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Evolution of the conceptual basis for the assessment of urban mobility sustainability impacts

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Abstract. In this paper we highlight the evolution of both the conceptual basis and the methodological approaches for the sustainability assessment of transport and urban mobility. Through the review of key contributions in the field we highlight the significant shift in perspective that has occurred over the past two decades, characterized by a series of changes in the development of urban mobility patterns. Perspectives, goals and strategies evolved to the point that they represent an actual shift in the paradigm, i.e. a change in the points of reference for conceiving an urban mobility system. The theoretical foundations for the evaluation of sustainability impacts have changed accordingly, flanking the emphasis on the environmental impact with an increasing attention to the social and economic impacts. Although fragmented, the literature on urban mobility principles and development provides useful insights on the rationale behind the above mentioned shift in the paradigm. We review such literature outlining the major traits of the studies regarding sustainable mobility that emerged over time. Second, we focus on the two main perspectives (that we label *principles oriented* and *planning oriented*) that shaped the way sustainable urban mobility is conceived today.

Keywords: Sustainable mobility, urban sustainable mobility, sustainability assessment, sustainable transport.

JEL Classification Numbers: M48

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1 Introduction

The sustainability of transport, and urban mobility in particular, has become over time a major concern for policy makers and a conceptual challenge for scholars of different disciplines. In spite of significant technological improvements being introduced over the past twenty years, according to EPA¹ transport is still responsible for 14% of global GHG emissions, more than half of NO_x emissions and about 15% or more of other harmful pollutants; moreover, unlike other sectors, it is estimated that transport will increase its emissions in the future. Within an urban context, the environmental impacts of transport are even more relevant, and flanked by further social and economic impacts given the involvement of a large majority of the world's population: indeed, according to UNFPA 54% of the world's population currently lives in urban areas and 80% of global GDP is produced in towns (UN 2014). In Europe, urban dwellers represent 73% of total population and such figure is on the increase. Cities are also crucial hubs for the transport of goods and people at medium and long-range, thus the quality of urban mobility infrastructures influences the quality of the entire transport system. Such framework placed urban mobility as a priority in the policy checklist as well as in sustainability research.

In parallel with growing concern about the environmental and socioeconomic problems related to urbanization processes, the assessment of the impact of Urban Mobility Systems (UMSs) on sustainability has become a crucial topic. The proceedings of the 1996 OECD conference "Towards Sustainable Transportation" represent not only a review of crucial issues but also a fair portrait of the debate, at that time, on the principles for sustainable mobility (OECD 1997). In transport, the debate on sustainable development and related principles had burst few years earlier (Banister & Button 1993; Whitelegg 1993), and the OECD proceedings fairly summarize both the consolidated knowledge and the (sometime even heated) debate on mobility of the time. For this reason, in the spirit of a twenty-year review, we adopt the OECD proceedings (OECD 1997) as a watershed, useful to highlight two decades of evolution on the thoughts on sustainable transport. For the aim of this paper we will refer to the ante-1996 positions and literature as "initial" or "original", as opposed to the current ones. Given this necessary simplification, in the next section we describe what we believe are the most relevant changes in the perspectives adopted by scholars assessing the sustainability impact of urban mobility.

¹ <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#transportation>

2 The emerging issues in urban mobility planning and management

In our view, over the past two decades research on mobility management highlighted a series of issues that were previously overlooked and that shaped the present debate on the assessment of transport and urban mobility sustainability. We here summarize the most significant evolutionary traits.

1) *A shift in the focus from “transport” towards “mobility”*. Mobility represents a broader concept compared to transport, since it “refers not only to actual movement, but also to a potential to move and thus to the spatial, economic, and social context of movement” (Gudmundsson 2003). As a consequence, contemporary analysis is much more interdisciplinary than twenty years ago, when technological development and public policies were basically the only levers of intervention. The emphasis on individual mobility and on the implementation of land-using infrastructures is replaced by a focus on providing sustainable accessibility through the integrated planning of land use and mobility (Bertolini et al. 2005; Curtis 2008; Geurs & van Wee 2004). The integration of mobility and land use planning, albeit with a long tradition, only recently reconsidered the role of transport demand forecasts in orienting infrastructural development.

