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BEYOND URBAN STRUCTURE AND TRAVEL PATTERN. THE "MOBILITY ENVIRONMENT" AS AN INSTRUMENT FOR PLANNING AND EVALUATION

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ABSTRACT

Over the last years there is a growing interest to insight on the relationships between urban structure and travel patterns. Nevertheless, it is notably the lack of concepts and methods for application in urban transportation planning which try to incorporate this knowledge into the practice. To address this problem, the article aims to propose the concept of "mobility environment" as an instrument for mobility planning and evaluation, jointly with a method for its identification.

To illustrate and assess the worth of mobility environments, an application has been developed for a metropolitan transit corridor in the city of Granada (Spain), where the institutions have promoted the incorporation of light rail system. From the results obtained, a discussion is open about different important aspects considered for the definition and application of mobility environments: applied perspective, simplicity and spatial design.

Key words: Sustainability, urban form, public transport, Light Rail System.

I. INTRODUCTION

Urban mobility is increasingly subject to a greater number of demands (environmental, social, urban, technological, modal etc). Their response lies largely in the generation of both conceptual and methodological integration methods as well as instrumental. In particular, literature emphasizes that the search for an effective integration between elements of urban structure and travel patterns among others factors, is a determination to face such demands

as reflected on an academic level and institutional. This is of the view that urban structure and travel patterns are reciprocally related, which seems an obvious academic standpoint, but hardly has an effect in daily practice. Thus taking measures to balance both aspects (urban structure and travel patterns) encourage positive externalities such as better access to urban activities, jobs, facilities and improvements in living standards etc. In contrast, without this balance negative externalities would be encouraged e.g. congestion, pollution, stress etc.

The mobility management of the 'Predict and Prevent' paradigm versus the traditional 'Predict and Provide' requires the need to jointly assess urban structure and travel patterns. It is therefore essential to know precisely what kind of relationship exists between the two aspects and to develop concepts and methods that strengthen their integration in practice essentially from the earliest stages of the planning process.

As a result, a large number of studies have been proliferated in recent years, focused on figuring out the most important factors of the relationship between urban structure and travel patterns. However, many of the tools used in mobility planning (eg local mobility plans, environmental impact assessments, cost-benefit analysis etc), have problems when transferred to practice. This may be a consequence of –among others- the sophistication level of many researches and the lack of spatial perspective..

The article aims at highlighting this issue and proposes a method for effective integration between urban structure and travel patterns based on the concept of mobility environment. The method is noted for its simplicity and applicability to transport planning practice. To test its suitability and usefulness, an application has been developed for a metropolitan transit corridor in Granada (Spain) where it has been decided to incorporate a new Light Rail Train. The actual application came about because of a request from local authorized institutions on the corridor to collaborate with the University in order to promote and improve integration of this new urban transport system.

Once the general approach to the article has been introduced (section 1), the article is organized into four sections there after. Section 2 introduces the concept of mobility environment on a theoretical level. Section 3 proposes a method to identify such mobility environments. Section 4 focuses on the practical application of this method to a specific corridor in the metropolitan area of Granada, Spain. Finally, section 5 sums up the main conclusions and a brief discussion on the results.

II. THE CONCEPT OF MOBILE ENVIRONMENT

Inspired by the work of Bertolini y Djist (2003) claiming the need to identify mobility environments as being a prelude to the development criteria and strategies for urban mobility planning, the article will go into this on a methodological level. The work of these authors can be seen in the seminal approach to theoretical work done opening two major ways forward. On one hand, there is a need to examine spatial dimension of such mobile environments. On the other, how can be developed a specific method to identify them in any given territory.

The research of Cervero (2002) in Montgomery County is also relevant for this article at conceptual level. That work is based on the use of spacial units as determining elements of travel patterns. As well as variables such as density, diversity and design, the author also

introduces other socio-economic factors. This work is illustrative regarding the selected criteria linked to urban structure. The spatial dimensions of urban structure units of study seems less relevant in the context of urban planning, though unlike the concept of mobility environment as shown in this paper.

Other research that may help contextualize this article is that done by Rodriguez et al (2009). In it the author identifies different urban units in order to generate synergistic action between non-motorized mobility and the Transmilenio bus system. It is therefore a significant example of the potential to define urban areas as a basis on which to develop planning strategies related to mobility. However, there is a lack of methodological detail when combining aspects that link urban structure and travel patterns which is the line of study we will go into in our research. Another relevant example is the paper written by Damelle and Casas (2012) with respect to the public transport infrastructure on elements of urban structure. Unlike this research, influential spaces are not set out for such infrastructure and this is another important aspect that will have an impact at methodological level on the concept of mobility environment as presented here.

