

Driving Smartization Through Intelligent Transport*

Francesco Bifulco, Cristina C. Amitrano, Marco Tregua
University of Naples Federico II, Naples, Italy

Smart cities initiatives are developing all over the world, due to their support in favouring a better provision of services, in connection with the aim of achieving efficiency in cities management. More and more big corporations are interested in this topic to develop their businesses, as several issues are linked to these projects, like environment, water management, energy policies, education, culture, and so on. In literature these issues, known as drivers, were also related to sustainability aims which could be reached through the accomplishment of better performances within environment, economy, and society. This study synthesizes all the different drivers identified by scholars and industry players in a model, in order to use it as a framework to depict the linkages among the various smart cities projects. Since transport resulted as one of the most considered drivers in the analyzed contributions, the research questions were delineated to describe its role in the different phases of smart initiatives, and to understand if it could encourage and enable the other drivers' development. The multiple case study was chosen as the fittest methodological approach and it was conducted with the selection of three smart cities, one for each of the most cited platform models developed by industry players, which had started transport initiatives at least three years ago: Singapore (IBM), Amsterdam (Accenture), and San Francisco (Microsoft). The analysis of the official documents set up by city departments and by the industry players showed transport as a driving force in smart cities projects which conveys a smart approach to different domains, especially energy savings, environment, and safety. The results also showed smart mobility as a pivot in stimulating investments and citizens' participation on different city drivers, especially as it concerns environment and services to both citizens and businesses. Smart transport initiatives, hardware and software infrastructures, technological devices, and people participation to smartization were closely interrelated in smart cities projects and they could be successfully used to achieve sustainability aims for different stakeholders.

Keywords: smart cities management, platform models, transport driver, sustainable mobility, ICTs

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Francesco Bifulco, associate professor, Department of Economics, Management, Institutions, University of Naples Federico II.

Cristina C. Amitrano, Ph.D. candidate, Department of Economics, Management, Institutions, University of Naples Federico II.

Marco Tregua, Ph.D., Post-Doctoral Fellow, Department of Economics, Management, Institutions, University of Naples Federico II.

Correspondence concerning this article should be addressed to Francesco Bifulco, Department of Economics, Management, Institutions, University of Naples Federico II, Campus Monte S. Angelo, Via Cintia, 26-80126 Naples, Italy. E-mail: francesco.bifulco@unina.it.

Introduction

Cities' growth and sustainability became more important than in the past, as new challenges for quality of life and new technologies had led to projects labelled as "smart cities initiatives". These ideas have been built around different cities issues, like transport, social participation, economic growth, health services, waste management, building efficiency, and energy policies.

Firstly, the study investigates the evolution of smart cities as a concept used in public management literature, aiming to the identification of a range of issues linked to this notion. In order to reach this aim, the attention was focused on the platform models and, in particular, on the most common ones, both in literature and from empirical evidences.

After this first step, the research is focused on transport services because of their relevance in lots of smart cities projects. More into detail, the study analyzes the role played by stakeholders and the support through technology in the so-called "new urban mobility" (e.g., infrastructures such as sensors and smartphones applications) taking into account some best practices.

In the conclusion, this work underlines the linkage in smart contexts among transports, stakeholders, models, and contexts to define the elements leading to successful smart mobility initiatives and to frame them as a stage towards smartization of cities.

Literature Review

The Evolution of Smart City Concept

At the beginning of the 20th century, the increasing interest in technologies and the movement of people from rural areas to urban ones brought to the emergence of the association between the label "smart" and cities, in particular thanks to the activities of the most important ICTs corporations.

The smart cities concept had a path towards a more comprehensive notion. It started from a focus on some components known as hardware (viz., technological infrastructures) and it went to the software ones, namely, human and social capital (Batty et al., 2012), before mixing both of them. In this conceptual evolution, it is possible to observe that in the 21 century "smart" was linked to the already known conceptualization of digital city, "that monitors and integrates conditions of all its critical infrastructures" (Hall, 2000), with a specific reference to the above cited hardware components (Ishida, 2002). In the halfway of this process, a different focus on both people involvement and smart communities (Coe, Paquet, & Roy, 2001) has been proposed, leading to ties to software features to attain "social and human development (...) in a participative governance model" (Fusero & Massimiano, 2012).

As the years goes by, the two perspectives above cited started to merge, leading to a definition of smart city as "an organic whole—a network and a linked system" (Kanter & Litow, 2009); hence nowadays the hardware approach and the software one move together towards a definition linked to the quality of life and the sustainability (Caragliu, Del Bo, & Nijkamp, 2009) by integrating three fundamental dimensions, namely, technology, people, and institutions (Nam & Pardo, 2011).

The Role of the Industry Players in Smart Transport Initiatives

The way in which the notion of smart city arose, gave the opportunity to investigate on the most important empirical evidences, both from an industrial perspective and from a territorial point of view. As it regards the first aspect, this research is focused on the models proposed by industry players and to the way they are shaped

thanks to different features to be considered. These features are known as drivers and smart interventions are built on them. The role of industry players is particularly relevant as they set up the so-called platform (Anttiroiko, Valkama, & Bailey, 2013), viz. a support based on ICT to integrate different services and improve them time by time, thanks to data collection.

This research has been performed in different steps: The literature review strictly relates to management issues and the research among all smart city projects, thanks to reports presented online in the official web channels. In this way it has been possible to identify 20 companies acting in the proposal and in the implementation of platforms to support smart cities management.

