BETWEEN ENGINEERING AND ANTHROPOLOGY: HOW TO COPE WITH THE PLANNING PROCESS OF PUBLIC TRANSPORT IN LATIN AMERICAN CITIES?

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ABSTRACT

Planning and designing an efficient public transport system represents an important but difficult challenge for public authorities. Frequently, the lack of coordination between different public and private stakeholders involved affect serious obstacles. Considering related problems experienced in the city Santiago de Chile, this paper suggests a comprehensive planning approach that integrates diverging interests, such as engineering and social sciences. Accepting the important role of existing planning tools (Origin-Destination surveys leading to mathematical models, purely qualitative studies), further additional methods are taken into consideration, i.e. specific motility surveys and detailed GIS-based observations. The overall goal consists in the development of a comprehensive mobility information system that integrates the various methods and tools and forms a central platform for planners and decision makers in the transport and urban development field. Besides, this exercise offers an adequate opportunity to reflect about the advantages of new technology use, facilitating the process of information collection and analysis.

1. INTRODUCTION

Designing and implementing a modern and efficient public transport system that enhances equal access to opportunities all along the city is one central concern in today's world cities of emerging economies. Especially on the periphery of urban agglomerations - where often the majority of captive transport riders live – an inadequate transportation system can easily contribute to social inequalities. Besides a wide set of challenges related to the definition of service quality, regulation and monitoring, the planning and dimensioning process of the network is a crucial issue. Experiences in several cities have shown that regulation and

modernization processes incorporating the re-designing of the network may confront serious social problems, ought on the one hand to serious accessibility changes and drawbacks concerning network density, walking distances and travel times, on the other hand also to orientation, information and affordability problems.

A vast number of public transport and mobility studies come from engineering -rather working on entire urban level with a strong mathematical orientation-, as well as anthropological analysis - focusing rather on in-depth assessment mainly in a micro-level of local communities. It is also possible to find additional quantitative indicators and data on transportation and mobility (other than inputs for engineering models) but in general they refer to small specific groups of people or subject. This leads to the existence of a methodological gap - and its related planning tensions - that should be overcome. Taking these challenges into account, this paper suggests the design of an information system for planning and decision making that integrates diverging interests of disciplines such as engineering and social sciences. Accepting the important role of existing planning tools such as Origin-Destination surveys leading to mathematical models, and additional purely qualitative studies, further additional methods are taken into consideration, such as specific motility surveys and detailed GIS-based observations on a micro-block level.

The challenge consists then in the development of a comprehensive mobility information system that integrates the various methods and tools and forms the central platform for public planners and decision makers in the transport and urban development domain. The intent to address the next issues forms the centre stage of interest if this paper: What are the relevant questions that have to be formulated, which are the indicators that can help to answer them and what are the most suitable methodologies and techniques that allow to count on the necessary information to build those indicators. It is clear that a lot of high quality research has been done around the world and that the ideas presented in this paper are not new. For that reason, this paper builds on the author's own experiences in Latin American cities, academic literature and applied research work for the policy making process. These sources show that a lot of information is gathered and there seems to be awareness about the gap between divergent interests and approaches. . Nevertheless, it is hard to find an integrative approach that synthesizes this information around substantive questions in a comprehensive, integrated manner. Even if I this seems to be an obvious fact, it is rarely explicitly developed in scientific literature nor in public documents or information systems.

The subsequent paper consists of three basic parts. In chapter 2 the dilemma and tensions between existing methodological streams, i.e. engineering and qualitative research of social sciences are sketched, in order to emphasize their various strengths and limitations. Chapter 3 sketches the set-up of an integrated mobility information platform based on the use and development of existing methods as well as the integration of new ones. In chapter 4, the paper concludes, exposing the strengths but also weaknesses of the proposals and emphasizing possible options of further work.

2. RESEARCH FRAMEWORK: PERTINENT INFORMATION FOR PUBLIC TRANSPORT DEVELOPMENT

The planning and design process of an adequate public urban transport system forms a difficult challenge, involving an interdisciplinary team of experts. As will be argued in the following, the appropriate combination of engineering methods (with more recent, rather qualitative working methods (may enable better and more sustainable planning results. Moreover, the implementation of costly technology has to be accompanied by appropriate information in order to succeed and to have the impact expected in terms of system improvement.

