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INTEGRATED RESEARCH INITIATIVE

« Land use and transport interactions »

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Executive Summary

The road transport system is closely linked to the land-use system. The road system connects territories at all spatial scales (countries, region, urban areas, municipalities, etc.). On the other hand, passengers and freight travel behaviour are strongly influenced both by land-use (the density and nature of activities and people for instance) and the road transport system (e availability and costs of the different transport means). Hence, research in the field of the interactions between land-use and the road transport system is of strategic importance for ERTRAC and supports many other roadmaps.

This integrated research initiative on land use and transport interactions (LUTI) addresses the reciprocal interactions between land use and surface transport, both the infrastructure side and mobility side, for both freight and passengers. The purpose is to identify the principal challenging topics for Europe in the coming years. The objective is also to provide elements of decision for policy makers in the fields of land use and transport planning.

The scale of this research initiative is the urban/metropolitan level. It takes into consideration all type of users, all type of vehicles, urban and inter-urban road infrastructure and its relationship with other types of infrastructure, all types of modes and the interconnection between them (multimodality). Public, collective and private transport, motorized and non-motorized (walking, cycling, etc.) trips are considered here.

The research initiative identifies four major research topics in terms of governance, integrated transport, sustainability and modelling tools in line with the ERTRAC SRA 2010:

• Governance: this topic mainly provides understandable actions and policies for horizontal and vertical coordination of land use and transport planning;

• Integrated transport: this topics aims at developing instruments, such as tools, methods, quantified data repositories etc., which will enable the assessment of the influence of LUTI to the various transport systems and services;

• Sustainability: this topic addresses the three dimensions of sustainability (environmental, social and economic) and aims to develop tools that will allow better understand the synergies and conflicts between these dimensions and LUTI;

• Modelling tools: it focuses on the development of integrated LUTI models to contribute to design and assessment of policies.

Acronyms and Terminology

ERRAC	European Rail Research Advisory Council
ERTRAC	European Road Transport Research Advisory Council
ETP	European Technology Platform
EU	European Union
GHG	Greenhouse Gas
LUTI	Land Use and Transport Interactions
QGET	Quality Growth Enhancement Tools
SRA	Strategic Research Agenda
TLUMI	Transportation and Land Use Model Integration
TOD	Transit Oriented Development

1. Introduction

Since the 2010 White paper, a lot of new and integrated transport policies have been developed to meet the challenges to mitigate traffic congestion, reduce CO_2 emissions and encourage economic growing, etc., (European Commission, 2001). However, the old challenges remain but new have come. The European White paper published in year 2011 has announced a new goal to help establish a system that underpins European economic progress, enhances competitiveness and offers high quality mobility services while using resources more efficiently (European Commission, 2011). Responding to the new challenges of the transport sector, the development of policy initiatives becomes more comprehensive, more difficult and more diverse.

One of the vital policy actions to meet the new challenges beside exploit the potential of new technologies, better multimodal services and cleaner energy, etc., is to develop land use and transport interaction strategies. LUTI planning which refers to the methods used by the public sector and other actors to influence the distribution of people and activities in spaces of various scales is essential to achieve sustainable transport. In the urban context, a mixed strategy involving land-use planning and transport planning enables economic growth and job creation as well as reduce congestion and emissions.

The motivation to address this integrated research initiative on LUTI is to define guidelines and topics to cover research, development and innovation enablers on LUTI for Europe. The LUTI research initiative is complementary to the other ERTARC roadmaps in contributing to achieve the objectives set in the ERTRAC Strategic Research Agenda. The corresponding researches topics designed in this initiative are planned both for the infrastructure side and mobility side, both for freight and passengers, in a way that maximizes the positive impact on economic growth and minimizes the negative impact on the environment.

1.1. Background

Land-use is composed of two distinct attributes (Rodrigues, 2013): the nature of land use, which relates to which activities are taking place where, and the level of spatial accumulation, which indicates their intensity and concentration. Thus, it is relevant to distinguish between:

- Formal *land use*: it encompasses the qualitative attributes of space such as its form, pattern and aspect. Many indicators are proposed by literature (Tsai, 2005), including density, compacity or the number of poles (defined by a remarkable concentration of locations) which indicates if the territory is monocentric or polycentric;
- Functional *land use*: it concerns economic nature of activities (such as production, consumption, residence, and transport) and the nature of people (revenue, size of households, average age, occupation, etc.). Again, many indicators are used in literature, like the number of jobs per worker, which indicates if there is a good balance of jobs,

services and housing or on the contrary a strong imbalance between the number of jobs and the number of residents within a given territory.