The literature review on models gave us one more hint about the considerations to be done on the platforms. In particular, the study singled out the most cited models among the 20 previously identified. It can be asserted that scholars have focused their attention on three models more than others by looking at the percentage of citations; namely, these models are proposed by: IBM (Schaffers et al., 2011), Accenture (Bélissent, 2010), and Microsoft (Roy, 2005).

IBM's model (IBM, 2009) is considered as an "actionable business architecture for smarter city" and the drivers shaping it are named city's core systems (city services, citizens, business, transport, communication, water, and energy).

The model set up by Accenture (2011) is introduced as an "open platform" allowing the integration of cities' crucial components, listed as follows: office and residential buildings, natural resources management, transportation, health and safety, waste management, education and culture, public administration, and services.

The third model taken into account has been proposed by Microsoft (2013) and it is slightly different from the two previous ones. As a matter of fact, it starts with two features considered as critical to develop the model. These are technological solutions and governance, since they support the definition of activities for services, citizens and stakeholders' involvement, financial resources' management. Then they are tied with several other components, presented and conceived in a similar way to the other two models. They are presented as follows: energy and water, transportation and infrastructures, economic development, education, health and social services, public safety and justice, tourism, culture, and leisure.

As it emerges from the three models, most of the attention is paid to the drivers and among all of them "transport" is one of the few coming out always with the same tag. The way in which it is conceived, the services defining it, and the linkages with other drivers are due to its importance for economic development, tourism, and for society in a more general perspective. As it concerns this last aspect, citizens' quality of life and jobs creation are highlighted (European Union, 2011), but they are not directly referred to in the models.

The research is focused on transport initiatives in the framework of the three platforms which have been observed more in detail with the following description:

- IBM defines the city transport system as shaped by all characteristics of its road and public transport networks, from service provision to pricing, with particular reference to switching among ways of transport;
- Accenture proposes its intelligent transportation initiatives by applying strategies and by creating new technologies to help offset emissions and to enable the development of efficiency policies related to energy grids;
- Microsoft establishes projects on transports aiming to an innovative and eco-sustainable approach. This is mainly related to initiatives in public transport system in order to satisfy citizens' needs.

This overview was completed with the elaboration of a model able to synthesize all the information obtained from the different platforms' features (see Figure 1), thanks to the identification of five drivers: environment and energy, mobility, social participation, economic development, and services to citizens.

Differences among models are due to the necessity to customize the models to the context in which they have to be implemented and even because of the expertise owned by the specific industry player acting in a context. The drivers are useful to summarize what are the main areas of interest when supporting smart initiatives are:

- environment and energy: In this domain the waste policies to be performed are addressed to utilities and grids management, natural resources management, and building efficiency;
- mobility: Transport is the most important part of this driver; tourism is taken into account too, as it regards linkages among different ways of transport;
- social participation: This driver consists of a logic to favour citizens' involvement in smart initiatives, from their definition to their implementation and control. In detail the community, the leisure services, culture and cultural heritage are central in it;
- economic development: In this driver different aims are merged, like services to businesses, services to local administration, and territorial development in a more general meaning;
- citizen services: The range of aims is related to education, safety, health services, and waste disposal.

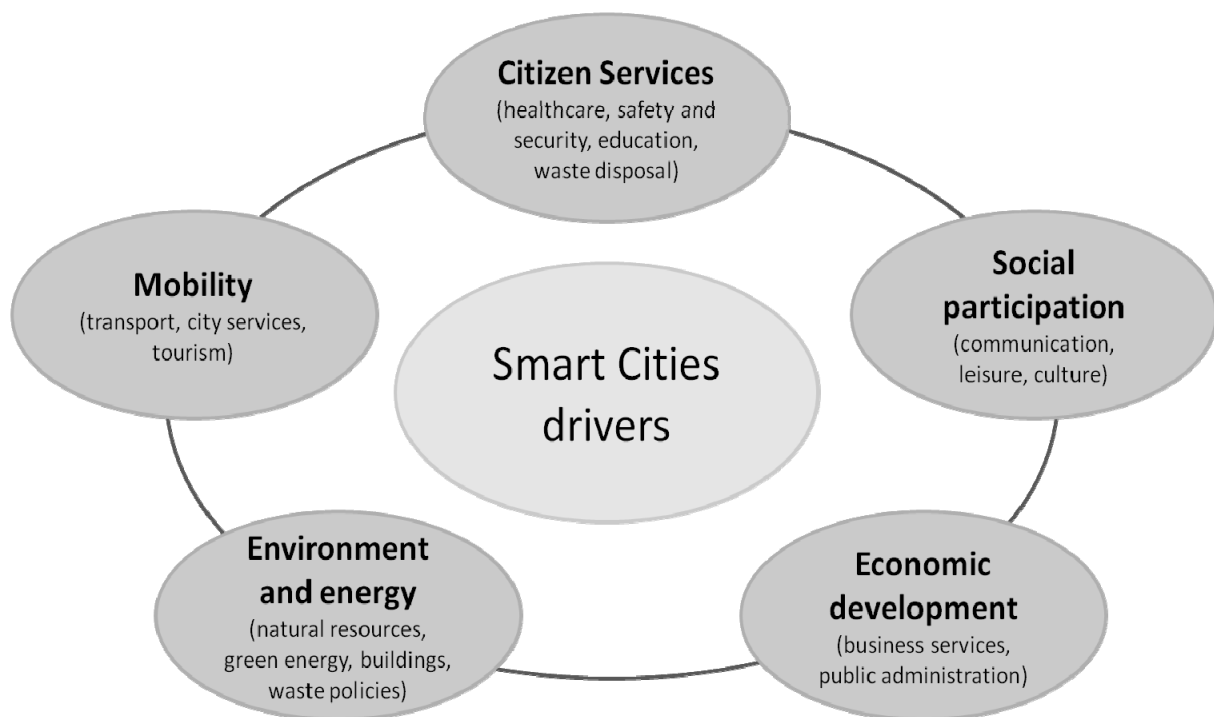


Figure 1. Smart cities model based on common drivers (authors' elaboration).