2.1 Traditional methods: focus on the trips

In Latin America, as also in other developed countries, these methods are quite hegemonic, providing the planning authorities the concrete figures for the design of transport supply. in daily transport planning procedures. Indeed, the dimensioning of the supply is normally based on a quantified demand analysis carried out by transport engineers, i.e. the establishment of so-called OD-matrices (matrices showing the origins and destination of trips in the different transport modes). These matrices are developed on the basis of a theoretical model where the urban area is divided into a set of traffic cells, wherefore rather homogeneous interior transport behaviour is assumed. The traffic flows between these cells are estimated on the basis of generating and attracting sources per traffic cell, such as number of inhabitants and number and type of labour and other central activities (education, commercial, recreational etc.). Building on basic socioeconomic information related to car ownership rates per person, income, age and gender, practitioners make assumptions concerning the traffic modes and also the routes / itinerates chosen in order to implement trips from one cell to another (classical four-step modelling or also advanced integrated modelling). In order to “adapt” this theoretical construct to the real word, data are needed, mostly taken from a respective OD (Origin-destination Survey) and additional traffic counts along main transport axes and at central transport nodes. The OD surveys feed the modellers with exactly the data they need such as number or trips per person and day for the different purposes, traffic modes used, temporal distribution of trip activities over the day as well as basic socioeconomic information of the population.

These data are extremely relevant, though it is rather obvious that they are able to cover only a part of real transport demand, since they refer to the actual trips done (observed demand) and cannot reflect all these trips which might have been done if the transport supply would be somehow different. Thus, the crucial concerns of transport research for the causal and directional relationship between transport demand and transport supply is touched. Moreover, there remain the questions for the fuzziness of inner-cell trips and the concentration on home-work-based trips as well as the under-estimation of rounds-trip loops. Concerning the latter, trip chaining is a more and more important issue where people intend to tackle with increasing time-space restrictions by chaining activities before arriving to the final destination, i.e. their work or living place. Moreover, strong criticism has been done to

the fact that the reflection of human behaviour, i.e. travelling and moving, is based on the basic assumption of absolute rationality of these human beings (Pattaroni et al., 2009). It is obvious that reality looks different, but the estimation of irrational behaviour is extremely difficult to deal with in planning. Finally, OD surveys face two further obstacles, related to their enormous costs. The first and more important is that, like the population census, the interval between surveys is in most cases very high. They are normally gathered - and taken as valid - in rather long intervals (e.g. every 10 years, as has been the case for many years in Chile1). Thus, there is a high risk of outdated information for the long period in between the various data collection points. The second obstacle is related to the high aggregation level and the lack of a finer segmentation of socioeconomic groups, which may be relevant and meaningful.

Nevertheless, putting the sense of transport demand modelling based on OD surveys into question is awkward, since it is crucial and forms the probably most convenient way to represent the traffic patterns on the whole city level in a comparably easy way of quantification. So one may doubt the basic assumptions and the theoretical construct the models are based on, as well as the calibration methods under regard of observed, effectively implemented trips, but one has to admit their utility for the dimensioning of transport supply on entire city level. This is particularly relevant concerning the decision making process at the central level. Without denying the importance and convenience of transport models, this paper argues that it is desirable to enhance the discussion on additional and further-going, complementary methods.

2.2 "Younger" methods: emphasis on the individuals

These methods uncouple the domain of transport analysis and planning from the pure focus on trip making and the quantification of observed flows. Instead, the individual is moved in the centre stage of interest. The conviction that pure transportation engineering focusing in trips people make cannot be enough in order to really understand people's transport needs roots already back to the School of Chicago in the 1930's when the natural and environmental determinants of human decisions and behaviour became of research interest (Kaufmann, 2008). The conviction of the common importance of productive, human and social capital for an individual's societal integration let emerge new research theories and methods. These methods intend to deeply understand people's behaviour and consumption patterns, not only based on classical socioeconomic criteria but also the individual's attitudes, values, experiences and perceptions. These factors are themselves strongly influenced by the person's role in society, social networks as well as social status. In this context the term of "mobility" is introduced, dealing with the person's capacity to move either in space or society (see, for example, Urry, 2007; Le Breton 2005 and 2008; Flamm and

[1] Since 2006 the method changed and annually smaller samples are carried out; nevertheless, smaller samples mean also less statistical power and less generalization potential for the entire city level.

