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Soft Mobility as a Smart Condition in a Mountain City

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Abstract. Nowadays soft mobility is a crucial issue towards a most sustainable urban environment. Not only because it promotes a less polluted atmosphere among the always dense and busy urban fabric, but also because it avoids several traffic problems. The use of bicycles, or mechanic mechanisms to support the pedestrian mobility is an emerging requirement of cities' quality. In this sense, this article aims to discuss the soft mobility as a requirement of smart cities having as a case study one mountain urban area. It refers to the urban area of Covilhã on the highest mountain of Portugal with nearly two thousand meters high. During the last decades, this city's transformation process has driven to an urban sprawl to the suburbs, increasing the efforts in terms of transportation required by the commuters. In fact, the number of inhabitants living in the city centre is decreasing in favour of the peripheral neighbourhoods. At the same time a set of several mechanic mechanisms such as public lifts, has been built in order to promote a soft pedestrian mobility. However, in many cases, because of the lack of connection and continuity of pedestrian paths in between these mechanisms, they are not allowing a pedestrian mobility network at the city scale. Thus, this paper aims to present a set of good practices in terms of pedestrian mobility network at the city scale, in order to promote a smarter urban environment. The principal results are that soft mobility is a key issue in order to turn cities smarter, among several other factors such as smart economy, smart people, smart governance or smart living. The major conclusions show that the concerns with mobility are key tools to achieve the smart city sustainability, providing and efficient and flexible traveling across the urban fabric, boosting the use of non-polluting ways of mobility. At the same time, there is the conclusion that the underlying areas of development for a smart city, despite its cultural or territorial environments, include several aspects such as reducing the transportation problems as congestion, traffic jams or painful accidents.

1. Introduction

Nowadays the literature reveals that soft mobility is a crucial condition towards a smarter city in terms of sustainable urban environment. On the one hand, soft mobility promotes a less polluted atmosphere among the always dense and busy urban fabric. On the other hand, soft mobility helps to avoid several traffic problems, such as congestion, traffic jams or painful accidents.

In this sense, this article is focused on a mountain urban area in Portugal, Covilhã, on the hillside of Serra da Estrela mountain. From an old textile, industrial urban fabric, this city became during the last four decades a university city, because of the University of Beira Interior. Its urban development model was based on the spread of new housing neighbourhoods to the detriment of the city centre, which is in



decline, losing their inhabitants. In fact, this model of urban development is having as a result two different realities of the Covilhã urban fabric, which are the following: an everyday emptier city centre, plenty of empty buildings and closed commercial shops vs. an everyday busier urban peripheral area, full of shopping centres and tertiary buildings. Therefore, the mobility on between these two parts of the city is crucial in order to ensure the continuity of the urban fabric as a whole. However, there is a gap of the mobility conditions in between the different parts of Covilhã. Consequently, this paper will be focused on solutions for pedestrian mobility network at the city scale, in order to promote a smarter urban environment.

2. Requirements of smart cities

2.1. Main general features

The understanding of the requirements associated with smart cities is on behalf of the question: How can the cities be smarter?

The best answer that should be given is based on the identification of the high-impact areas of improvement for the cities. These areas are correlated with the characteristics of the urban areas. Therefore, the researchers who support clearly the idea of smart city, have noticed as a certain way in which there are no systems operating in an isolated way, in the cities. In this sense, the smartness of an urban area is supported by the organic integration its various systems (like transportation, energy, education, healthcare, food, building, water, public safety, or physical infrastructures).

At the same time, some authors are trying to find out the required assets to delineate the features of smart city. Following this idea, the research drives to four possible dimensions [1]. The first dimension focuses on the application of electronic and digital technologies and devices, in order to collect and create digital information, which will produce knowledge based on city's scale approach. The second dimension uses information communication technology (ICT) in order to transform the daily life of dwellers in cities, making it easier. The third dimension aims to apply the ICT in the basic infrastructures of cities. Finally, the fourth dimension brings the ICT and people together in order to achieve several goals like human inclusion, good innovation systems and tools in learning and knowledge.