Smart Mobility Projects and the Other Smart Drivers

Starting from the considerations introduced in the previous parts, different drivers can lead cities towards smartization. All of them are linked and integrated in the platform, thus they depend on ICT (Wolfram, 2012).

A smart city project is addressed to the creation of an enrichment of broadband networks and of the other embedded systems, such as optical fibre, wireless networks, smart devices, sensors (Schaffers, Ratti, & Komninos, 2012), and these issues are directly tied to smart transport initiatives. This is due to the necessity of developing the projects starting from the initial investments in new hard infrastructures, like high-speed optical sensors and wired and wireless networks to enable intelligent transport system (Haque, Chin, & Debnath, 2013).

Besides this, smart transport projects are closely linked with citizens' participation and energy policies. Firstly the linkages to environmental worries are taken into account from the most important institutions, such as in the 20-20-20 Strategy in Europe, which is referred to three targets to be reached by 2020 (European Union, 2008): the reduction of harmful emissions, the improvement of energy efficiency, and the increase in renewable energies' consumption. These goals can be achieved only with a focalization on sustainable urban transport systems (European Union, 2011) demanding initiatives addressed to the decrease of cars usage, the improvement of public transport network, the spread of electric vehicles (Kley, Lerch, & Dallinger, 2011) and the rising of new forms of mobility such as bicycling (Gossling, 2013), and car sharing (Rienstra & Nijkamp, 1998).

Sustainability is considered as pivotal in improving quality of life and to enable social and personal growth both for people and businesses (ABB, 2012). Similarly the sustainability issue led to the enlargement of the helices model, namely, the models for interaction among subjects to achieve innovation (Carayannis, Barth, & Campbell, 2012). In the "Quintuple helix model" natural environment is taken into account as the framing context and as a set to resources to be safeguarded. One more approach to favour sustainability is suggested by Bettencourt (2013), defining mathematical models to save 15% of resources when providing services to a population doubled.

The vision of sustainability depends on three basic domains, namely, economic, environmental, and social. Tanguay, Rajaonson, Lefebvre, and Lanoie (2010) proposed the overlapping of these three fields to define what is a sustainable approach; more in detail, sustainability can be achieved through the contemporary accomplishment of better performances related to environment, economy, and society at the same time.

Then, the other strong relationship to be focused on takes place between smart transport and citizens' participation as underlined by the most recent European projects focused on the need to motivate mobility mindset amongst politicians, civil servants and the several interest groups as well as citizens (Enemark & Kneeshaw, 2013): Smart mobility regards not only transport opportunities but also a potential benefit connected with the quality of space and the use of new electronic information devices. These concepts are related to the following issues: combination of hard and soft investments, participation as a method to facilitate new mindsets, an integrated approach, and sustainability (Bührmann, Wefering, & Rupprecht, 2011).

The European Commission has supported a participative approach in urban development since the 1990s¹ (European Commission, 2011), with a focus on the development of strong relationships between public institutions, firms and civil society (Bifulco, Tregua, & Amitrano, 2014). The evolution of these projects during the years has conducted nowadays to an increasing interest in co-design and co-production (Piller, Vossen, & Ihl, 2012), e.g., the ULSGs (URBACT Local Support Groups) in which city stakeholders are involved in supporting the research of urban sustainable solutions to be collected in the so-called Local Action Plan

¹ Through the programmes: URBAN I-II (1994-99/2000-06) and URBACT I-II (2000-06/2007-13).

(European Union, 2013).

The above delineated linkages between transport system and ICTs, energy policies and participation help cities to achieve results such as the integration of technologies and communication into a more comprehensive and multi-faceted strategic approach; moreover other challenges emerge, like the enhancement of new forms of mobility, the reduction of CO₂ emissions, the intensification of users' (citizens, tourists, businesses) involvement, and the support to the economic growth (Bodhani, 2012).

The interrelations among these desired results can be searched out in the way the three mentioned smart cities platforms include them in their models (IBM, 2009; Accenture, 2011; Microsoft, 2013): IBM considers transport as one of the driver inside the city infrastructure systems, closely interrelated to business and energy; Accenture includes transportation in the set of service domains with the aim of involving new strategies and technologies; finally Microsoft encloses transport, urban planning and infrastructures in a unique driver, focusing on public transport's improvement and innovation.

It has recently been underlined that policies developed to promote the use of public transport or too much focused only on technological innovations can just reach insufficient and temporary achievements (Spickermann, Grienitz, & von der Gracht, 2013) and these poor results are linked to the projects' confluence on mono-modal transport. A solution can be found in a more appropriate multi-modal mobility, allowing the overcome of the conflicting choice between private and public transport modes (Grotenhuis, Wiegman, & Rietveld, 2007).