2) *From eco-centrism and techno-centrism to socio-centrism*. The last decades witnessed an increased relevance of transport impacts as a consequence of the political prominence given to sustainability in general and to the specific issues caused by transport in particular (Button & Nijkamp 1997; Gudmundsson 2004). The initial emphasis on the environmental impact, mostly summarized in terms of pollution and land consumption, has been integrated (not substituted) over time by an increasing attention on social and equity aspects (Banister 2002), to overcome the evident discrepancy between a techno-centric approach to transport planning and its effects in terms of socio-economic impacts on the urban environment (Hoogma et al. 2002). Moreover, the increasing relevance of the urban dimension highlighted a variety of issues requiring a system-based policy orientation (Goldman & Ghoram 2006) and enhanced the contribution of approaches other than economics and engineering (i.e. geography, urban planning, behavioral sciences, management).

3) *The emerging inherent value of travel*. The view of travel as a derived demand (i.e. merely providing utility through reaching the destination) rather than an inherently valued activity, has been questioned and gradually abandoned, replaced by an emerging concept of mobility opportunity as a key contributor of economic and social benefit (Banister 2008). Such a shift in perspective has an impact on assessment insofar it induces different framing of variables that are traditionally

assumed as priority goals of transport planning and proxies of travel quality as well (e.g. speed and time minimization). Nowadays the concept of sustainable commuting considers the overall door-to-door journey from a multi-modal perspective, thus including a combination of means of transportation (walking and biking included) as a way to maximize efficiency and effectiveness of commuting (Kumar et al. 2013).

4) *The relevance of the local context.* The last two decades boosted the peculiarities of specific areas of transports and the dichotomy between issues related to transport in general vs urban and local environment; indeed, the implementation of local sustainability principles may be in conflict with the principles of sustainability applied at macro-regional level (Vickermann et al. 1999). In fact, although mobility infrastructure are considered as a crucial element in the development of territorial cohesion, it has become evident over time that a poor planning of overall land use and the development of surface transport create physical barriers that might result in ghettoization and in the disruption of social cohesion, rather than in its support (Miciukiewicz & Vigar 2012). Such awareness impacts on sustainability assessment to the extent it boosts the relevance of the involvement of citizens and stakeholders in the planning stage (Banister 2008), which is now considered an indicator of sustainability itself.

5) *A broader and more complex articulation of economic and financial issues related to mobility.* Originally, the economic sustainability of transports and UMSs was somehow given for granted, problematized in strictly economic terms of public costs vs public benefits (Lakshmanan et al. 2001) and in market vs public control. Little attention has been paid both to the external costs of transport and to the financial sustainability of UMSs (Buehler & Pucher 2011). Today great emphasis is given to the trade-off between socio-environmental improvements and the economic sustainability of transport. Two aspects to be investigated clearly emerge. First, it is necessary to define a method for the assessment of the external costs of transport (Bickel & Friedrich 2013; Essen et al. 2011), in order to set an efficient pricing for transport infrastructures (Maibach et al. 2007). Second, the assessment of UMSs' economic benefits envisaging the creation of efficient business models for transport services, in order to trigger dynamics of business model innovation capable of supporting the sustainability transformation of markets (Schaltegger et al. 2016). It is noteworthy that, although there is widespread consensus among experts, companies (testified, for instance, by the WBCSD program Sustainable Mobility 2.0) and policy makers on the relevance of the issue, the possible development of business models to support sustainable urban mobility is still receiving little attention from academic literature and with a focus angled towards specific solutions rather than to the overall mobility system (Cohen & Kietzmann 2014; Christensen et al. 2012).

This list of evolving traits is necessarily affected by subjectivity, since the literature is fragmented and usually tends to dwell on one or more specific aspects within such topics, rather than trying to systematize the conceptual roots of the various arguments. In our opinion this is due to the fact that most of the studies on measuring the impact of urban mobility in terms of sustainability are oriented almost exclusively towards the empirical application of measurement methods and instruments. Moreover, given the multidisciplinary nature of mobility issues, several strands overlap with respect to the various branches of knowledge involved, making the systematization even more complicated. On the other hand, the impact of the evolution in perspectives on mobility assessment is evident and its relevance in terms of policies has increased accordingly. The missing link is however represented by a gap in the definition of basic principles. In other words, though it may seem paradoxical there is no consensus on what principles should be at the basis of the mobility assessment. In the next section we try to show how the evolution of perspectives on sustainable mobility have privileged the practical implementation of policies with respect to the definition of conceptual basis for the assessment of the impact of urban mobility on sustainability.