To sum up, there are several fields of activities described in the literature in relation to the term Smart City, including the following: industry, education, public participation, or technical infrastructures. These activities are called soft factors components for smart city. They can be described with more details according to Vito Albino opinion, related with the following contents [2]:

- Smart industry implies industries in the areas of ICT as well as other industries that are using ICT in their production processes, also for business sector;
- Smart city is used regarding education for inhabitants, producing smart inhabitants in terms of the education grade levels;
- Smart city implies a process of participation in between the city government i.e. local authorities, public administration in general and their citizens.

In this sense, smart city is further the use of ICT in order to provide technical infrastructures and to discuss the use of modern technologies in every day urban life. Therefore, the authors are pointing out six characteristics which can help to develop the city in order to be smarter. These characteristics are called the "smart city wheel" and they comprise the following aspects [3, 4]:

- Smart economy;
- Smart people;
- Smart governance;
- Smart mobility;
- Smart environment;
- Smart living.

For every set of the above characteristics there are a certain number of factors. Each factor is described by a certain number of indicators in order to describe the preparedness and use for smart city.

2.2. *Mobility as a pivotal issue*

More than 1 million [5], people die globally every year in traffic accidents, including pedestrians and bikers. More recently, the governments are trying to develop solutions in order to address problems related on mobility, such as traffic jam congestion and accidents by soft mobility issues, i.e. mobility for pedestrians, cyclers and other ways of moving in vehicles free of fuel consumption.

According to the same author, these short of policies aim to start with a new approach to decrease all the previous problems and drive technology for future with clean energy fueling. They are called a mobility revolution in cities areas.

These concerns with mobility are key tools to achieve the smart city sustainability, providing an efficient and flexible traveling across various modes, booting the use of non-polluting ways of mobility. Therefore, the issue around 'Smart Mobility' is a way of meeting the transportation needs in terms of people and capacity, as well as enhancing economic, environmental, and human resources. It includes an important aspect of local and international accessibility such as the following examples:

- Apply the use of ICT on the infrastructures for transportation, in order to get sustainable, innovative and safe transport systems;
- Encourage using soft mobility ways, such as walking, cycling or bike sharing. At the same time is important to encourage strategies such as the car sharing, or smart mobility cards to reduce carbon emissions, travel time and painful accidents;
- Provide automated and electrified metro ways, which allows short headways and very high capacity of transport, in terms of number of passengers;
- Promote using an advanced parking such as the park and ride, in order to get efficient management of multiple on-street parking spaces, taking the cars away from the city center;
- Encourage local accessibility by satisfaction with access to a qualified public transport network.

In contemporary societies, the daily life in cities is characterized by many hours lost every day and every year in congestion problems.

Thus, the use of smart mobility solutions, will economize time, and money. In this sense, smart mobility is a powerful tool to achieve a more sustainable future by making transport system networks safer, reducing the cost for individual in particular, and for society as a whole. A lower consumption of resources such as land and fuels, spending less time in traffic, will give to cities inhabitants more time for important things, including cultural and community issues.

Therefore, smart mobility supported by the use of ICT, can provide an integrated transport and logistics system, saving time and reducing costs, CO₂ emissions, and improving commuting efficiency.

3. **Soft mobility solutions in a mountain urban area**

3.1. *The mountain city of Covilhã*

Covilhã is a mountain urban area (Fig. 1), head of a municipality with the same name, with 50.000 inhabitants. It is an example of a city set along to the hillside, located on the Serra da Estrela, which is the highest mountain area in the continental Portuguese territory. The urban fabric is spread all-over 400 and 800 meters high. Consequently, there is no practically piece of flat land in the city. Thus, there is always the need of going down or coming up, to walk everywhere on foot. On this sort of topographic conditions of the terrain, the urban mobility for pedestrians is a major challenge.

From an industrial city based on the textile sector, Covilhã became, during the last four decades, a students' city, based on the 8.000 students that are attending to the University of Beira Interior. The historical neighbourhoods of cities like this one, are characterized by an urban morphology of very narrow and winding streets, with no conditions for the traffic of cars.