Based on the foregoing, in this article mobility environment is considered as a spatial unit for planning, resulting in an integrated assessment of urban structure and travel pattern factors to provide information on the following four dimensions of mobility:

a) Urban: relating to elements of the urban structure that impact on travel patterns.

b) Environmental: linked to the efficiency of mobility in the use of space and energy.

c) Socio-Economic: related to factors that can influence travel patterns when selecting certain modes of transport.

d) Modal: has to do with existing travel patterns based on aspects such as the provision of public transport, private vehicles, pedestrian paths and interchanges, etc.

III. IDENTIFICATION OF "MOBILITY ENVIRONMENTS" IN THE STUDY-CASE.

Five mobility environments were identified: (i) Proximity and local dimension environment (ii) Proximity and traffic distribution environment (iii) motorized traffic environment (iv) metropolitan centrality environment (v) Inter-modal stations environment.

The first of the identified environments is the proximity and local dimension environment, which refers to the sections of the corridor that mobility is characterised by a strong local dimension of the closet urban environment and therefore most of their mobility flows should be highly mediated by local demands. It is located in section 1 (town of Albolote), 3,4,5 (municipality of Maracena), 18, 19 (municipality of Granada) and 25 (municipality of Armilla). The proximity component is very important as so many of the residents needs could be covered without using motorized transport, hence, not spaces that stand out as centres of attraction in metropolitan mobility. Nor are such urban areas characterised by high volumes of traffic which is a result of not being connected to relevant transverse streets neither from the point of view of non-motorized or motorized mobility.

The results obtained show that they are places with high or very high residential density (≥95 dwellings/Ha) except section 1 in Albolote and section 3 in Maracena which is a consequence of their own urban structure that rural residential densities are around 35 dwellings/Ha. The non-residential intensity is medium to high in all cases surpassing the 100 urban

activities/1000 dwelling with a strong predominance of commercial services over other non-residential activities, as well as having a wide coverage of activities in almost all time slots throughout the day. In terms of travel patterns, non-residential activities are in areas with low levels of motorized traffic with an average of 46.02 vehicles/urban activity and 4.30 bus/urban activity.

Proximity and traffic distribution environment is the second mobility environment identified. In reference to those sections on the corridor that mobility is not only characterized by a strong local dimension of urban environment as in the previous case, they also have traffic distribution functions between different parts of the corridor. In light of this, it could be said that their mobility flows are mediated both by local demands of the immediate environment of the corridor, and the distribution of traffic and public transport in this space. This is a consequence of their connection to relevant transverse streets in most cases. The proximity component is important in this environment so that many of the residents needs can be covered without the use of motorized transport even though their location in the city makes them places with high motorized traffic that does not necessarily meet local demands but their role as traffic distributor routes. All sections that identify mobility environments are influenced by relevant cross sections on a non-motorized and motorized mobility level, reinforcing the role of these sections as circulatory distribution elements within the corridor. These sections are specifically 11,14,15,16 and 17 in the city of Granada.

The indicators show sections that are part of this proximity and traffic distribution environment sites with high or very high residential density (≥86 dwellings/Ha). The non-residential intensity is high in all cases exceeding 120 urban activities/1000 dwelling with a strong commercial-service domain over other non-residential activities, as well as having a wide spectrum of activities in virtually all time slots of the day. In terms of travel patterns it should indicate that they are spaces with low levels of motorized urban traffic of non-residential activity with average values of 36.34 vehicles/activity and 4.04 bus/urban activity.

The third environment identified in the corridor is the motorized traffic environment which refers to the sections that mobility is characterized by a very weak local dimension of urban environment. This is something that reinforces their status as transit and/or circulation points. They are identified in sections 6,8,9,10,21 (city of Granada) and 24 (municipality of Armilla). Thus, the proximity component is irrelevant in most cases because many of the residents needs can not be satisfied in the same place, hence, from a mobility point of view they become places used exclusively for motorized traffic or movement from one place to another in the corridor, or between the corridor and the rest of the urban area. This is a situation that is enhanced by its role as a circulatory route in the design of the city itself in many cases. Connecting these sections with relevant transverse streets can be a key issue in strengthening its role as sections to pass through. This is a situation which occurs in section 10 of the corridor, for example.

The results obtained show that they are usually places with low or very low residential density (<30 dwellings/Ha), with the exception of section 6 (52,43 dwellings/Ha) in the north of Granada and section 10 (133,28 dwellings/Ha). The non-residential intensity is low or very low with an average of 53.56 urban activity/1000 dwellings with predominantly commercial services over other non-residential activities. This is something that is insignifi-

cant considering the low level of non-residential activity which in turn makes it difficult to identify temporal distribution patterns of those activities. In terms of modes of access, one must indicate that they are spaces with high or very high levels of motorized traffic on a non-residential activity level with an average of 384.27 vehicles/urban activity and 23.68 buses/ urban activity.