3 The evolution of perspectives on urban mobility principles

The debate on sustainable transport and related principles had burst in the early '90s (Banister & Button 1993; Whitelegg 1993). The earlier discussion struggled to faithfully adhere to the principles of sustainability as originally expressed in the "Bruntland Report"; consequently, the principles for sustainable transport were enunciated almost regardless of the field of application. For instance, Gudmundsson & Höjer (1996) identify as principles for the sustainable transport: a) to safeguard a natural resource base within critical loads, levels and usage patterns, b) to maintain the option value of a productive capital base for future generations, c) to improve the quality of life for individuals, d) to secure an equitable distribution of life quality. The authors conclude "the mobility patterns, which dominate western societies today, are not in accordance with these sustainable development goals" (Gudmundsson & Höjer 1996, 280).

The starting point of the discussion underlines the (obvious) unsustainability, yet principles derived from the original institutional approach to sustainability are far too generic and detached from the huge variety of individual needs to provide any guidance to decision makers in situations involving trade-offs. In other words, the price of adopting a rhetoric aligned with the "Bruntland Report" one is the feebleness in solving the everyday dilemmas (Greene & Wegener 1997). But of course the general principles of sustainability maintain their role in the subsequent discussion on mobility. Currently, the institutional vision is merged into the outcomes of the pragmatism

introduced by a gradual shift towards operating principles, in the attempt to overcome the inherent contradictions in the concept of sustainable mobility and to provide principles that can serve as a guide for policy-making.

Gudmundsson (2004) identifies three approaches to the assessment of sustainable transport. The first approach stems from the implementation of a policy agenda and includes sustainability into transport planning through the consideration of specific indicators. The second approach stems from the replication and adaptation of the sustainability concept in the field of transports to determine its implications (Gudmundsson 2004, 37), while the third approach is actually the synthesis of the previous two. Stemming from this contribution, we believe that the actual differences in predominant perspectives reflect the different goals of those (experts and scholars) who tried to give conceptual soundness to the inherent contradictions in the concept of sustainable mobility.

Drawing inspiration from the important contribution of Gudmundsson (2004), in all this we see at least two predominant perspectives (here labeled “planning oriented” and “strategy oriented”), that reflect the different goals of expert practitioners and scholars who tried to give conceptual soundness to the sustainable mobility concept.

The first approach (*planning-oriented*) sees principles’ definition as a priority subordinated to the management of the trade-offs emerging when conflicts among priorities become evident (i.e., the contradictions between desirable and undesirable effects of mobility systems). This approach focuses on planning, on how mobility systems should be set up and on what decision makers should do, given both priorities and consequences (desirable and not) of the evolution of mobility demand (Banister 2008; Kennedy et al. 2005). It is acknowledged that decision-making processes tend to focus on goals and impacts that are easy to measure, overlooking more complex assessments constituting an obstacle to define the achievement of sustainability as an end-state (Litman & Burwell 2006, 333). Since principle definition is a “bottleneck”, it is eluded by focusing on the policies enabling a “more sustainable” mobility (Goldman & Gorham 2006, 263). The defining feature of such approach is the focus on planning activities, process definition and measurement, while the actual definition of comprehensive principles for sustainable mobility remains in the background. This approach relies on the sustainability assessment through reporting and/or indicators as a goal-oriented premise in pursuing sustainable urban development; consequently, in such perspective the development of indicators, benchmark analysis, databases, etc., constitutes a priority both for research and for policy implications (Gudmundsson 2003; Hiremath et al. 2013; Hüging et al. 2014; Joumard & Nicolas 2010).