There are different smart mobility projects that can be realized to ensure all the activities and the expected results (Goldman & Gorham, 2006), such as city traffic management with databases that predict congestion and suggest alternative routes to avoid it, based on real-time travellers' information collected through mobile phones' applications; moreover there are projects aiming to support the usage of card systems, the development of infrastructures for non-motorised modes and the provision of new services, like charging/refuelling for clean vehicles, solutions of data management that collects information from traffic, transit, construction, incidents, parking, special events and weather conditions, even to create a platform based on a common database.

In particular, the most challenging solutions faced by cities' transport authorities are linked to the diffusion of Internet technologies and mobile phones. These latter have allowed the development of many applications enabling the so-called "netizens" (Park, 2007) to take a huge control on how and when they access transport: There are applications allowing citizens to get and give information on buses, railway, subways, taxis, bicycles, parking areas, and traffic (Schaffers et al., 2012). Today people can plan their journey in a more efficient way thanks to information spread by websites or applications and even more they are able to interact and generate contents thanks to the use of technologies (Obrist, Geerts, Brandtzæg, & Tscheligi, 2008; Jensen, Ruiz Vicente, & Wind, 2008; Kaplan & Haenlein, 2010).

These technological tools are also able to change another project characteristic, adapting it to modern times: the smart card system allowing different activities, like ticketing, payment and multi-modal use of public transport. Summing up, nowadays it can be observed the evolution from the well established plastic cards to other new technologies such as contactless banking cards and mobile phones: An example is a sort of special SIM card equipped with a built-in pay chip promoted by China Mobile Communications Corporation (Lin, 2012).

Purpose and Methodology

Purpose

The research aims to analyze smart cities initiatives starting from a focus on the so-called drivers that characterized all models; these can be synthesized by being decomposed through their description from industry players' official reports. Then the three selected platform models were investigated because—as cited above—it was preferred to pay more attention to the most common models in literature.

In particular, our attention is centred on the driver labelled as transport and particularly on the role played by smart transport projects within their implementation towards the rise of smart cities through the analysis of some cases linked to the three models that were put at the basis of this research. So, thanks to these choices, the first research question is defined as follows:

RQ1: What is the role played by transport in different phases of smart cities initiatives?

Then the research went on deeper trying to understand in which way the driver transport is linked with the others. In detail, the attention was focused on the ways in which the role played by transport and emerging from the answer to RQ1 can emerge and on the way in which transport is directly linked to the evolution of the smart cities initiatives and especially on the relationship between new technologies implemented and users' participation. In brief, the second research question can be presented as follows:

RQ2: Could transport play a pivotal role in smart cities among all drivers? And how is it encouraging and enabling other drivers' development?

Methodology and Data Analysis

In order to define our methodological approach, a multiple case study analysis (Yin, 2003) was carried out. In particular the cases have been selected as similar outcomes are expected (namely the phenomenon known in literature as “literal replication”—Thietart, 2001). Moreover the study identified empirical evidences aligned with the platforms that were considered in the literature review as the most cited and taken into account from scholars. One more reason to justify this choice is connected to the aim of achieving a holistic view (Gummesson, 2000) thanks to the study of many different features of smart cities initiatives.

The data were collected from the analysis of the official documents set up for each smart city, in particular the ones based on the platform models chosen thanks to the literature review. The documents from the empirical evidences are official reports prepared by city departments and by the industry players when considering the implementation of the plans.

The activities of data collection and analysis are tied to the involvement of the authors in an Italian project, named OR.C.HE.S.T.R.A. (ORganizational of Cultural HEritage for Smart Tourism and Real-time Accessibility—PON, The Operative National Program, 2007-2013). The participation to this project gave the opportunity to be in relation with several actors and to perform a detailed investigation among different cases of smart cities around the world.

As a consequence of these premises, it was decided to select one case for each of the three industry players cited in the first part of this paper. More into detail, the research identified the implementation of smart transport that had started at least three years ago, in order to have projects in a maturity phase, with a solid base of results and information and similar among them to give significance to the analysis. The projects taken into account had been performed—and they are still in progress—in Singapore (with the implementation of IBM platform), in Amsterdam (thanks to the intervention of Accenture), and in San Francisco (where Microsoft led the project of smartization).

Results

Singapore

The first case is the one developed with IBM support (IBM, 2009) in the city-state of Singapore. Since its independence from the Commonwealth of Nations in 1965, the city strived for overcoming poor infrastructures, housing shortages, pollution, rapid population growth, and natural resources limitations as an island.

Within these challenges transport always played a strategic role because the limited land could not allow expanding roads very much and therefore car usage growth had been controlled since the 1970s, with schemes like car quotas and congestion charges.

These aims related to a more sustainable transportation system were achieved also thanks to a long time collaboration with IBM, indeed since 2006-2007 a pilot test on traffic prediction took place in the city: IBM's Traffic Prediction Tool became able to forecast traffic flows by using historical traffic data and real-time traffic inputs from the Singapore Land Transport Authority (LTA) i-Transport system.

This collaboration was carried on with an alliance established in 2008 with IBM as a research partner in the Singapore Urban Transport Solution (STARS) program to leverage on advanced technologies and develop new ideas and solutions.

Another further step was done in 2010 when an agreement was signed for the development of decision support tools to help the city in managing its infrastructures and resources (water, transport, and energy) and improving the quality of its urban services thanks to a focus on the use of sensor networks. Within this program IBM helped Singapore LTA to ensure a cost-effective travel experience for citizens with a distance-based pricing system as an additional feature on the existing electronic payment ticketing one (i.e., a single contactless card called EZ-link used for bus, trains, taxis, electronic road pricing—ERP, and electronic parking system payments—EPS).