Kaufmann, 2006; Kaufmann et al., 2004; Gutierrez, 2009!)[2]. Under this paradigm, it is unfolded the concept of motility which can be understood as "potential for being mobile", independent of the question if a physical movement, i.e. a trip, is carried out or not. This potential combines three domains, wherefore in addition to physical access to transport also the individual's competences and appropriation capacities and willingness are required (Kaufmann et al, 2004).

Social science researchers have started to tackle previously typical engineering fields, such as urban transport, by qualitative in-depth interviews, ethnographical studies and participatory observations on a micro, i.e. community and neighbourhood level. These rather qualitative methods going into detail have several advantages compared to classical methods since they are able to discover on the one hand potential mobility restrictions in form of not-undertaken trips due to inadequate transport supply, on the other hand also problems experienced while effectively travelling, related for instance to unaffordable transport costs, lack of safety and security, comfort and easily accessible information as well as restrictions by the person's physical and cognitive capacities and competences. In the second case travelling may be experienced as burden and stress and get a very negative connotation; an aspect that would never have been explored by exclusive passenger or vehicle counts.

The importance of a multidimensional understanding of daily mobility (instead of a dichotomous one, i.e. "to travel or not to travel" and by which mode) has also been identified by the two authors of the present work, for the particular case of Santiago de Chile. There the introduction of the new, sophistically designed public transport system, the so-called "Transantiago", in February 2007 affected eminent changes in people's accessibility conditions and daily life activities. The previous deregulated bus-based system had been characterized by many, sometimes parallel bus lines under private operation by almost artisan providers (sometimes acting as the actual route designers). Despite eminent safety, environmental, and market-set fare problems, this supply had been especially convenient for the rather deprived periphery of the metropolitan area of Santiago. The new Transantiago aimed at integrating the private bus-based system with the public metro network, on the basis of a trunk-and feeder system and a common tariff union. Following the famous example of the Transmilenio in Bogota/Colombia, the idea had been to implement an efficient system that incorporated new busses, a modern GPS-control system, electronic ticketing, a sophisticated infrastructure of segregated bus lanes and fast-entrance stops. Nevertheless, this ambitious system resulted to fail and was opposed to strong initial resistance by all kind of users. In addition to many initial problems related to planning, design and implementation failures, severe problems have probably been related to changes in people's daily travelling behaviour, such as the need to get used to a totally new network, new stops, longer waiting times, changes between the different modes, making use of the electronic ticketing card etc[3].

[2] Mobility research has already rather long experience in the European and North-American context but is rather young in the Latin-American research world. For an interest review of the concept of mobility in the social sciences see Kaufmann (2009).
[3] For a discussion on Transantiago implementation problems see Muñoz and Gschwender (2008).

The two authors were able to reveal these mobility problems in detail by a set of qualitative and ad-hoc methods on community level. In this framework, they carried out around 40 in-depth interviews with the residents in different deprived areas (districts of San Bernardo, Puente Alto, Lo Espejo), control of the actual supply at strategic bus stops (observations of frequencies, waiting times, occupation rates and inquiry of main OD relations), as well as an ad-hoc survey in approximately 50 households asking for the resident's travel needs, perceptions and experiences (only in the peripheral district of San Bernardo). The results of the latter were crosschecked under support of a GIS with the socioeconomic information of these households, on the basis of the census results, disaggregated on level of housing blocks. By this manner the relations between more global, spatial and supply-related features on the one hand, and individual, social and emotional perceptions on the other hand, were identified. Being absolutely aware of the lack of representative power, the author argues that these detailed results on block-level are transferable to many similar settlements located at the urban fringe of the metropolitan area, where important parts of lower income households live (Hernandez, 2008; Witter, 2009).