Most contributions within this approach benefit from the massive effort of the EU to spread knowledge and investments in sustainable mobility, an effort that generated over time ground

experience and a large amount of documentation. A recent report from EU Com. DG Move (2013) represents a sharp example of how to apply the set of available analytical tools to measure the impact of UMSs, according to the pragmatic perspective of urban planners and policy makers (EU Commission – DG Move 2013). More in general, the steps taken by the European Union have particularly supported the dissemination of a common understanding of both sustainable mobility principles and planning tools (EU Commission 2001, 2007, 2009, 2013). In addition to official EU documents, many other contributions to improve mobility planning are produced by organizations (local authorities, companies, research institutes, etc.) that over time have carried out a long list of relevant projects on the topic. At present, the most adopted and well-known guidelines for the diffusion of Sustainable Urban Mobility Plans (SUMP) are those developed by Eltis, the Urban Mobility observatory. Such guidelines² are part of a vast platform³ devoted to providing adequate instruments and references to all parties engaged in the activities of sustainable urban mobility plans.

It is worth noting that, although the general principles for sustainable mobility stated by the EU are consistent with the Brundtland report concept⁴ (thus suffering from the same vague blurriness), the tools developed in the framework of European action are extremely practical. Moreover, the number of completed initiatives for the improvement of urban transport systems' sustainability is extremely high.

The second perspective (*strategy-oriented*) tries to adapt and operationalize the general principles of sustainable development (Gudmundsson & Höjer 1996) into the mobility field, thus identifying the rationale and the values at the roots of sustainability, in order to develop a vision-led and consensus-led strategy for sustainability as alternative to a plan-led approach (Doi and Kii 2012). The distinctive feature that distinguishes this approach is represented by the awareness that simple measures (i.e., indicators) do not solve the complexity related to the joint consideration of conflicting goals and their underlying problems. Complexity requires a “planning that considers goals and impacts regardless of how difficult they are to measure” (Litman & Burwell 2006, 333), or in other words a holistic strategy, like for instance in the case of land use planning and mobility planning (Curtis 2008; Doi and Kii 2012; Santos et al. 2010). Therefore, the quest for the principles guiding the choice of trajectories should be aimed at going beyond simple planning and related contingencies (Black et al. 2002; Gudmundsson & Höjer 1996; Holden 2012).

² http://www.eltis.org/sites/eltis/files/guidelines-developing-and-implementing-a-sump_final_web_jan2014b.pdf, p. 14.

³ <http://www.eltis.org/>

⁴ “A sustainable transport system meets society’s economic, social and environmental needs whilst minimizing its undesirable impacts on the economy, society and the environment.” Annex 10917/06 to the “Renewed EU Sustainable Development Strategy, as adopted by the European Council on 15/16 June 2006, <http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2010917%202006%20INIT>

The two perspectives present an evident cross-fertilization between theory-based and the policy-based contributions, that in literature merge with each other with very blurred boundaries. Also, in both cases there is a need for measures combining theoretical robustness and practical feasibility. Great effort was put to reconcile these two aspects, as to find “the right balance between a measure that is theoretically and empirically sound and one that is sufficiently plain to be usefully employed in interactive, creative plan-making processes where participants typically have different degrees and types of expertises” (Bertolini et al. 2005, 218).

This evolution generated contributions both from practitioners and from scholars of several disciplines trying to include in practical methods and tools the complexity of sustainability principles applied to mobility.

A recent report from EU Com. DG Move (2013) probably represents the best example of how to apply the set of analytical tools available for measuring the impact of UMSs, according to the pragmatic perspective of urban planners and policy makers (EU Commission – DG Move 2013).

As regards the academic perspective, two main types of contributions emerge. The first deals with methods' frameworks and indicators in an integrated way. Table 1 lists contributions providing reviews of frameworks, methods and indicators (both for sustainability assessment in general and for mobility in particular).

TABLE 1: Contributions on the topic of sustainable mobility overall framework, methods and indicators for assessment

Frameworks, methods and reviews of indicators and evaluation systems for sustainability in general	Böhringer & Jochem 2007; Hiremath et al. 2013; Ness et al. 2007; Singh et al. 2009.
Frameworks, methods and evaluation systems in the field of mobility	Gudmundsson 2004; Huang et al. 1998; Nicolas et al. 2003; Olofsson et al. 2015; Richardson 2005; Santos et al. 2010.
Reviews of indicators in the field of mobility	Black et al. 2002 Gudmundsson 2003; Hüging et al. 2014; Journard & Nicolas 2010.

