Smart Mobility in Smart City

Action Taxonomy, ICT Intensity and Public Benefits

Clara Benevolo, Renata Paola Dameri and Beatrice D'Auria

Abstract Smart City is a recent topic, but it is spreading very fast, as it is perceived like a winning strategy to cope with some severe urban problems such as traffic, pollution, energy consumption, waste treatment. Smart City ideas are the merge of some other more ancient urban policies such as digital city, green city, knowledge city. A Smart City is therefore a complex, long-term vision of a better urban area, aiming at reducing its environmental footprint and at creating better quality of life for citizens. Mobility is one of the most difficult topic to face in metropolitan large areas. It involves both environmental and economic aspects, and needs both high technologies and virtuous people behaviours. Smart Mobility is largely permeated by ICT, used in both backward and forward applications, to support the optimization of traffic fluxes, but also to collect citizens' opinions about liveability in cities or quality of local public transport services. The aim of this paper is to analyse the Smart Mobility initiatives like part of a larger Smart City initiative portfolio, and to investigate about the role of ICT in supporting smart mobility actions, influencing their impact on the citizens' quality of life and on the public value created for the city as a whole.

Keywords Smart city · Smart mobility · Digital city · Benefits · ITS

1 Introduction

During the latest 50 years, city dimensions have been increasing more and more, all over the world. By 2050, 70 % of population will live in cities [1]. Cities are both places of opportunities and places of diseases. Opportunities, because cities are

C. Benevolo · R.P. Dameri (✉) · B. D'Auria
Department of Economics and Business Studies, University of Genova, Genoa, Italy
e-mail: dameri@economia.unige.it

C. Benevolo
e-mail: benevolo@economia.unige.it

B. D'Auria
e-mail: beatricedauria.dauria@gmail.com

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places where people live and meet, where companies are settled and schools and universities are most present. Diseases, because in city traffic, pollution and waste production are worse than elsewhere and the cost of living is very high.

Public Administration and Municipalities are facing a challenging task, to harmonize a sustainable urban development taking into account the need of both creating job opportunities and preserving the environment, offering to people in city the best living conditions. Moreover, cities are looking for competitive advantage in attracting and retaining the best, more educated and skilled human resources for innovative and performing companies, and high touristic fluxes, also thanks to the perceived quality of life, to have the best performance in public value creation.

Smart City is considered like a winning urban strategy using technology to increase the quality of life in urban space, both improving the environmental quality and delivering better services to the citizens [2]. Several academic papers have been written about smart city, smart strategies and smart initiatives, interesting a very large set of topics: from waste treatment to air quality, from green energy production to buildings energetic efficiency, from open data to e-government in smart city. However, few works till now have been reasoning about more complex aspects, such as how all these topics—also very different each others—interact reciprocally, which benefits they could produce, how they impact on the quality of life of citizens, how much they are able to effectively solve the urban problems and how well the smart projects perform.

To respond to this questions, this paper introduces a deep analysis focalised on one of the most important topics in smart city, that is, smart mobility. Mobility is one of the most important facilities to support the functioning of the urban area [3]. However, transport produces several severe negative impacts and problems for the quality of life in cities, such as: pollution; traffic; street congestion; long time to cross the city and therefore a negative impact on work and life balance; high cost of public local transport services; and so on. Therefore, Smart Mobility is one of the most promising topics in Smart City, as it could produce high benefits for the quality of life of almost all the city stakeholders.

Smart Mobility is not a unique initiative, but a complex set of projects and actions, different in goals, contents and technology intensity. Especially ICT could be the pivot of a Smart Mobility initiative or completely lack. Our paper aims to analyse and classify Smart Mobility actions, considering their ICT content and their goals and trying to answer to the following Research Questions: are Smart Mobility initiatives necessarily ICT-intensive? Which are the main goals of the Smart Mobility initiatives? Which benefits could they produce?

In the further chapters, our analysis faces the Smart Mobility topic taking into consideration several aspects. In Sect. 2, Smart Mobility is rooted in the international literature about urban development, Smart City, smart actions impact on quality of life and stakeholders' expectations. In Sect. 3 the most recurrent Smart Mobility initiatives implemented in smart city strategies all over the world are analysed and a taxonomy is suggested. In Sect. 4 the role of ICT in Smart Mobility and the benefits of Smart Mobility for citizens' quality of life is described. In Sect. 5 we outline reached results, research limits and further works.