Some examples of the related research findings may underpin the added value of these methods. Regarding the example of the micro-research in the San Bernardo block, one could see that some of the interviewees used informal means, even when they had spatial access to formal options. The related reasons for the use of informal means were twofold, on the one hand the lack of trust in service frequencies and the expectation of crowded buses in peak hours, on the other hand a strong aversion to transfer between several bus or bus and metro services. The lack of confidence in specific transport modes as well as willingness to carry out mode shifts could also be revealed by the qualitative in-depth interviews in the deprived comunas of Puente Alto and Lo Espejo. There especially women with a lower education level declared to feel an aversion or even "fear" to use the metro, due to the lack of comfort, daylight, less orientation and simple lack of previous experiences. The results of these two qualitative and micro-level studies, especially related to the importance of emotions and perceptions of travelling, were actually confirmed by other studies in the metropolitan area of Santiago (e.g. Lazo and Contreras, 2009; Jiron, 2008; Avellaneda, 2007; Jaramillo, 1993).

Thus, summarizing the research practices and own experiences presented above, a maximum of understanding of mobility problems and the gap between actual supply and real demand, seem to be only possible on the basis of very detailed observations on a geographical "micro" level, under support of in-depth, often qualitative methods. Probably it is only this in-depth understanding that allows developing and formulating new theory, always under the condition that internal validity is guaranteed. However, central criticism refers to the lack of confidence and knowledge about the entire research universe, i.e. external validation of micro-level observations is hardly feasible and not justifiable. Moreover, external validation and the quantification of observed mobility phenomena are indispensable prerequisites for the planning process and correct dimensioning of transport supply and the definition of its main characteristics. Of course, dreaming from an ideal research and

planning context, one may require permanently updated surveys in all kind of urban areas, rather based on the mobility potentials of individuals than on pure Origin-Destination relations. These mobility surveys would go into detail, ask for the person's socioeconomic background but also his or her feelings, experiences and attitudes towards the different transport modes and towards travelling within the city in general. Obviously, such a methodological approach would hardly be applicable in the context of the development of an urban transport plan or specific transport projects, under given restricted resources by public authorities.

So, how to deal with this dilemma of multiple visions of transport and mobility? Which way to choose between a global view for the entire city, integrating some basic features but leaving others (maybe equally crucial ones), behind, or a more disaggregated way, putting emphasis on systematic details and heterogeneous human behaviour, but affecting significantly higher operational and monetary planning costs?

3. IS "IN DEPTH" INFORMATION A FEASIBLE INPUT FOR PLANNING PROCEDURES?

What can be done if existing tools such as the OD survey and qualitative methods do not seem to be enough? The authors suggest that an effective information system has to be built up, which integrates different methods and surveys, to be carried out in different time frames and different scope of details. This can normally be done by the revision of existing tools and their further development and new combination, in order to maximize their common output. However, planning authorities should less put their focus on methodological issues but on the interest to achieve a common consensus on research and policy questions and related indicators.

This consensus has to give unity to the information building procedure that has to be considered as a process and not as a by-product of separated methodological tools. Indeed, the discussion is not about divergent methods and disciplines but about concrete interests, questions and related indicators. Hence, the first and crucial step is to reach consensus on: a) what questions do we must ask to set a general framework on mobility? and b) which are the adequate indicators to answer them? In this context it is possible to identify four central questions that should frame the discussion on public transport and mobility: a) what is the actual spatial and economic access of people to transport and activities?, b) what are the obstacles of people to make use of this actual access conditions?, c) what else is missing in order to enable adequate mobility for everyone?, d) what are the institutional characteristics or what is the adequate institutional framework of public transport or, in other words, what are the institutional components that enhance or make it more difficult for the people motility? (public funded subsidies, public-private mix in the provision of transportation, mandatory implementation of supervision and control technology, etc).

For all these questions, important control variables have to be introduced, in order to know the way that mobility as capital is distributed over the population, both geographically and socioeconomically. As other types of capitals, they are assumed to be not equally distributed between individuals and households. For that reason, they interrogate on two key dimensions: space and territory on the one hand, and socioeconomic status on the other hand. These questions have to be kept in mind in order to review which tools - and as a result which information - are available to build up a permanent information system on mobility as important input for decision makers.

3.1 Potential of existing methods and tools and integration of new ones

After having defined what has to be known, the discussion on relevant information sources and work strategies can be started. In this context, a central concern is about information already available by classical data collection methods and the possibilities to maximize their utility concerning given interests. In that sense, the next paragraphs depict the most relevant characteristics of existing tools.