The second type of contributions focuses on the assessment of specific areas presenting peculiar methodological and practical challenges.

Table 2 illustrates a list of references dealing with frequently mentioned assessment areas. Each

area presents different levels of generality and, consequently, overlaps between areas occur (e.g., quality of life includes accessibility, health, safety perception, etc.).

TABLE 2: Areas of sustainable mobility assessment and related contributions

Accessibility	Bertolini et al. 2005; Geurs & van Wee 2004; Gudmundsson 2003.
Eco-efficiency	Doi & Kii 2012; Usón et al 2011.
External costs	Bickel & Friedrich 2013; Essen et al 2011; EU Com. DG Move 2013; Maibach et al. 2007.
Footprint	Amekudzi et al. 2009.
Land use	Bertolini et al. 2005.
Multimodality performance	Kumar et al. 2013; Mishra et al. 2012; Welch & Mishra 2013.
Participation, involvement	Loukopoulos & Scholz 2004.
Quality of life	Steg & Gifford 2005.
Societal impact	Dempsey et al. 2011.

Both the methods and the set of indicators proposed for measuring mobility systems' sustainability can be very different according to the above-mentioned perspectives (principles *vs* planning oriented) and to the area.

The technological, environmental and economic dimensions of mobility can rely on a vast set of tools to measure the direct impacts of transport. For variables such as emissions, energy consumption, investments, direct costs, etc. there are shared assessment methods and consensus over the direction of improvement (e.g., zero emissions). The complexity increases as a) more comprehensive measures of the impact are explored; b) sustainability impacts include social aspects. In such cases, data interpretation can easily get controversial. For instance, a lower number of travels means less impact on the environment but not necessarily a better quality of life, probably a lower social involvement, etc. Furthermore, the social environment is at the same time the object and the yardstick of the sustainability impact, as the societal perception of sustainability issues changes over time and across space. For instance, the acceptance of a given level of pollution or a congestion charge will change together with technological development, and might differ

significantly across countries, according to their level of economic development.

Not surprisingly, recent debate focused more on the social than on the economic or environmental side. This represents the most intriguing and promising field of research, for at least two reasons. First, efficiency and effectiveness of mobility systems have a direct impact on many of the key variables of social sustainability. Second, measures of social sustainability cannot be directly deduced by environmental and economic indicators, as they should be assessed on multiple scales (Dempsey et al. 2011).

To sum up, while in the past greater emphasis was given to specific indicators, in the last two decades the measurement of mobility impacts on sustainability is focusing on multi-faceted concepts encompassing aspects that summarize socio-economic and environmental factors. Three closely interrelated concepts, in particular, play an important role in linking the various aspects of sustainability, while being indicators for both goal planning and performance evaluation: land use, accessibility and multimodality (or interconnectivity).

Accessibility represents the most commonly used proxy for assessing the social impact of mobility. It has been defined in several ways (Gudmundsson & Höjer 1996, 275; Black et al. 2002, 186; Bertolini et al. 2005, 209; EU Com. 2013, 32), but all definitions refer to the range of activities (work, leisure, services) that can be accessed in an efficient way. A comprehensive definition which considers both land use (e.g.: urban sprawl, urban design) and the mobility system is the following: “The extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s).” (Geurs & van Wee 2004, 128).”

Land use is used to express both a measure of the impact of mobility infrastructures and as an accessibility enabler (Bertolini et al. 2005; Geurs & van Wee 2004). When used as expressive of the impact, “land use serves as an indicator of land-linked environmental problems, such as reduction of biological diversity, closing down of valuable food production areas and cultural landscapes, and conflicts between users vying to use the same areas.” (Holden 2012, 211).