The metropolitan centrality environment is the fourth environment identified. With reference to the sections of the corridor whose mobility is characterised by strong urban specialization, basically regarding industrial-technological uses and public facilities. It is located in sections 2 (town of Albolote), 13, 22 and 23 (city of Granada). Industrial and technological areas and the main university research campus' are located in these sections. So, these are places of mobility flow generation and centres of attraction and within the corridor. Connecting these sections with relevant transverse streets can be a factor that strengthens the identity of these environments as in section 13 and 14 of the corridor.

The indicators used show that they are places with practically no residential activity where the intensity of urban activities is very high. In all cases it exceeded 300 urban activities / 1000 dwelling with a strong industrial-technological and public facilities predominance on the other non-residential activities, concentrating most of its activities between morning and early afternoon. In terms of access and modes of travel it has to be said that they are areas with high levels of motorized traffic on a non-residential activity level because of its central location in the metropolitan area with an average of 123.48 vehicles / urban activity and 9.23 bus / urban activity.

Finally, the last environment identified is the inter-modal stations environment. This refers to a particular type of metropolitan centrality environment, which by their relevance as specific inter-modal oriented sites it was decided to treat them separately to the previous ones. This distinction was due mainly to the stakeholders who participated in the panel who stressed the importance or inter-modal stations on the mobility corridor, but not at the same level as the three previously identified vectors. This aspect was gathered at the time of processing the results obtained through the mobility environment category. The basic distinction with respect to metropolitan centrality environments lies in the fact that this environment is marked by the location of the main stations of public transport on the corridor such as the bus station in the north of Granada and the train station (future AVE station) in the central section of the corridor. The indicators used show that they are places with more residential intensity than other central residential environments previously shown. Residential intensity is high in the case of section 12 (164,187 dwellings/Ha) and lowest in the case of section 7 (42,62 dwellings/Ha). The intensity of non-residential activities also varies in each section being high in section 12 (240 act/1000 homes) and low in section 7 (52,81 activities/1000dwelling) with a predominance of commercial-services over other non-residential activities and also a temporal range covering the whole day practically. Concerning the modes of access, it should be noted that section 7 identifies high motorized traffic for non-residential activities of 471,81 y 46,56 vehicles/urban activity. These statistics are much lower in section 12 due to its high intensity of non-residential activity with 20,61 y 5,88 buses/urban activity.

IV. CONCLUSIONS

The method presented in this article puts the concept of mobility environment in operation as a tool for planning, effectively combining urban structure and travel patterns. The research begins by recognizing the rich scientific knowledge on this coupling and also underlines the methodological lack of tools to guide this knowledge into the decision-making process. It is noted that some of the main causes of this problem are related to the sophistication of existing research and its lack of applied perspective and/or weak spatial component. These are aspects on which the article tries to contribute new insights from both scholarly and practical perspectives.

The mobility environment was defined as a spatial unit for operational planning resulting in an integrated assessment of factors resulting in an integrated assessment of urban structure and travel patterns factors able to provide information on four dimensions relevant to mobility planning: (i)urban (ii) environmental (iii) socio-economic (iv) modal. The concept is acquired through a practical component of the proposed method. This component consists of three phases: (i) Definition of components, mobility indicators and vectors.(ii) Interaction matrix mobility indicators and vectors (iii) Definition of mobility environments. The method was validated on a corridor in the metropolitan area of Granada where authorized institutions took the decision to introduce a new Light Rail Train.

According to the approach of the article, the developed method is associated with a largely technical exercise in the process of mobility planning. So it is mainly aimed at professionals with expertise in the field. The use for them lies in having a simple and operational method through which operatively combine urban structure and travel patterns. So mobility environments act as a basic tool on which to propose strategies and guidelines. This eminently professional approach does not mean it is cut off from the real world. For this reason, the method identifies mobility environments by first gathering knowledge and experience of stakeholders involved in the planning process. This can be solved on a practical level by conducting workshops, Delphi panels, surveys etc. At this point, the article introduces a significant innovation with respect to the other research used throughout the study (see section 2).

The five mobility environments identified on the corridor of the metropolitan area of Granada are the most obvious examples of those previously mentioned. No special software or complex statistical application was used in their identification which supports the simplicity and applicability of the method. Furthermore, such mobility environments represent different realities within the corridor that had not been considered by the authorized institutions. The recommendation issued from the University was to address each mobility environment with a specified degree required by its own characteristics. However, the time span in which the project evolved didn't allow time to continue with the characterization and generation strategies for each mobility environment. Guidelines to optimize the introduction of the new Light Rail Train system were issued that the authorized bodies could take into account in order to conclude the collaboration between the University and other institutions.