2 Smart City and Smart Mobility: Some Reference Models

The Smart City topic, even if recent, has its roots in more consolidated urban strategies, deriving from different streams of study and finally merged into the Smart City vision. Thanks to a deep literature survey and analysis about the definitions and labels attributed to cities [4], we grouped the topics in three streams:

1. Digital city: it regards the use of ICT to support the creation of a wired, ubiquitous, interconnected network of citizens and organizations, sharing data and information and joining online services, supported by public policies such as e-government and e-democracy [5];
2. Green city: it regards an ecological vision of the urban space, based on the concept of sustainable development. Green policies in city regard both reducing the city footprint on the environment, reducing pollution waste and energy consumption, and preserving or creating public green areas like parks and gardens [6];
3. Knowledge city: it regards the policies aiming at enforcing and valuing data, information and knowledge available and produced in city, especially through its cultural institutions, but also produced and used by companies, innovative districts, technological parks [7].

Giffinger et al. [8] define Smart City as "a city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of activities of self-decisive, independent and aware citizens". (See also [9].) It emerges that technology and ICT—the Digital City components—are necessary, even if they are not the goal but the instrument, as the final aims are to improve the citizens' quality of life and to well manage natural resources (Green City), involving citizens thanks to a participated city governance (Smart City). Therefore, depending on the authors, each city is smart as far as it is committed into the implementation of smart economy (competitiveness), smart environment (natural resources preservation), smart governance (participation), smart living (quality of life), smart mobility (transport and ICT) and smart people (social and human capital).

Smart Mobility is therefore only one of the topics regarding the Smart City implementation [10]. It is however a crucial topic, impacting on several dimensions of the smart city, on numerous aspects composing the citizens' quality of life and regarding all the potential stakeholders expecting benefits from the smart city implementation [11]. Smart Mobility is seen like a slice of the Smart City, crossing all the components listed above [12].

From the literature analysis, we can gather the most important Smart Mobility objectives [13, 14]. They are summarized in the following six categories:

1. reducing pollution;
2. reducing traffic congestion;

3. increasing people safety;
4. reducing noise pollution;
5. improving transfer speed;
6. reducing transfer costs.

Moreover, a successful, smarter mobility system in city uses all the paradigms composing the smart city, that is: digital city, green city, knowledge city.

- Digital city, because the traffic system could use ICT and software applications for a lot of different aims, such as optimizing traffic fluxes, support effective public transport routes, collect citizens' opinions and suggestion about urban mobility, and so on [15].
- Green city, because the environmental impact of transport in city is one of the main causes of city pollution [16].
- Knowledge city, because the smartness of transport depends also on the sharing of civic values and on the citizens' smart behaviours [17].

Smart Mobility is therefore a multifaceted topic, involving all the smart city paradigms and generating a set of heterogeneous benefits for all the smart city stakeholders. They can act like agents of the Smart Mobility initiatives, that is, to be the movers of the actions, or gain the resulting benefits, or the both.

3 The IT Governance and Service Model: Basic Principles

Because of the enormous potential adverse impact of a poorly managed mobility system on the quality of life, Smart Mobility is often presented as one of the main options to seek more sustainable transport systems [3]. It could also be seen as a set of coordinated actions addressed at improving the efficiency, the effectiveness and the environmental sustainability of cities. In other words Smart Mobility could consist of a hypothetically infinite number of initiatives often (but not always) characterized by the use of ICT. As pointed out by Staricco (2013) there are two meanings of Smart Mobility respect to the use of ICT: the first one refers to an efficient and effective mobility system and is independent from the role played by ICT, but it is rather connected to the use of appropriate technologies;[1] while the second one relates to a mobility system characterized by a consistent and systematic use of ICT.

The Smart Mobility sector presents a remarkable breadth of contents and implications because of the large number of variables to which is connected. It is possible to identify several studies focused on individual applications, while it is

[1]The author reports the case of Curitiba, in Brazile, where efficient transport solutions have been taken but very low-tech and low-investment.

more difficult to find studies that provide an holistic and interrelated vision of these actions. Due to the complexity of the urban mobility scenario, the aim of this paper, which operates a multiple level classification of a large number of Smart Mobility initiatives due to a deep literature review, is trying to provide an overview of this area through the proposal of an action taxonomy considering three aspects:

1. Smart Mobility actors: who are the main agents moving the smart initiatives;
2. Use and intensity of ICT in Smart Mobility initiatives;
3. Goals and benefits of Smart Mobility actions on smart goals.