Interconnectivity (or multimodality) refers to “public, ordinary networks in urban areas, particularly in metropolis where the citizens may utilize the combinations of several modes of transportation” (Kumar et al. 2013, 796). It is often associated with accessibility, although the two concepts are distinct insofar the latter normally refers to areas and services, whereas the former refers to the mobility systems. Interconnectivity is measured through “frequency, speed, distance, capacity, required transfers, and activity density of the underlying land use served by a transit node, for all modes” (Welch & Mishra 2013, 31).

4 Conclusions and Outlook

The assessment of the impact of mobility on sustainability made significant progress over the past twenty years, becoming a priority for policy makers: indeed, today companies have to consider mobility (which includes yet is not limited to transport) from the perspective of sustainability impacts, and consequently from the standpoint of long-term competitiveness. As the social awareness of mobility-related issues increases, citizens represent a key-target of reporting concerning such area. Yet, besides reporting the impacts of mobility, the future challenge will be that of taking into account the costs of mobility non-development. There is (recent yet) building awareness on the effects of the prevalence of private mobility as associated with under-development, health issues, lower quality of life, lower business and employment opportunities, hence lower competitiveness: namely, what is often (and somehow reductively) called external costs. Sustainability and management scholars have to find viable solutions to report such external costs beyond the monetary value provided by an economic approach, thus contributing to the full control and awareness of corporate's impacts.

Twenty years of focus on the sustainability impacts of mobility led to greater awareness of the overall improvements related to proper mobility management and reporting. We envisage at least three major implications for both policies and corporate practice.

The quest for efficiency will benefit from considering mobility management (concerning fleets, logistics, commuting) as a long-term oriented investment, coordinated with local and regional mobility policies. At the same time, the constant advancement in UMSs will reshape business models around new concepts of "freedom of movement" separate from that of "private mobility". This will push companies involved in the provision of mobility services to shape their strategies on different business models, and to enhance the paradigmatic evolution of the personal mobility concept (Stocchetti 2013). On the other hand, we could expect several changes in the business models of products and services related to urban mobility, and we believe that there are many unexplored opportunities still to be explored.

References

- Amekudzi, A. A.; Khisty, C. J. & Khayesi, M. (2009): Using the sustainability footprint model to assess development impacts of transportation systems, *Transportation Research Part A: Policy and Practice*, Vol. 43, No. 4, 339-348.
- Banister, D. (2002): *Transport planning*. London: Taylor & Francis.
- Banister, D. (2008): The sustainable mobility paradigm, *Transport policy*, Vol. 15, No. 2, 73-80.
- Banister, D.; Button, K. (Eds.) (1993): *Transport, the environment and sustainable development*, London: E & F Spon.
- Bertolini, L.; Le Clercq, F. & Kapoen, L. (2005): Sustainable accessibility: a conceptual framework to integrate transport and land use plan-making. Two test-applications in the Netherlands and a reflection on the way forward, *Transport policy*, Vol. 12, No. 3, 207-220.
- Bickel, P. & Friedrich, R. (Eds.), (2013): *Environmental external costs of transport*, Berlin, Springer Verlag.
- Black, J. A.; Paez, A. & Suthanaya, P. A. (2002): Sustainable urban transportation: performance indicators and some analytical approaches, *Journal of urban planning and development*, Vol 128, No. 4, 184-209.
- Böhringer, C. & Jochem, P. E. (2007): Measuring the immeasurable. A survey of sustainability indices, *Ecological economics*, Vol. 63, No. 1, 1-8.
- Buehler, R., & Pucher, J. (2011): Making public transport financially sustainable, *Transport Policy*, Vol. 18, No. 1, 126-138.
- Button, K. & Nijkamp, P. (1997): Social change and sustainable transport, *Journal of Transport Geography*, Vol. 5, No. 3, 215-218.
- Christensen, T. B.; Wells, P. & Cipcigan, L. (2012): Can innovative business models overcome resistance to electric vehicles? Better Place and battery electric cars in Denmark, *Energy Policy*, Vol. 48, 498-505.
- Cohen, B. & Kietzmann, J. (2014): Ride on! Mobility business models for the sharing economy, *Organization & Environment*, Vol. 27, No. 3, 279-296.
- Curtis, C. (2008): Planning for sustainable accessibility: the implementation challenge, *Transport Policy*, Vol. 15, No. 2, 104-112.
- Dempsey, N.; Bramley, G.; Power, S. & Brown, C. (2011): The social dimension of sustainable development: Defining urban social sustainability, *Sustainable development*, Vol. 19, No. 5, 289-300.