These efforts towards sustainability and a better quality of life have been gathered together in the so-called Sustainable Singapore Blueprint launched in April 2009 with the vision of making Singapore a liveable city in 20 years. The blueprint was created around four strategies to boost resources efficiency, enhance the urban environment, build new capabilities, and foster community actions (e.g., through MyTransport.SG portal and some apps).

A further step was taken in 2012 when Singapore LTA reached out the Singaporeans through a series of consultations in order to understand their priorities and needs.

As a result of this process, three issues were identified as the most important and valuable for commuters (see Figure 2):

- (1) more connections to different places;
- (2) better services features, included reliability, comfort, and convenience;
- (3) liveable and inclusive community, reaching for the well-being of several communities and the enhancement of public spaces.

These results were put together in LTA Masterplan (LTA, 2013a), containing the Authority's strategies towards the development of a sustainable urban mobility system, in particular the importance of citizens' participation in the co-creation of better transport services.

All these efforts in urban mobility are measured annually throughout the use of different indicators focused on roads and traffic conditions, pedestrian and commuter facilities, public transport capacity and journeys, motor vehicle population (by type of vehicle and of fuel used), and utilisation (LTA, 2013b).

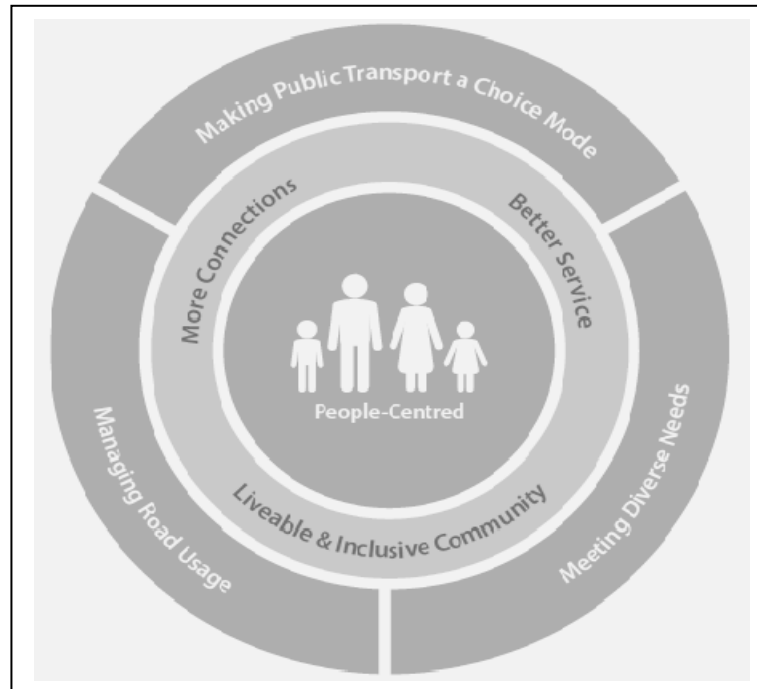


Figure 2. People-centred land transport system (LTA, 2013b).

Amsterdam

The second case investigated is the capital city of the Netherlands and is referred to the platform model developed by Accenture (Accenture, 2011).

Since 2009 the city of Amsterdam launched a public-private program called Amsterdam Smart City (ASC) in which the municipality was a partner in the execution together with the Amsterdam Economic Board, Liander, and KPN. The starting point of ASC was the roll-out of new infrastructures that enabled all types of new services through the implementation of three different projects: “Smart Energy Grids”, “Fiber to the Home”, and “Open Data” (electricity, connectivity, and data). These initiatives allowed the ASC’s partners to develop and implement innovations focusing on energy savings, more efficient healthcare, less traffic congestion and services for a higher quality of life.

Among the different partners, Accenture was chosen and involved in ASC as a strategic one to change transportation patterns and behaviours, reduce carbon emissions, and develop a smart-grid and smart-metering technologies. In particular, Accenture aided Trans Link Systems (viz. a joint venture of the five largest Dutch public transport companies) to launch the world’s first nationwide, multi-modal, electronic fare management system for public transport with the development of smart cards (OV-chipkaarts).

All these mobility-oriented (based) initiatives had a municipal supervisory by the transport division (Geemente Amsterdam—DIVV) which also played a role in the research domain with the elaboration of many publications. These DIVV released an interesting and detailed study on Amsterdam mobility (Geemente Amsterdam—Dienst Infrastructuur Verkeer en Vervoer, 2010) including the results of a 25 years analysis on citizens’ travel behaviour. This research tries to delineate the evolution and trends in traffic and transport in and around the city of Amsterdam and identifies the cause-effect relationships among trips’ duration and frequency, passengers, different mobility modes (cars, bicycles, public transport) and parking (see Figure 3).