Therefore, there is the need to find solutions to ensure the pedestrians mobility, avoiding the use of the car, offering to the inhabitants an attractive alternative of sustainable mobility [6], provided by which is called soft mobility.



Figure 1. The city of Covilhã, located on the slopes of Serra da Estrela mountain (Portugal).

3.2. *Soft mobility system solutions*

3.2.1 *The importance of the sidewalks*

The soft mobility solutions are one of the main issues regarding smart cities. In fact, the smartness of urban areas is depending on the improvements on mobility, using alternative ways with less pollution, and more friendly of the pedestrian.

In this sense, the improvement of accessibility begins by recognizing that its main goal is to facilitate the movement of people, rather than the traffic of the car [7]. Therefore, the first priority is to use soft and active manners of mobility, in order to promote the walks on foot or the use of bicycles. In addition to this, there is a set of mechanical supports for the pedestrian mobility, such as lifts, funiculars and public transport services, which should be considered. In terms of urban design, the previously referred ways of mobility, require wide sidewalks, routes with priority for pedestrians on the detriment of the car, or bicycle paths, all of them articulated in a soft mobility network supported by a reliable system.

Considering the example of Covilhã, there are no conditions for a universal accessibility for all citizens, because of the sidewalks which are frequently obstructed by cars, or urban equipment like bins, lighting, or telephone boxes (Fig. 2). The crosswalks are mainly poorly positioned, which often increases the risk of crossing the street for pedestrians. Such as Jane Jacobs [8] refers, in many cases, city planners and urban designers do nothing but settle how to stock more cars in the city.

3.2.2 *The connection in between the city centre and the new neighbourhoods*

The most recent urban developments, regarding the last two decades, and the consequent city spreading are having as a result a shortage of continuity in terms of pedestrian mobility system in between the city centre and the peripheral areas (Fig. 3).



Figure 2. Examples of sidewalks with no walkability conditions in Covilhã (Portugal).

In fact, the spreading of the urban fabric of the city of Covilhã is a result of a fragmented growth, supported by new urban developments, which were built one by one, without an idea about the city development as a whole. During this process of urban expansion, many people has moved from their houses in the central part to the new urban developments. The latter has received the majority of financial investments, both public and private, being the new home for bank agencies, healthcare services or University buildings.

This sharp spread has been a reason for the speeding of the population decreasing at the historical urban centre, where many shops are closed, many houses are empty and where only the elderly poorest people is still remaining. This is because, they have a lack of choices, to afford a house around the most expensive areas of the city, in the peripheral zones, leaving with scarcity of conditions, in old buildings.

On the contrary to the historical parts, the new areas were built in an urban design model which is more suitable for car users, with wide streets and huge parking spaces. However, they have greatest distance to walk until the city centre. More far away and supported by a fragmented urban model is the outskirt of a city, more difficult is its situation in terms of pedestrian mobility, and more expensive is the public transportation system. The low density of these outskirts neighbourhoods is a weak guarantee of the sustainability of an efficient service [9], including in terms of public infrastructures, or transportation. In this sense, the public transport solutions should be able to carry on bicycle, in order to allow the citizen to do part of its daily movement by public transport and part by bicycle. However, this solution is not yet available considering the public transports of Covilhã, where the bicycles are not allowed.

Therefore, the key word is the connection in between all parts of the city, throughout a pedestrian mobility city which should comprise not only a set of several mechanisms such as lifts or funiculars, particularly useful in difficult urban topographic terrains, but also with a system of sidewalks along city streets, with continuity in between all walkability solutions.

Another solution is the use of electronic boards on the public spaces, strategically located in order to inform the pedestrians about the conditions of functioning of the soft mobility mechanisms which are operating in the city. These electronic boards could give to the pedestrians, information about the timetable of the lifts or funiculars, or the breakdowns situations, in order to allow them to make another option or to take another pathway if necessary. With this information, pedestrians could better plan their routes along the city.



Figure 3. The spreading of the urban fabric in Covilhã a result of a fragmented growth process.