The suggested taxonomy is based on a literature review; the survey regards economic papers regarding policies and technologies for urban mobility and smart mobility, especially in European cities.[2]

First of all the initiatives are classified into four main groups respect to the different key actors, such as:

- public transport companies and organizations;
- private companies and citizens;
- public bodies and local governments;
- the combination of all of them, when all these actors realize together integrated initiatives (for example, Integrated Transport Systems—ITS).

Each action is then related to a major, minor or non-existent incidence of ICT technology and finally is connected to the most important and recurrent Smart Mobility goals. This study wants, in fact, deeply explore the interrelations between initiatives, aims and enabling technologies. The final results of this taxonomy is summarised in Table 1. Below there is a description of each group, a brief illustration of the actions composing each one, the intensity of ICT involved and the benefits of each action on the Smart Mobility goals described above.

3.1 Public Mobility: Vehicles and Innovative Transport Solutions

This group includes all the initiatives carried out by the companies or organizations suppling the local public transport services in the city. It is composed by actions of different nature but characterised by a common factor, that is, they aim to positively change the quality of public transport under different points of view. As shown in Table 1, this set collects either solutions involving a change in the fleet of transport vehicles and fuels (such as the adoption of electric vehicles, vehicles EUR 5, vehicles with automated driving or CNG vehicles) or interventions which improve

[2]The most innovative Intelligent Transport System have also been collected from the offer of the main international vendors.

Table 1 Smart mobility taxonomy, ICT intensity and targets

	Intensity of ICT adopted			Benefits in Smart Mobility					
				Reduction of pollution	Reduction of congestion	Increased safety	Reduction noise pollution	Improving transfer speed	Reducing transfer costs
1. Public mobility: vehicles and innovative transport solutions									
Electric vehicles	L			*			*		
Vehicles EUR 5	L			*			*		
Use of alternative fuels (LPG, methane, hydrogen, bio-diesel, fuel cell)		M		*					*
Vehicles with automated driving		M				*			
Integrated management of public transport vehicles		M		*	*	*	*		*
Collective taxis	L				*	*	*	*	
Integrated ticketing system		M						*	*
2. Private and commercial mobility: vehicles and innovative transport solutions									
Electric vehicles	L			*			*		
Vehicles EUR 5	L			*			*		
Use of alternative fuels (LPG, methane, hydrogen, bio-diesel, fuel cell)	L			*					
Vehicles with automated driving		M				*			
Car sharing (with georeferencing and geotagging)	L				*				*
Car pooling	L				*				*
Hire and ridesharing services		M			*				*
Bike sharing (with georeferencing and geotagging)				*	*		*		*

(continued)

Table 1 (continued)

	Intensity of ICT adopted			Benefits in Smart Mobility					
				Reduction of pollution	Reduction of congestion	Increased safety	Reduction noise pollution	Improving transfer speed	Reducing transfer costs
Piedibus	L				*	*	*		
Automotive navigation system		M				*			*
Eco-driving	L			*		*	*		
3. Infrastructure and policies to support mobility									
Infrastructure, changes and addressing mobility									
Parking	L								
Park and ride	L			*	*		*		
Bicycle lanes	L			*	*	*	*		
Columns recharge electric vehicles	L			*					
Message signs about mobility		M			*				*
Integrated traffic lights		M		*	*				*
Pedestrian zones or auto-free zones	L			*		*	*		
Restricted (or limited) traffic zones	L			*		*	*		
Bus lane or bus only lane	L				*	*			*
Parking guidance system		M		*	*				
Systems for speed control and management		M			*				*
Mobility management based on the level of pollutant emissions	L			*					
Integrated policies to support smart mobility initiatives									
Traffic flows division (private, public, commercial)	L			*	*	*	*		
Integrated ticketing		M							*

(continued)

Table 1 (continued)

	Intensity of ICT adopted			Benefits in Smart Mobility					
				Reduction of pollution	Reduction of congestion	Increased safety	Reduction noise pollution	Improving transfer speed	Reducing transfer costs
tariff integration between public and private transport		M							*
Incentives for the use of less polluting fuels	L			*					
Control of emissions	L			*					
Speed limit sign	L					*			
Economic incentives and/or higher taxation measures (congestion pricing, ecopass, cordon pricing, road pricing, park pricing)	L			*	*				
Tax incentives and/or measures such as higher taxation on polluting fuels	L			*					*
Regulation of access (pedestrian areas, time bands, ZSL, STL)		M			*		*		
Redesign of city times (public schedules, school schedule etc.)		M		*	*	*			
Redesign of the city and its spaces (residential and industrial areas, integrated neighborhoods etc.		M		*	*	*			*
4. Systems for collecting, storing and processing data, information and knowledge aimed to design, implement and evaluate policies and integrated initiatives of SM									
Demand control systems for access to reserved areas (cordon pricing, congestion pricing, electronic tolling, electronic tolling with GPS, pay as you drive)			H	*	*	*		*	
Integrated parking guidance systems		M	H		*	*	*	*	*