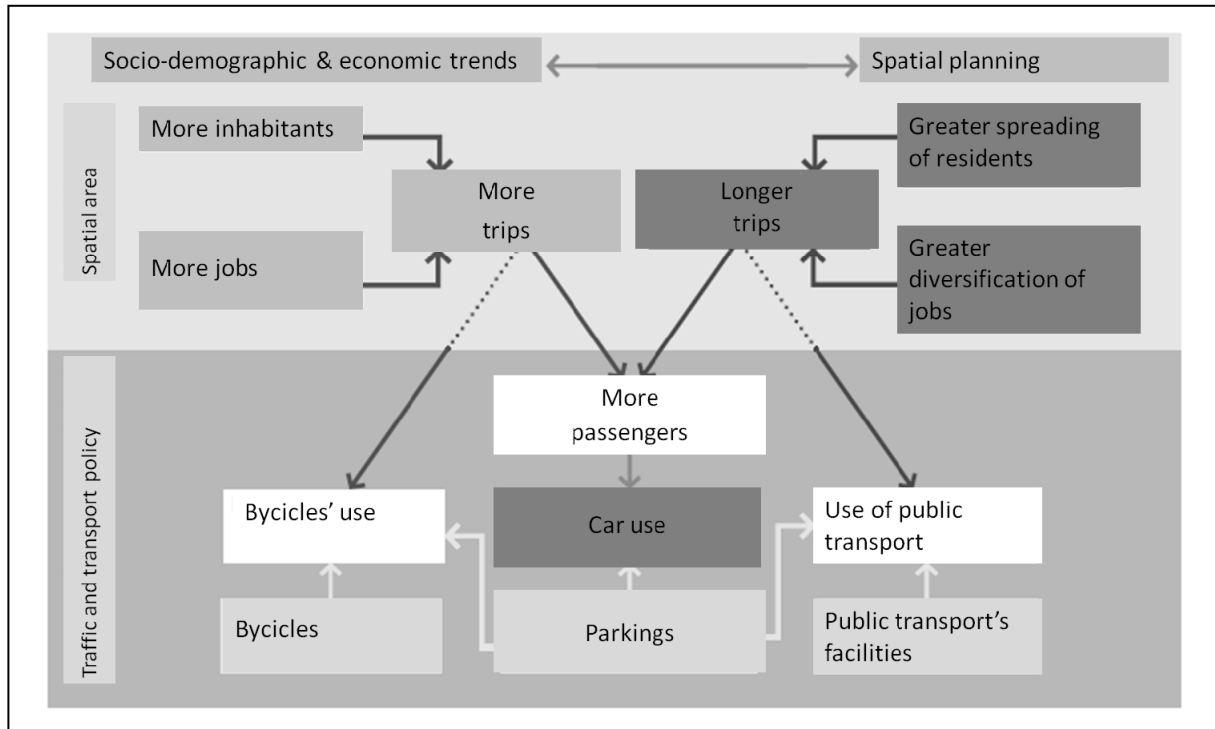


Figure 3. Analysis of trends and development in Amsterdam mobility (DIVV, 2010)

The ASC program is to fulfil of projects (20 up to 2011) and those ones linked to smart mobility can be synthesized as follows:

- Smart traffic management;
- WeGo, an online peer-to-peer car sharing platform;
- Ring-Ring, an innovative smartphone application for Bike community;
- REloadIT, an innovative technology for clean mobility;
- Ship to grid, shore power stations allowing ships' connection to green energy;
- Moet Je Watt, a charging system in combination with smart meters.

All these projects are linked to the achievement of a sustainable urban mobility system that since 2011 has been included in the Sustainability Programme 2011-2014 (City of Amsterdam, 2011). This plan has brought to the creation of the so-called Amsterdam Sustainability Index (ASIndex), made up of 10 indicators: Two of them are referred to the pillars of sustainable mobility and air quality and they are measured by the bicycle share in modal split and the share of clean trucks and lorries (Jonkhoff & van Eijnatten, 2012).

San Francisco

The last case taken into account is referred to the City and County of San Francisco in California which applied Microsoft model (Microsoft, 2013) in its smart transport initiatives.

Since 2004 the city launched a smart parking project in the Bay Area in collaboration with other public and private partners. Microsoft is one of them and the company offered a software for the testing and still now San Francisco uses Microsoft technologies to collect real time data on public transport and traffic flows. In particular, thanks to "Windows Azure" and "Bing Maps geo-referencing system", the data are collected, analyzed, and used to develop new services and applications or transform the existing ones.

The principal promoter of smart mobility projects, San Francisco Municipal Transportation Agency (SFMTA) exploited these technologies to reach four strategic goals:

- Create a safer transportation experience for everyone;
- Make transit, walking, bicycling, taxi, ride sharing, and car sharing the preferred means of mobility;
- Improve the environment and quality of life in San Francisco;
- Create a workplace that delivers outstanding service.

These strategic purposes represent part of the core goals identified by the SF County Transportation Authority (San Francisco County Transportation Authority, 2013) and they are related to main public priorities (see Figure 4): enhance transit capacity and services (making trips the most time/cost effective), favour pedestrian safety and traffic calming, facilitate the community partnerships for mobility, and improve transit system maintenance for reliability (bringing the system to a good state in terms of maintenance).