3.2.3 The lifts and funiculars network

Having as example the case of Covilhã, during the last decade, several mechanisms were built in order to facilitate and to support the pedestrian mobility. Given that the city is crossed by two streams; Goldra and Carpinteira that are coming from the top of the mountain, throughout the urban fabric, until the river Zêzere, where they finish; these mechanisms include a pedestrian bridge over one of these streams, Carpinteira. This pedestrian bridge (Fig. 4) makes the connection in between the city centre and a very popular neighbourhood, known as Penedos Altos, mainly for housing and some public buildings such as the municipal swimming pool. Besides the pedestrian bridge there are several funiculars that have recently been built.

However, in many cases these soft mobility mechanisms are working in a separate way, and consequently, they are not allowing to provide a continuous pedestrian mobility network. Among the reasons for this problem there is the localization of these mechanisms in the urban fabric, far away from the main public services, such as hospitals, the university buildings, or the public transports main stations, such as the train station or the bus station.

Another reason is the fact that on the sessions of the streets in between the elevators and funiculars, in many cases there are no proper sidewalks; or they are too narrow, or their pavement materials are absolutely deteriorated, or they are occupied by cars as parking areas, or they simply don't exist. Therefore, the pedestrian system needs to be completed in order to make it more efficient, by connecting the points of main interest of the city and the lowest, highest parts in terms of topography.

Such as in other historical city centres, where the number of inhabitants is decreasing since the last decades, because of the attractiveness of new urban developments in commercial peripheral territories, the historical part of Covilhã is losing population. The two main public transport interfaces (Figure 4); the train station (*Gare Covilhã*) and the bus station (*Central de Camionagem*), on the peripheral area; are the main entrances of the city, including for students, and have revealed the capacity to attract new housing neighbourhoods and the fanciest shopping centre *Serra-shopping*.

The red lines (Fig. 4) are related to the elevators and funiculars of the city, built to facilitate the pedestrian journeys, which are the following: the lift of Jardim Público, a public garden, the funicular of São João, the funicular of Santo André, and the funicular of Goldra stream. Considering an influence area of 150 metres around them, it is possible to conclude that there is a lack of public or commercial buildings inside of these spaces. Consequently, it is possible to conclude that they are not connecting the most attractive functions of the city.

Considering the orange dots (Fig. 4) which represent the main public or private buildings with more attractiveness in the city, such as the University services and departments, or the main shopping and commercial centres, it is possible to conclude that the majority of these dots are outside of the influence areas of the lifts or funicular mechanisms. The same conclusion is revealed considering the yellow dots (Figure 4), which represent other services or public buildings such as bank agencies, schools, the municipal theatre or the public library. In summary, the reliability of the soft mobility system in Covilhã is still very low.

In summary, besides of these mechanisms (pedestrian bridge, lifts and funiculars), there is a shortage of other measures, considering the public spaces, in order to improve the conditions of walkability in the city.

4. Conclusions

The first main conclusion is that the success of a soft mobility network on the urban fabric, connecting all city's parts, is depending on the continuity of pedestrian paths, comprising the mechanic mechanisms, and the sidewalks. Only having a pedestrian network is possible to guarantee a pedestrian mobility for all citizens, operating at the city scale.

As the literature revealed, among other factors such as smart economy, smart people, smart governance or smart living, smart mobility is a pivotal factor to promote a smarter urban fabric and a more sustainable city.

Another conclusion is that the goal of making the cities more pleasant to ride a bicycle or to walk around on foot, can be stimulated by mechanisms such as lifts or funiculars, which are particularly useful in sloping urban topographies, such as the city of Covilhã.

If to cycle is a wonderful choice in order to save money, to improve the physical condition, or to decrease the pollution emissions, there is still a lack of consideration about the use of bicycle as a soft mobility solution, especially regarding sloping cities. In this case the use of bicycles needs to be defined with other complementary measures such as the permission of carrying them in public transports, elevators or funiculars.



Figure 4 – Evaluation of soft mobility mechanisms in Covilhã, Portugal (based on google Earth)

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