(continued)

Table 1 (continued)

	Intensity of ICT adopted			Benefits in Smart Mobility					
				Reduction of pollution	Reduction of congestion	Increased safety	Reduction noise pollution	Improving transfer speed	Reducing transfer costs
Variable Message Signs (VMS)		M	H		*	*		*	
Urban Traffic Control (UTC)		M	H	*	*			*	*
Video surveillance systems for area and environment security		M	H			*	*		
Integrated systems for mobility management			H		*	*	*	*	*
Traffic data collection systems (section control, variable speed limit control, ramp metering etc.)		M	H		*	*			
Expert systems for the correlation and filtering of events (Automatic Incident Detection—AID)		M	H		*	*		*	
addressing and control systems of urban and suburban traffic (section control, ramp metering, variable speed limit, activation of the emergency lane for congestion)		M			*	*		*	
Systems for the management of fleets and logistic		M	H	*	*			*	*
Systems for managing fleets of vehicles of public transport adapted to UTC (system of planning, monitoring and reporting of public transport service, integrated electronic ticketing system, information system for users of public transport)		M		*	*			*	*

the quality of public service without however impinging on vehicles (such as the introduction of an integrated ticketing system or the provision of collective taxis).

Analizing the ICT intensity in these smart initiatives, it is possible to notice a heterogeneous picture. The actions range from low to medium ICT intensity. In the case of interventions on vehicles, they can involve different technologies than ICT, such as the use of electric motors, or may be ICT intensive, as in the case of driveless vehicles. Regarding the integrating ticketing, ICT intensity is high only if this policy is based on a set of applications requiring the use of smart devices such as the mobile phone. In this case, the SMS-based solutions do not require large investments but it needs citizens involvement and readiness in terms of technological literacy and their willingness to use this system. For this reason ICT, when introduced into an environment ready to accept it, is able to determine a significant step forward for the creation of a modern and sustainable urban transport system [18].

3.2 Private and Commercial Mobility: Vehicles and Innovative Transport Solutions

This group regards initiatives carried out by private citizens and companies, even if supported and stimulated by public policies. It includes a range of interventions that can include both the introduction of vehicles with certain characteristics, and actions regarding the mode of transport which affect the citizens' behaviours.

Among the solutions most frequently cited in the Smart Mobility literature, we can find some actions belonging to this group such hybrid cars and car-sharing. Hybrid vehicles would allow a pronounced reduction of pollutant emissions without requiring, as a primary need, the development of new technologies.

Car sharing is a service that allows you to use a car reservation, picking it up and bringing it back in a parking lot, and paying due to the use made. It allows reduction of urban congestion, reduction of polluting emissions (gas and noise), reduction in employment of public space and, in general, a new push towards the use of public transport [19]. Findings also show, following the adoption of car-sharing, one modal shift to other alternative modes of transport respect to the private car, such as walking or cycling [20, 21]. Nevertheless, there are possible disadvantages. According to Mariotti [22] the strong importance related to the possession of the car may partly explain the lack of role played today by most of the active car-sharing initiatives.

As evidenced in Table 1, many of the initiatives of private mobility are low ICT intensity, as bike sharing, another very frequent initiative. It is because almost all these initiatives depend on the behaviour of single citizens and it does not involve the role of ICT.

3.3 Infrastructure and Policies Supporting Mobility

The third set includes two sub-groups of actions: infrastructure and policies supporting Smart Mobility.

The first sub-group includes infrastructural projects which, in different ways, affect urban mobility: for example, the creation of bicycle lanes or interventions aiming at changing mobility as the creation of restricted traffic zones. The expansion or creation of bicycle lanes is an intervention that is closely linked to the use of the bicycle as a mean of private transport and could have positive effects on the spread of bike-sharing; initiative that, despite the difficulties linked to the topography of each city and the possibility of theft, led to a modal shift from car to bike from 2 to 10 % in cities like Paris, Montreal and Lyon [23]. The closure to traffic of certain urban areas for time zones or periods of the day in order to reduce pollution and congestion represents an other interesting solution adopted by municipalities. As highlighted by De Ciutiis [24] among the major objectives sought by the LTZ (Limited Traffic Zone in Italy), there may be safety compliance, particularly in the city centre, especially in the peak hours of pedestrians, the reduction of pollution levels and the increase in revenue administration where it is expected to pay a congestion charging.