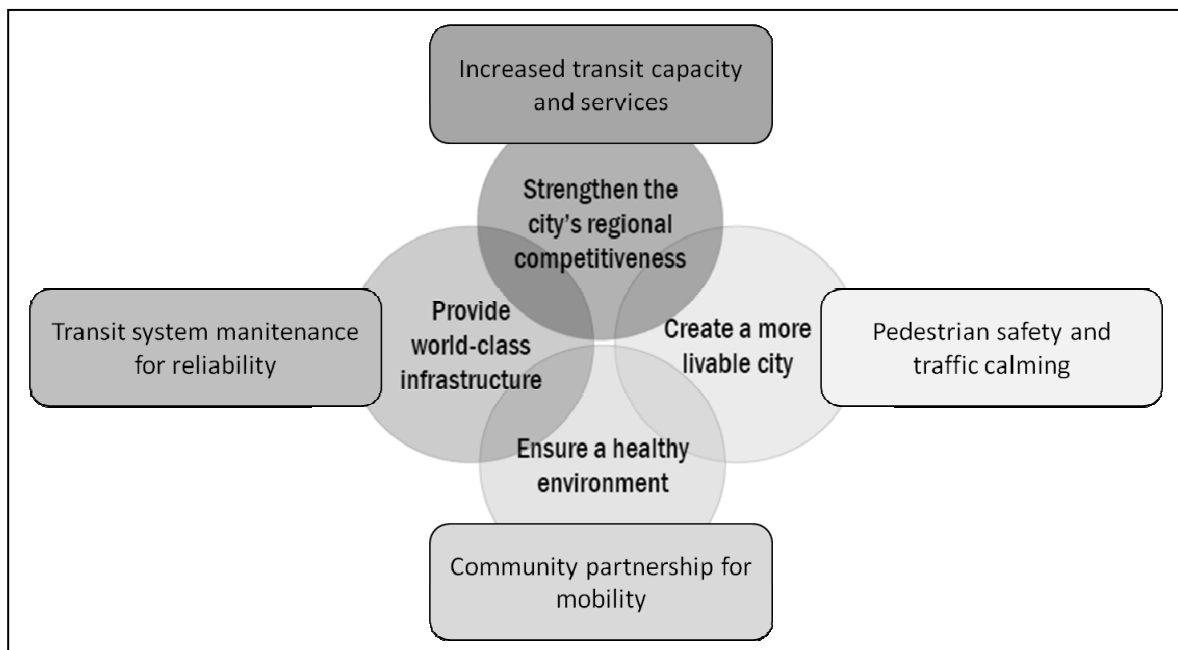


Figure 4. Four core goals and public's priorities (SFCTA, 2013).

One of the most important aims is the creation of a more liveable city, so SFMTA's attention has been focused on the development of smartphone applications (e.g., Muni+, Smiling Ride BART, Walkonomics) and the persuasiveness of alternative mobility solutions usage. In particular, "SFpark" initiative to reduce traffic by helping drivers find parking spaces consists of a collection of real-time information (using wireless parking sensors) about where parking is available and this information is redistributed via a smartphone app to drivers. It also periodically adjusts garage pricing up and down in line with demand, encouraging drivers to park in underused areas and garages, reducing demand in overused areas. Another important solution is related to innovative mobility that concerns a wide range of solutions from car sharing, biofuels, electric vehicles (EV) with public charging stations and bike sharing (e.g., Bay Area bike sharing program started in summer 2013).

All these alternative modes set up one of the indicators created by SFMTA to measure the monthly trends of urban mobility system: Each indicator is related to one of the four strategic goals (SFMTA, 2014): In particular these reports make analysis of the improvement of safety (public transport's vehicle

collisions/100,000 miles), transit and parking performance (percentage of on-time departures and arrivals, parking reliability rate of SFpark spaces), customer services (percentage of malfunctions observed), and environmental quality (metric tons of CO₂ emanated by the transportation system).

Discussion

After analyzing all three cases, it has been possible to answer the RQ1 stating that smart transport initiatives in smart cities have an important role so that transport can be defined as a driving force. This role is showed through the linkages with quality of life improvement and enhancement of efficiency in different fields, viz. two of the most important topics in smart city domain; moreover transport activities perform their role in a high number of city areas linked to it.

These projects can help cities in overcoming territorial issues as it happened in Singapore and they can even aid the reaching of eco-sustainable goals as it emerges from Amsterdam experience and furthermore they can stimulate alternative ways of moving around the city as experienced in San Francisco. These features of projects can enable a faster achievement of sustainable aims, as they favour better performance for society—due to a higher quality of services both for citizens and businesses, they positively affect economy—by reducing costs for local businesses, citizens, and local firms, too, and they improve the quality of environment—thanks to the usage of the decreased CO₂ emissions.

Smart transport projects have so many links with citizens' quality of life, technologies, reduction of pollution, new city services and greener energies, but above all the city managers approaches linked to this driver are closely linked to citizens' participation and collaborative initiatives between public and private actors.

So referring to the RQ2, the study provides a positive answer stating that smart transport projects can play a pivotal role in smart cities, in particular its most relevant function is to stimulate citizens' involvement in city life. Citizens' engagement is becoming one of the most important factors allowing the success of a smart city initiative. Nowadays different researchers have introduced the concept of "Smart Citizens" (Hemment & Townsend, 2013), referring to urban people's fundamental role of co-creators and their participation in the process of specifying, evaluating, and developing the applications and services required to meet their needs. Smart cities have to consider citizens at their heart, enabling them to have the ability to use modern and future internet technologies to transform their way of living and working (Blauhut et al., 2011).

The three cases have showed that the first investment in infrastructure is followed by ICT solutions to allow people participation through the access to open data, the use of smartphone applications, and the opportunity to interact with local government in city management activities.

In particular, the city of Singapore since 2011 created a portal (Retrieved from <http://data.gov.sg/>) as part of its "open data" initiative and in order to encourage people's usage of this huge amount of publicly-available data in April 2013, the government has launched a competition, "Apps4SG" for the development of new apps (ended in January 2014).