In terms of systematic and regularly published indicators, there are the basic mobility indicators that can be derived from OD surveys and related data analysis procedures. Besides that, the OD surveys could also provide more precise description of individuals' and households' mobility patterns. Indeed, one could take much more advantage of these databases by linking socioeconomic characteristics to trip patterns and habits. I.e., the known and measured trips are a highly valuable input to build travel patterns that consider not only origin and destination but also stages involved (trip chaining), lengths, purposes (but in a disaggregated way), income, gender, household expenditures for travelling etc. It would be possible without any bigger questionnaire enlargement, to build typologies of individuals regarding specific mobility peculiarities (or at least known trip patterns). So the indicators on travel behaviour would allow forming categorical groups such as - just as an example - "round trips poor women" or "number of daily trips of people living in peripheral areas".

In this framework, a central concern refers to the definition of relevant groups, i.e. how many and based on which criteria? Having a look to literature, one can find two basic approaches (Ohnmacht et al, 2009) First of all the classical "vertical" factors related to human capital, and second, the rather recently better defined "horizontal" factors related to lifestyles, attitudes and consumption patterns. Independent of which criteria are selected, the necessary information to pick one and its detailed specifications will not come from conventional OD surveys. The way how to define these groups and related criteria and benchmarks have to be decided case-wise, but one may assume that in Latin America the classical concept still counts much stronger that the one based on urban lifestyles. Possible reasons for this assumption are based on the significant modal share of public transport options and the importance of economic factors, e.g. the affordability of fares.

This question leads again to the other mostly used methods, the qualitative ones. Indeed, these are a great opportunity to tackle the question of mobility distribution between different

social groups and to come up with relevant factors that perhaps could be easily included in a survey questionnaire. An – in some cases already common - method in the sense of in-depth analysis of specific and individual travel patterns are the so-called travel diaries, asking for a person's daily or weekly out-of home activities. Nevertheless, these diaries have been fronted harsh criticism since they are difficult to implement in a comprehensive way. Still more crucial, the results are doubtable, since people tend to forget about certain trips, e.g. in walking distances, and the fatigue-effect after some days is high. Here the technical progress may help, and the example from Switzerland is of interest where in several studies GPS pocket equipments were distributed among a set of voluntary participants. These people were willed to carry with them the GPS over the whole research period, allowing the tracking of all their activities during that time. The parallel implementation of a travel diary and the posterior interrogation of people's activities in an in-depth interview enabled to compare and make consistent actual and perceived trips, in order to reduce the related bias and to improve the methodological research approach (Flamm et al., 2007).

However, as already mentioned, these more qualitative studies do not allow for generalization and quantification. Remembering the research results commented before it is significant to know for instance the percentage of the population that "breaks" the fare union logic (including the need to carry out mode shifts) due to inadequate public transport supply characteristics (Hernandez, 2008), or the percentage of people that avoids specific transport modes due to security reasons and personal aversion (Witter, 2009). In this moment the discussion on additional methods becomes pertinent.

Additionally, two methods are proposed which are rather new in the Latin American context and meant to complete the OD surveys and qualitative studies: a survey putting emphasis on the whole complexity of motility issues as well as an in-depth GIS-based spatial analysis of motility conditions and distribution.

Thus, a motility survey might be feasible in a working period of every 3-5 years, tackling the questions of physical and economical access to transport, but also the perceptions, associations, experiences and feelings related to travelling and the use of different travel modes. These questions refer to the topic of competences and capacities. Finally, also some questions related to the person's appropriation process, i.e. his or her willingness, problems and restrictions in relation to the person's lifestyle are of interest, in order to touch the normally unknown sphere of not-observed, not implemented trips which might have been done under a different mobility framework. An interesting example for the feasibility and utility of this type of surveys can be the case of Switzerland, where the rural interurban bus network, operated by the national post company, is today under process of modernization and reorganization. In order to get to know the real demand and needs of the rural residents – and not the observed effective use of the busses that is under given supply characteristics rather low, the post carries out a comprehensive mobility survey in approximately 17,000 households, where the people's lifestyles, attitudes and values related to travelling are inquired. An activity-based travel diary completes the information, in order to get to know crucial trip information such as origin and destination relations, trip chaining, modes and

purposes. While the first part tries to discover the competence and appropriation part of the interviewees, the travel diary tackles the access part of mobility, in completion to classical OD panel studies, which are carried out regularly (every five year) in whole Switzerland in approximately 60,000 households (Website Swiss Administration, 2009).