- Doi, K. & Kii, M. (2012): Looking at sustainable urban mobility through a cross-assessment model within the framework of land-use and transport integration, *IATSS research*, Vol. 35, No. 2, 62-70.
- Essen, H. V., Schroten, A., Sutter, M. O. D., Schreyer, C., Zandonella, R., Maibach, M., & Doll, C. (2011). *External Costs of Transport in Europe*, Report, Delft, CE Delft.
- EU Commission (2001), White Paper. European Transport Policy for 2010: Time to Decide, Brussels, 12.9.2001, com(2001), 370 final.
- EU Commission (2007), Green Paper. Towards a New Culture for Urban Mobility, Brussels, 25.9.2007, com(2007) 551 final.
- EU Commission (2009), Action Plan on Urban Mobility, Brussels, 30.9.2009, com(2009) 490 final.
- EU Commission – DG Move (2013): *Study To Support An Impact Assessment Of The Urban Mobility Package*, final report.
- Geurs, K. T. & Van Wee, B. (2004): Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport geography*, Vol. 12, No. 2, 127-140.
- Goldman, T. & Gorham, R. (2006): Sustainable urban transport: Four innovative directions, *Technology in society*, Vol. 28, No. 1, 261-273.
- Greene, D. L. & Wegener, M. (1997): Sustainable transport. *Journal of Transport Geography*, Vol. 5, No. 3, 177-190.
- Gudmundsson, H. (2003): Making concepts matter: sustainable mobility and indicator systems in transport policy, *International Social Science Journal*, Vol. 55, No. 176, 199-217.
- Gudmundsson, H. (2004): Sustainable transport and performance indicators, *Issues in environmental science and technology*, Vol. 20, 35-64.
- Gudmundsson, H. & Höjer, M. (1996): Sustainable development principles and their implications for transport, *Ecological Economics*, Vol. 19, No. 3, 269-282.
- Hiremath, R. B.; Balachandra, P.; Kumar, B.; Bansode, S. S. & Murali, J. (2013): Indicator-based urban sustainability. A review. *Energy for sustainable development*, Vol. 17, No. 6, 555-563.
- Holden, M. E. (2012): *Achieving sustainable mobility: everyday and leisure-time travel in the EU*, Aldershot: Ashgate Publishing, Ltd.
- Hoogma, R.; Kemp R.; Schot, J.; Truffer B. (2002). *Experimenting for sustainable transport: the approach of strategic niche management*, London, Spon Press.
- Huang, S. L.; Wong, J. H. & Chen, T. C. (1998): A framework of indicator system for measuring Taipei's urban sustainability. *Landscape and urban planning*, Vol. 42, No 1, 15-27.