The second sub-group is represented by a series of integrated policies that can be implemented to change the mobility system, in particular by the public decision maker (for example: incentives for the use of less polluting fuels, tax incentives or measures such as higher taxation on polluting fuels). Other interventions that may alter the urban mobility may be the redesign of the city and its spaces (residential and industrial areas, integrated neighborhoods etc.).

The two sub-groups contain actions which range from low to medium intensity of ICT: for example a low-intensity ICT initiative is represented by an intervention amending, introducing or expanding a pedestrian zone. An intervention to medium intensity ICT is, however, the introduction of a control system of the speed that is supported by sensors, cameras and devices based on Information Technology devices.

3.4 Intelligent Transport Systems

The fourth group consists of a large number of Smart Mobility solutions characterized by a medium-high intensity of ICT.

Intelligent Transport Systems (ITS) are advanced applications to collect, storage and process data, information and knowledge aiming at planning, implementing ad evaluating integrated initiatives and policies of Smart Mobility. They are a large and heterogeneous set of applications, including:

- Demand control systems for access to reserved areas (cordon pricing, congestion pricing, electronic tolling, with GPS, pay as you drive);
- Integrated parking guidance systems;

- Variable Message Signs (VMS);
- Urban Traffic Control (UTC);
- Video surveillance systems for area and environment security;
- Integrated systems for mobility management;
- Traffic data collection systems;
- Expert systems for the correlation and filtering of events; etc.

In this set the role of ICT is essential in supporting applications and systems of detection and processing of data and information. These systems can be very sophisticated and are designed to handle different kinds of information in respect of various activities related to mobility: you can then treat systems designed to detect and drive traffic, video surveillance systems, systems addressing the parking and so on.

According to ENEA [25] experiences made so far in the EU countries, USA and Japan show that the introduction of ITS technologies has significantly contributed to improve the efficiency, safety, environmental impact and overall productivity of the transportation system. These applications, as pointed out by the European Commission, are an attractive solution to many of the problems of the transport sector: in the road sector it is possible to record reductions in journey times (15–20 %), in energy consumption (12 %) and in emissions of pollutants (10 %), as well as increases in network capacity (5–10 %) and decreases in the number of accidents (10–15 %). Significant results have also been achieved in the fleet management and logistics processes of goods and in the exercise of public passenger transport.

This category is perhaps the most advanced frontier in terms of Smart Mobility solutions. It is a series of possible actions that can be implemented only under certain conditions: it is necessary, first of all, that the use of ICT is adopted in an integrated manner and to cover not only a few number of projects. The adoption of these solutions requires a holistic view, the presence of previous policies and an integrated vision across different dimensions of urban living. The rapid development of ITS technologies should be subject to reflections weighted with respect to purchasing decisions because decisions not taking into account the already started innovations can lead to unsolvable errors. In fact, many solutions are not expensive in the introduction phase, but they run the risk of poor acceptability by the community [9].

4 Smart Mobility Actions and Smart Goals

The different groups shown in Table 1 and the actions composing them, highlighted in the first column, are related to two other macro-variables evidenced in the second and third columns: the intensity of ICT for each action and the goals pursued by

such actions. As already pointed out previously, the first macro-column, titled "Intensity of ICT adopted", has three sub-columns, indicating a low, medium and high level of intensity of ICT. From the intersection between these columns and the rows corresponding to different actions you can then observe the level of intensity of ICT. It is a systematization of a large number of initiatives discussed in the literature, with an emphasis on ICT. As can be seen from this classification, it can be state that the wide range of initiatives analyzed is often but not strictly and necessarily tied to high intensity of ICT. Although the new frontier of innovation is certainly linked to the adoption of mobility solutions for ITS, we can say it is possible to adopt solutions and changes in the system of mobility without the need for large investments or sophisticated technologies. We can therefore argue that ICT is a pivotal, but not necessary technology to start the implementation of Smart Mobility initiatives; its importance however increases when the complexity and the maturity of Smart Mobility projects become higher. In ITS or other integrated Smart Mobility policies, ICT plays a crucial and fundamental role.

The second column Benefits is composed by six sub-columns, regarding the six smart goals as listed in Sect. 3. The goals highlighted are those pursued through the examined actions. As evidenced in the table, not all cells are complete because not all actions can be associated with a target, while some of them contribute to the achievement of more objectives.