It is clear, though, that this information is not sufficient in order to address some actual conditions of the supply side. In fact, the motility survey mainly refers to the demand side of mobility. In addition, it is needed to take advantage of the available GIS resources to tackle a deeper approach to the supply side and, more generally, spatial accessibility conditions in the city. Given spatially referenced information for the transit network (and its most important supply characteristics) and for a set of relevant destination categories, it is possible to count on indicators regarding accessibility to the network but also the time and costs, in order to reach to the locations of relevant activities. Even if this is not exactly a new approach, the authors argue that its usefulness in the context of transport and mobility planning is currently underestimated and could be significantly enhanced, particularly in the Latin American context.

A central condition in this framework is related to the need of precise and updated cartography of the transit network and of some key services, which have to be identified in the map. Once this condition is guaranteed, it is possible to calculate distances to different types of public transport supply (more or less frequent services, routes with overnight available services or not, etc) and impedance calculations (in terms of time and costs) to reach key activities, e.g. schools and hospitals. In the best scenario, spatially referenced socioeconomic data (from census and household surveys) should be included in the analysis to define potentially special target groups for some services (e.g. 6-12 years old children for the service of primary schools). Again an example from Europe is of interest. The core national accessibility indicators from Great Britain compile a comprehensive spatially referenced data set, which includes for all municipalities the locations of relevant destination categories (education, health care, employment opportunities, supermarkets and convenience stores). As a result this system comes up with a number of concrete indicators by which they combine socioeconomic characteristics, travel impedances and normative mobility thresholds. Thus, a concrete example is the percentage of young people (at the age of 16 to 19 years) as target group, living within 30 and 60 min of a further education college by the different travel modes (DFT 2009a; DFT 2009b; SEU, 2003)[4]. Once again, despite the importance and value of this information, it tells us only a part of the story, Moreover, and due to its own nature, this set of indicators are spatially biased.

However, there exist already some initiatives from public and private sources that take account of indicators on mobility. In addition to the cases mentioned above, and just to set a

[4] New or cheaper technology enhances the opportunities to feed the planning process as well as the understanding of public transport phenomena with high quality information. Indeed, the progress in personal computers capacity and GIS software enables to count on updated and spatially referenced information and to process it without spending too much time. Note that in the past, given technological restrictions, only some military institutes and the national statistics offices were capable to deal with pretty complex GIS tools and procedures.

few examples, one could consider the Latin American Urban Mobility Observatory (Observatorio Latinoamericano de la Movilidad)[5]. This is a very interesting effort to standardise a set of indicators for the region. However, they refer to information on economic issues (costs, fares, etc), trips (modal share, etc), infrastructure, environment and energy use. There is almost no reference to spatial accessibility and motility indicators. As a result, one can have an approximation of the "big picture" but not to the performance of public transportation and mobility system as a whole.

Another example for the Latin American case (more specifically the city of Belo Horizonte in Brasil) can be found in Gomide et al. (2005). This document presents an interesting presentation of indicators on public transport indicators through a 'synthetic index for public transport adequate service' that uses geo-referenced data. They address four dimensions by building indexes for each one (affordability, availability, accessibility and acceptability) and a synthetic index that takes account of all of them. The basic empirical evidence (which is geo-referenced) comes from a survey to public transport users and is analysed in maps on the level of regions and subregions[6]. However, the activity locations and some supply variable such as schedules and actual headways (that could easily be generated from existing data) are not taken into account, giving important information on the real household's travel conditions.

An important number of other examples are available. Some consist of conjuncture studies and others are part of an entire information system. However, the systematic review of these works is out of scope of this paper[7]. What it is important to take into account is that - similar to the European examples - there is not a single systematic, multidimensional and simultaneous approach, which would fulfil the prerequisites of an effective information system. In the following a first approach is given for the development of such a mobility system.

3.2 Setting up a comprehensive mobility information system

As already said, overall goal is to set up an integrated mobility information system that gathers the different information sources and allows deriving a comprehensive set of meaningful and quantifiable mobility indicators.