Since 2010 the municipality of Amsterdam built up a wide open data program (Retrieved from <http://amsterdamopent.nl>) which includes experiments with crowdsourcing to learn how interaction with civilians can support local policies and contexts to realize apps: In October 2012 the second project "Apps for Amsterdam" was completed and three apps were selected for further development (in order to join "Apps for Europe" competition in 2014).

Lastly, the city and county of San Francisco has enacted an open data policy since 2009 and launched the portal DataSF.org; over these years, the project has allowed the development of more than 70 apps for city residents by civic innovators and companies.

As a result of the analysis, all the information achieved can be synthesized in Table 1: In column one the three cities-case studies can be found and in rows the most relevant examples of smart mobility indicators and mobile phone applications are showed, in order to underline the strong relationship between smart transport projects, sustainability and citizens' participation, especially through ICTs.

Table 1

Examples of Indicators and Mobile Phone Applications in Smart Mobility Initiatives

		Smart cities		
		Singapore	Amsterdam	San Francisco
Smart mobility indicators	Name	-Public transport journeys -Motor vehicle population	-Bicycle share in modal split -Share clean trucks and lorries	-Transit performance -Customer service
	Measures	-Average Daily Passenger-Journeys ('000) + Average Journey Distance -Private Cars + Other Cars + Taxi + Buses + Goods & Other Vehicles + Motorcycles	-Percentage of bicycles in total movements of bicycles + mopeds + motorbikes + cars on the Singel canal -Percentage of trucks and lorries with Euro 4 or cleaner engine	-Percentage of on-time performance -Percentage of addressed colour curb requests + hazardous traffic signs reports + public meter malfunctions
	Data source	-LTA -Department of Statistics, Singapore	-DIVV -TNO, research institute	-SFMTA -SFMTA
Apps for mobility	Name	MyTransport.sg	Bike Like a Local	Muni + App
	Developer	LTA	Private	SFMTA
	Main functions	Bus and bike information and maps, multi modal trip planning, social/twitter feed	Maps and information on where and how to park bikes	Bus-taxi-bike information and maps, personalisation of services with MyConcierge, traffic data, events information,

Note. Source: Authors' elaboration.

Conclusions

Thanks to results achieved in connection with RQ1 and RQ2, the study underlines the relevant role played by transport projects in favouring the development of smart cities initiatives.

As it regards RQ1 ("What is the role played by transport in different phases of smart cities initiatives?"), transport systems can play a relevant role in conveying a smart approach to different domains, first of all to energy savings, environment, and safety. This implication has to be considered as an empirical evidence of what has been stated in literature; more in detail the reference to the model proposed by Tanguay et al. (2010) is depicted even in the cases taken into account, thanks to the positive consequences achieved for different stakeholders.

From our RQ2 ("Could transport play a pivotal role in smart cities among all drivers? And how is it encouraging and enabling other drivers' development?"), it can be stated that citizens' involvement is one main topic to take into account in cities becoming smart, as citizens represent one of the main actors in this approach. Their presence all over the territory, their participation through ICTs, and their ideas and perspectives about services represent pivotal input (Enemark & Kneeshaw, 2013) to improve projects, both in the planning phase and when they are in progress.

Our literature review gave us the chance to underline how the transport system and the related ICT

infrastructures are considered from different but narrow perspectives, without a detailed interpretation of their impacts.

The performed investigation on the three empirical contexts leads to a more complete point of view; hence the close linkages emerging among smart transport projects to be deployed, technologies to be used as tools, hardware, and software infrastructures to implement the projects, and people participation to smartization (see Figure 5), can be underlined with a parallel focus on sustainability aims achieved through these approaches. The sustainable perspective in smart cities is widened towards economical, social, and environmental issues.

As a consequence, the contribution to the existing literature consists of interconnections to be highlighted and results to be achieved as they can frame a wider and more comprehensive vision on smart cities projects.

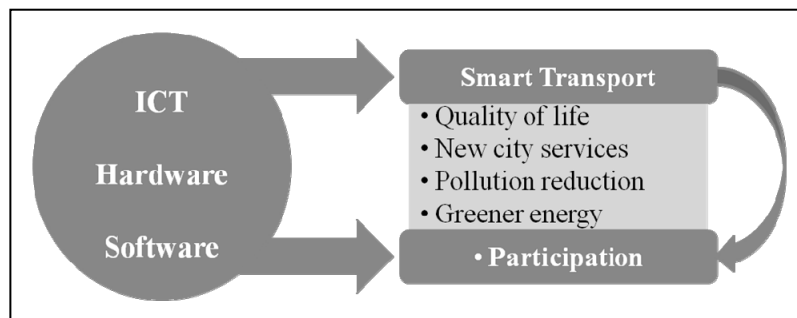


Figure 5. Our interconnection model (authors' elaboration).

So the existing literature can be enriched in terms of connections among topics to be underlined and potential results as they can compose a wider framework related to smart cities initiatives.

Limitations and Further Research

The analysis is based on the investigation of three cases chosen for their different perspectives but the study is a result of an examination on documents prepared only by the various actors engaged in the smart cities initiatives. Additional research can be conducted through in-depth interviews with different stakeholders; more in detail it could be interesting to consider users' perspectives in order to understand how they perceive the new ways to provide these services. One more step is based on a wider investigation related to other industry players and, as a consequence, to other cities becoming smart.

Furthermore as projects are still ongoing a longitudinal perspective and a long range monitoring can be adopted in order to study the development of smart cities, strengthen the identified interconnections and, find new additional ties.

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