal during those hours, and are then distributed by means of cargo-bikes and electric vehicles (https://www.comune.milano.it/-/transizione-ambientale.-c40-milano-vince-il-bando-per-la-logistica-urbana-a-zero-emissioni).

5. Mobility Management Actions

The Mobility Management is the set of initiatives that each organisation, both public and private, puts in place to manage the mobility of its workers, with particular attention to systematic home - work (study) - home travel. Starting from the analysis the systematic travel of employees/students, the objectives are the reduction of the use of polluting vehicles, the enhancement of the quality of systematic travel and the creation of facilities and infrastructures.

From an operational point of view, Mobility Managers, coordinating at the SSD level, must identify the criticalities in systematic travel that lead to excessive use of unsustainable means or poor-quality travel by employees/students. The primary objective is to identify solutions that can be shared between companies/universities/schools of different levels of the SSD to increase their effectiveness or to share the costs to be borne.

Specifically, mobility management actions as four main aims. The first one is discouraging individual private car use (company shuttle service, company cars by reservation, reduction of parking spaces etc.). The second objective is encouraging the use of public transport (request for the improvement of Local Public Transport lines operating near the company, agreements with LPT companies in order to provide discounted subscriptions). Another important solution is promoting cycling and/or micro-mobility (electric scooters, electric recharging stations for e-bikes and scooters, realisation of changing rooms with showers for employees, purchase of company bikes for use by reservation). The last, but not least, aim is reducing demand for mobility by drawing up a plan to encourage smart working or to encourage co-working in locations of proximity to employees' residences/domiciles.

In conclusion, in the next few lines some best practices are briefly described.

1) Politecnico di Milano's Home-Work (Home-University) Travel Plan. The proposed actions contribute to the achievement of the SDGs (Sustainable Development Goals) of the 2030 Agenda and are aimed at achieving greater sustainability in the

movements of the Politecnico di Milano's population. (https://www.campus-sostenibile.polimi.it/mobilita-sostenibile/piano-spostamento-casa-lavoro-pscl/).

2) Mobility4Mi project (AMAT - Municipality of Milan, Legambiente, ABCittà and Consorzio Poliedra). An example of good practice is the Pedibus, i.e. a bus made up of primary school pupils who, accompanied by parents or grandparents on a voluntary basis, walk to school in groups according to routes identified in advance by competent technicians and approved by the Local Police from a safety point of view. This sustainable mobility initiative, in addition to encouraging a reduction in the use of private vehicles by families, encourages children to move (active mobility), to socialise with other children and to behave in a more sustainable and environmentally friendly manner (https://www.amat-mi.it/it/progetti/mobility4mi/).

3) Merezzate+ The project, co-financed by the Smart Sustainable Districts programme of the Climate-KIC, among the good practices has seen the activation of several Pedibus lines, in two different Milanese institutes, adjacent to the REDO Milano district in which about thirty children were involved (https://www.poliedra.polimi.it/en/project/merezzate/).

6. Innovative systems and sharing mobility

The increasing pressure on passenger transport systems has reinforced the demand for new and innovative solutions, with the integration of different transport services into a service accessible on demand, according to the concept of Mobility as a Service (MaaS).
In order to make SSDs active in the development of the sustainable mobility strategy discussed above, work must be done to promote the provision of services that can achieve the modal shift needed to support decarbonisation goals. Specifically, the main objectives to be worked on are provide alternative mobility services to the private car, integrated mobility services and exploit the opportunities of new technologies to improve mobility services.

Specifically, SSD can be equipped to host community car-sharing, a service of sharing vehicles, preferably electric, which are placed at designated stations within the district. The station is the point of departure and arrival of each journey made with these vehicles, and is also the place where electric recharging takes place, where it is possible to find equipment for the cars (e.g. child seat, bicycle rack, ...), and where it is possible to find the necessary information for the correct use of the service.
Community car-sharing can include a fleet of different vehicles (e.g. cargo-bikes, minicars, family cars, vans) to meet multiple needs.
As an example, the 15-Minute City model proposes sustainable urban spatial planning based on the concept of proximity, to reduce car journeys within the city, favouring active mobility (cycling or walking). The objective is to enable people to move quickly

within neighbourhoods using bicycles, electric scooters, and scooters. In addition to building infrastructure for this objective (e.g. through the gradual introduction of cycle spaces in every street in the city), shared mobility and micro-mobility services can also be made competitive for short distances.

In the end, to do this, community involvement in the co-design of solutions can be decisive for the selection and sizing of the innovative mobility services.

In conclusion, in the next few lines some best practices are briefly described.

1) Community car sharing: experimentation with community car sharing within research projects, such as Sharing Cities (https://www.amat-mi.it/it/notizie/41/) or Green Move (http://gm.polimi.it/). In particular, the Sharing Cities project aims to create a smart neighbourhood with "almost" zero emissions within cities, to promote a sustainable lifestyle and respond to environmental challenges. This is the origin of the collaboration with E-Vai, which will offer an electric car sharing service for the exclusive use of several apartment blocks in the Porta Romana area, contributing to sustainable mobility and specialising the intervention at SSD level.

2) GaiaGo platform to be proposed in the redevelopment of some districts in Milan, including Crescenzago, which is the subject of a Reinventing Cities call for tenders (https://www.c40reinventingcities.org/en/professionals/winning-projects/crescenzago-1371.html). In addition to the platform to manage the use of community electric vehicles, a virtual place is if implements a mechanism to incentivise purchases from neighbourhood economic activities, integrated with the sharing mobility service.

3) Cicletteria di Parma offers storage, maintenance and rental services for bicycles and cargo bikes. The project is part of the wider Parma Bike Sharing - Mi muovo in Bici service (https://www.infomobility.pr.it/?page=default&id=4806), which regulates Parma's automatic bicycle rental system. The system offers traditional bicycles, without pedal assistance and without a locking system because when not in use they must always be hung up at a dedicated location to leave them available for the next user.

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