[5] This is a initiative at the Latinamerican level and it has not published products yet. The description refers to a presentation during the XV Congreso LAtinoamericano de Transporte Publico y Urbano (CLATPU) in Buenos Aires, april 2009.
[6] Affordability, for instance, has to do with the percentage of poorest households income spent on public transport purposes.
[7] See for example the National Urban Indicators System of Brazil (available on line at http://www.cidades.gov.br/secretarias-nacionais/saneamento-ambiental/indicadores/indicadores); the Urban Mobility Observatory from Bogota (available on line at http://www.transitobogota.gov.co/omu/contenido/categoria.aspx?catID=8); the Urban Mobility Information System of the Asociacion Nacional de Transporte Publico of Brazil (available on line at http://portal1.antp.net/site/simob/default.aspx) PNUD (2008); MDMQ (2008). All on line resources were last retrieved on January 2010.

Regarding the indicators separately considered, they should fulfil two basic requisites: a) they have to provide deeper information than the trips effectively done and b) they have to inform on the whole (or at least a major part) of the city. In the table presented below the different methods described above are presented, including their objectives and role within the information system, investigation intervals and information-depth. The information is finally transferable to a list of indicators which at this point are presented just in an exemplary way, without claiming for completeness.

Table - Method, information and indicator table (OWN ELABORATION, 2009)

	Objective / End and period / intervals	**Information provided to feed information system**	**Exemplary indicators (quantifiable)**
Qualitative studies: Ethnography, in-depth interviews, focus groups	To understand mobility habits, to collect information not reachable by traditional means. To feed quantitative tools with useful and relevant research questions and possible segmentation variables. It is not necessary a fixed frequency. Their results will be inputs for quantitative tools.	Subjective and deeper perspectives (feelings, sensations). To have in depth knowledge of trips features and lifestyles in order to have a better classifications of socioeconomic groups.	Not applicable, since not quantifiable, but giving important input for other methods
"Classical" OD survey (with adjustments proposed)	Transport modelling tasks (calibration of models). Basic relations between population / socioeconomic groups and typical trip patterns To be carried out all 5 – 10 years	Origin and destination of trips Number o trips per person and day Trip purposes Traffic modes used Temporal distribution of trip activities over the day Basic socioeconomic information	Modal split, disaggregated per transport purposes (part of OD survey) % of people who choose a specific mode due to reasons that are not related to time and cost minima (as conventional planning basis for modelling procedures); thus the % of people who may provoke high uncertainties in the subsequent modelling process. Expenditures on transport purposes in relation to the person's and/or the households' income % of trips that include more than one destination and purpose (trip chaining of activities) % of trips that include more than one travel mode (trip chaining of travel modes) Education level; household income; age, gender Number of trips per person and day for the different purposes (also social, recreational etc. trips)

Motility survey	Deeper knowledge of subjective perspectives and obstacles regarding public transport; Formulation of indicators for the whole city, especially on the competences and appropriation dimensions of motility. To be carried out all 3 – 5 years	Modal choice (preferences and motivations) Policy perceptions Policy Legitimacy Perceived obstacles Not done trips and reasons Spending on transport Activities Activities preferences Obstacles derived from the network (access and security) Obstacles derived from competences Obstacles derived from activities Socioeconomic indicators (survey as primary source)	*Some pieces of information originated in this tool are inputs for other methods (not expressed as indicators).* % of people who declare to find travelling and moving in the city as difficult % of people who do not have a car, a) in their own household, and b) in their closer environment of friends, family and neighbours % of people who use public transport less than once a week % of people who evaluate the public transport supply as bad or very bad, including related reasons (also safety, security, comfort, emotional etc. reasons) % of people who evaluate the local transport policy and authorities as bad and very bad. % of people who declare willingness to shift to public transport (or % of people who are former users of public transport) % of persons that have no access to information systems about routes, schedules, etc.
Spatial analysis (GIS) with emblematic destinations	Network analysis; good cartography. Permanent / whenever updated information is available (for instance when a census take place). For public transport routes yearly updates would be convenient and possible.	Proximity to services or routes (or bus stops) according to quantity, type (feeder (local) or trunk service), Overnight services, quantity of routes, scheduled frequency of services, indicators of violent events (police reports, victimization surveys). Social indicators at geographical cell level (block or group of blocks): income level, internet access, motorization rate, basic goods ownership, access to basic services. From census or household surveys.	% of people who cannot reach a public transport station within 5 or 10 minutes walking % of people who do not have adequate access to education, health, commercial and recreational facilities and green space within a given threshold of distance or travel time in the different modes[8] ***Education sector[9] (DFT, 2009a):*** % of children aged 5 to 10 years within 15 and 30 minutes of a primary school by public transport/walking, by cycling, and by car. % of children aged 5 to 10 years who receive free school meals within 15 and 30 minutes of a primary school by public transport/walking, by cycling, and by car. % of people aged 16-19 years within 30 and 60 minutes of a further education college by public transport/walking, by cycling, by a composite of public transport/walking and cycling, and by car. **Health sector (DFT, 2009a):** % of households within 30 and 60 minutes of a hospital % of households without access to a car within 30 and 60 minutes of a hospital % of households within 15 and 30 minutes of a general practitioner % of households without access to a car within 15 and 30 minutes of a general practitioner **Employment**