- Hüging, H.; Glensor, K. & Lah, O. (2014): Need for a holistic assessment of urban mobility measures—Review of existing methods and design of a simplified approach. *Transportation Research Procedia*, Vol. 4, 3-13.
- Joumar, R. & Nicolas, J. P. (2010): Transport project assessment methodology within the framework of sustainable development, *Ecological Indicators*, Vol. 10, No. 2, 136-142.
- Kennedy, C.; Miller, E.; Shalaby, A.; Maclean, H. & Coleman, J. (2005): The four pillars of sustainable urban transportation, *Transport Reviews*, Vol. 25, No. 4, 393-414.
- Kumar, P. P.; Parida, M. & Swami, M. (2013): Performance Evaluation of Multimodal Transportation Systems, *Procedia-Social and Behavioral Sciences*, Vol. 104, 795-804.
- Lakshmanan, T. R.; Nijkamp, P.; Rietveld, P. & Verhoef, E. T. (2001): Benefits and costs of transport, *Papers in Regional Science*, Vol. 80, No. 2, 139-164.
- Litman, T., & Burwell, D. (2006). Issues in sustainable transportation. *International Journal of Global Environmental Issues*, 6(4), 331-347.
- Loukopoulos, P. & Scholz, R. W. (2004): Sustainable future urban mobility: using ‘area development negotiations’ for scenario assessment and participatory strategic planning, *Environment and Planning A*, Vol. 36, No. 12, 2203-2226.
- Maibach, M.; Schreyer, C.; Sutter, D.; Van Essen, H. P.; Boon, B. H.; Smokers, R.; Schrotten A.; Doll C.; Pawlowska B. & Bak, M. (2007): *Handbook on estimation of external cost in the transport sector*, Delft, CE Delft.
- Miciukiewicz, K., & Vigar, G. (2012). Mobility and social cohesion in the splintered city: challenging technocentric transport research and policy-making practices. *Urban Studies*, 49(9), 1941-1957.
- Mishra, S.; Welch, T. F. & Jha, M. K. (2012): Performance indicators for public transit connectivity in multi-modal transportation networks. *Transportation Research Part A: Policy and Practice*, Vol. 46, No. 7, 1066-1085.
- Ness, B.; Urbel-Piirsalu, E.; Anderberg, S. & Olsson, L. (2007): Categorising tools for sustainability assessment, *Ecological economics*, Vol. 60, No. 3, 498-508.
- Nicolas, J. P.; Pochet, P. & Poimboeuf, H. (2003): Towards sustainable mobility indicators: application to the Lyons conurbation, *Transport policy*, Vol. 10 No. 3, 197-208.
- OECD, (1997): *Towards Sustainable Transportation*, Proceedings of the Conference held in Canada Vancouver, British Columbia 24-27 March 1996.
- Olofsson, Z.; Hiselius, L. & Várhelyi, A. (2015): Development of a Tool to Assess Urban Transport Sustainability—the Case of Swedish Cities, *International Journal of Sustainable Transportation*

(forthcoming, accepted author version published online at <http://www.tandfonline.com/doi/full/10.1080/15568318.2015.1055535>).

Richardson, B. C. (2005): Sustainable transport: analysis frameworks. *Journal of Transport Geography*, Vol. 13, No. 1, 29-39.

Santos, G.; Behrendt, H. & Teytelboym, A. (2010): Part II: Policy instruments for sustainable road transport, *Research in Transportation Economics*, Vol. 28, No. 1, 46-91.

Schaltegger, S.; Hansen, E. & Lüdeke-Freund, F. (2016): Business Models for Sustainability. A Co-Evolutionary Analysis of Sustainable Entrepreneurship, Innovation and Transformation. *Organization & Environment*, Vol. 12, No. 1, 1-26.

Singh, R. K.; Murty, H. R.; Gupta, S. K. & Dikshit, A. K. (2012): An overview of sustainability assessment methodologies. *Ecological indicators*, Vol. 15, No. 1, 281-299.

Steg, L. & Gifford, R. (2005): Sustainable transportation and quality of life, *Journal of transport geography*, Vol. 13, No. 1, 59-69.

Stocchetti A. (2013): Are carmakers ready for the «peak car»?., in Stocchetti A.; Trombini G.; Zirpoli. F. (Eds.) *Automotive in transition. Challenges for strategy and policy*, Venice, Edizioni Ca' Foscari – Digital Publishing.

Tricker, R. C. (2007): Assessing cumulative environmental effects from major public transport projects, *Transport Policy*, Vol. 14, No. 4, 293-305.

UN (2014): World Urbanization Prospects: The 2014 Revision, Highlights. Department of Economic and Social Affairs, Population Division (*ST/ESA/SER.A/352*).

Usón, A. A.; Capilla, A. V.; Bribián, I. Z.; Scarpellini, S. & Sastresa, E. L. (2011): Energy efficiency in transport and mobility from an eco-efficiency viewpoint. *Energy*, Vol. 36, No. 4, 1916-1923.

Vickerman, R., Spiekermann, K., & Wegener, M. (1999). Accessibility and economic development in Europe. *Regional studies*, 33(1), 1-15.

Welch, T. F. & Mishra, S. (2013): A measure of equity for public transit connectivity; *Journal of Transport Geography*, Vol. 33, 29-41.

Whitelegg, J. (1993): *Transport for a sustainable future: the case for Europe*. London, Belhaven Press.