Several findings derive from the analysis of Table 1 respect to the benefits associated to the Smart Mobility actions. First of all, an interesting evidence is the fact that certain actions contribute to the achievement of these objectives more pervasively than others. Looking, for example, at some integrated systems based on ICT such as ramp metering or urban traffic control systems, it is possible to observe a positive effect that affects almost all the objectives underlined. In this case it is possible to say that the ICT, if properly directed, would seem to have a greater positive benefit than other initiatives.

Finally, observing the listed objectives it is also possible to note that these are closely related to those of a smart city as well as to the concept of well-being expressed by the OECD. In its "Better Life Index", in fact, the OECD underlines the most important areas that a society has to improve in order to enhance its quality of life. The concept of well-being is wide but it is possible to individuate some common targets to look at: the safeguard of the environment is strictly related to the reduction of PM10 concentrations in the air and green house gas emission and is one of the most important. Also personal safety and a good balance between work and life time are shared goals between well-being and Smart Mobility. It is possible therefore to argue that Smart Mobility directly impacts on the quality of life of people living in cities and to design a link between Smart Mobility actions and well-being indicators. This could be very useful to better support Smart Mobility implementation, especially choosing the most effective actions and prioritizing the ones better impacting on citizens' well-being.

5 Conclusions: Results, Limits and Further Work

Several interesting findings emerge from the analysis of Smart Mobility actions rooted into the stream of studies regarding the Smart City and also its more consolidated components, that is, Digital City and Green City.

The main contribution of this paper is the proposal of an action taxonomy regarding a comprehensive approach about Smart Mobility; it deeply differs from the analysis founded in literature, generally focused on specific Smart Mobility subjects.

Smart Mobility emerges from the survey like a pivotal component of Smart City strategies and Smart Mobility and Smart City goals are often overlapped. Smart Mobility contributes to Smart City aims with its specific but harmonised goals, impacting on the most important Smart City objectives such as reducing the environmental footprint of the city or improving the citizens' quality of life. The six Smart Mobility specific goals we suggest are fully linked with the broader Smart City ones.

ICT is not a must-to-have technology to implement Smart Mobility actions; several of them are based on other technologies (regarding vehicles or fuels for example) or on no technology at all but it depends only on a better, more virtuous citizens' behaviour, such as using public transport or bike instead of private car. However, the role of ICT becomes fundamental when complexity, integration and extension of Smart Mobility programs increase. Therefore we can argue a positive correlation between the Smart Mobility maturity and the use of ICT.

From the survey an evolving path in Smart Mobility actions and programs emerges; it includes three phases, that we can call: Starting, Intermediate and Mature. The Starting phase regards smart actions belonging to the first three groups showed in Table 1. Actions are often immature, not spatially coordinated, regarding only a small portion of the urban area, difficult to replicate elsewhere. It specially regards pilot initiatives implemented in European smart cities at the beginning of this smart wave. The Intermediate phase includes several Smart Mobility governance actions, such as pilot projects repetition, integrated mobility plans, measuring benefits and negative impacts. The Mature phase is characterised by the use of ITSs, collecting, processing and sharing data, information and knowledge above a complex and integrated Mobility System. This fourth set of initiatives is successfully implementable in cities only if they have already realized an implementation readiness, based on a large knowledge about Smart Mobility in city and a good level of citizens' involvement and awareness about Smart Mobility opportunities and potential benefits.

Finally, smart people are the winning card to implement sustainable, successful and effective Smart Mobility Systems, including both high technology applications and virtuous and aware behaviours. Especially in the most mature phases of the Smart Mobility implementation, each citizen is a proactive actor, accepting a limitation in its own transfer freedom (reducing the use of private car, for example) and embracing the pursuing of shared smart aims.

Despite the largeness of this analysis, it is possible to find some weaknesses and elements to be consolidated. The main weakness is represented by the need to move from a theoretical to an empirical analysis in order to validate the proposed classification. At present, only few initiatives are already fully implemented, the more of them are in the start phases and it is therefore imossibile to evaluate the real benefits produced by Smart Mobility, regarding both single initiatives and a whole Smart Mobility portfolio.

As soon as the maturity of Smart Mobility acrions will increase, the validation of our model would be stronger; it should especially regards:

- The validation of the suggested taxonomy, that is, the classification of Smart Mobility actions in the four sets described in Table 1;
- The analysis of produced benefits especially for the citizens' quality of life;
- The definition of a set of indicators to measure the benefits.

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