[8] The relevant activities and destinations should be locally defined. Education, health and employment seems to be of universal interest. The same is valid regarding which points in the space are effectively considered as providing the relevant activity or service (for instance which hospitals should be considered for the health sector).
[9] The indicators by sectors are based in DFT, (2009)

			% of people of working age (aged 16 to 74 years) within 20 and 40 minutes of a location with more than 500 jobs % percentage of people for selected economic sectors within 20 and 40 minutes of a location with more than 500 jobs of each of those sectors.

4. SUMMARY AND CONCLUSION

It could be shown that existent tools for public transport planning and related information collection methods are often not enough in order to tackle the transport problems and needs of the inhabitants of Latin American cities. Considering the tensions between divergent conventional approaches of engineering and qualitatively oriented social sciences, it has been argued that both streams are important but not sufficient for mobility analysis. That is why this paper tries to develop these methods and to add some newer features, based on a concrete *motility survey* (looking for the people's mobility potential) and a detailed spatial analysis on block level, under support of a GIS tool. Finally, the different tools – to be used in different time periods - are assembled together, offering a comprehensive mobility information system for transport planning and decision makers.

From this compilation of information sources can be derived a set of relevant mobility indicators that are quantifiable and implementable. These indicators are seen as crucial in order to develop and maintain a data set for adequate transport analysis and development, under given benchmarks to define by the authorities. This may enable a transparent and integrated planning process, which is on the one hand politically legitimate, on the other hand feasible under given restricted resources. And not only the planning process but also the system's monitoring possibilities are of importance, since – just in other public planning sectors such as health or education - public authorities should have access to information that indicates how the system "transport and mobility" is doing and to be able to intervene, if necessary. So indeed, examples from Europe have shown that the various additional methods are already used and give their certain added value to the local transport design process.

As it was stated, the ideas presented in this paper are not new. Additionally, the listing of indicators has to be completed according to other, locally specific interests. Specific interests – dependent on the local context - have made it also impossible to define at this stage concrete user groups of transport, the data should be disaggregated for. Moreover, it always will remain a big challenge to integrate different information sources originating from different working sectors (engineering and social sciences, transport and urban planning etc.), which hardly can be achieved in an optimal way. However, technological improvements may facilitate more and more this integration process, and help to reduce the operational obstacles and difficulties related. Finally, the availability of financial and human resources to really implement a motility survey and maintain an up-dated spatial analysis system are more

doubtable in the Latin American context. Hence, further research in relation to the feasibility of such a mobility information system is definitely needed.

Nevertheless, the authors here just intended to come up with the reflection on the imperfections and drawbacks of existent planning tools and to enhance the discussion of possible adjustments and solutions. To some extent, the motivation to write this paper consists of the wish to make explicit some "*obvious*" facts, which do not seem to be that obvious for some actors or disciplines. Again should be stressed that the existence of *all* common tools is justified and bear important potential. This potential should be used and further developed in the frame of a - never optimal, but significantly improved - planning and design process, with a stronger emphasis on social equity and the needs of deprived population groups.

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