Land use encompasses different spatial scales: local (for instance at the level of a municipality), urban, regional, national and even international. But whatever the scale of analysis, formal and functional land use both influence the transport options made available, seen as a traffic system considering both the infrastructure side and the mobility side (of passengers and goods) in terms of geography of trips, average number of trips, length (distance and duration), modal share and relationships between the modes (including multimodality). Reciprocally, formal and functional land uses are not independent from the different characteristics of the transport/traffic system, especially in terms of accessibility to the jobs, services and customers. Indeed, to a certain extent the location decisions of people and economic activities take into account the costs of mobility (in terms of money and time). Hence land use contributes to determine the need for spatial interaction, or transport services, but transport/traffic, by the accessibility it provides, also determines spatial development (Wegener, 2003).

To summarize (Figure 1), according to Wegener and Fürst (1999):

- The distribution of land uses, such as residential, industrial or commercial, over the urban area determines the locations of human activities such as living, working, shopping, education or leisure;
- The distribution of human activities in space requires spatial interactions or transport services that leads to trips in the traffic system to overcome the distance between the locations of activities;
- The distribution of infrastructure in the transport system creates opportunities for spatial interactions and can be measured as accessibility;
- The distribution of accessibility in space co-determines location decisions and so results in changes of the land-use system.

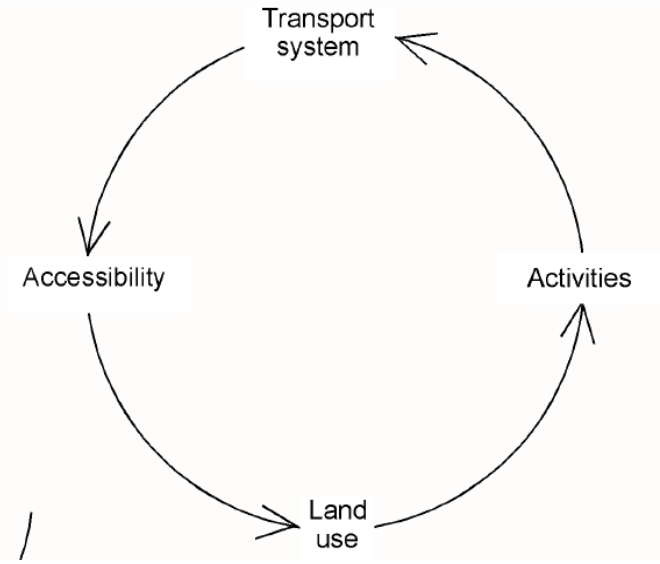

Figure 1 The land use and transport system interaction

1.2. Aims and objectives of this research initiative

This integrated research initiative on land use and transport interactions (LUTI) addresses the reciprocal interactions between land use and surface transport, both the infrastructure side and mobility side, for both freight and passengers. The purpose is to identify the principal challenging topics for Europe in the coming years. The objective is also to provide elements of decision for policy makers in the fields of land use and transport planning.

The scale of this research initiative is the urban/metropolitan level. Indeed the regional and the national/international levels have totally different research dimension. The main problems of LUTI are at low scale, where daily trips are generated and attracted. Hence Metropolitan (urban agglomerations) coordination is very important for this topic.

This research initiative takes into consideration all type of users, all type of vehicles, urban and inter-urban road infrastructure and its relationship with other types of infrastructure, all types of modes and the interconnection between them (multimodality). Public, collective and private transport, motorized and non-motorized (walking, cycling, etc.) trips are considered here.

The research initiative aims at having a systems approach of the interactions between land use and transport interactions. The main components of the system are the following: urban (or metropolitan) areas, road infrastructure (and the interactions with other infrastructures), the users (through location decisions and mobility patterns), all modes of transport, and stakeholders (private and public actors).

The research initiative identifies research topics related to metropolitan land use and transport policies, in particular sustainability, transport planning, governance, and the financial cost of transport. Research priorities are also developed in relation to the impact of LUTI on the performance of the passenger and freight transport systems, in particular regarding location decisions, the integration of modes, and transport safety and security.

One objective is to identify research lines to help decision makers, land developers and transport operators to measure the impacts of their sectorial decisions. Therefore, the research proposal are oriented to support better and more integrated decision making processes at strategic level and to help select the adequate policies/strategies in each particular city or metropolitan area.

1.3. Link to ERTRAC SRA

Developing through research a body of knowledge and solutions to better understand, plan and manage land use and transport interactions is expected to deliver a significant contribution to the

grand societal challenges identified in the ERTRAC Strategic Research Agenda, in particular the challenges of reliability and decarbonisation.

Influencing land use and transport interactions relying upon the results of research activities could for instance improve significantly accessibility by reducing the length of trips and increasing the interactions between services and persons and services through infrastructures. LUTI has also an important impact on the energy efficiency of the urban mobility system, mainly, again, by influencing the length of trips but also through its impact on the transport demand.

Finally, land use and transport interactions can further strengthen the outcome of some other ERTRAC roadmaps such as roadmaps on the electrification of road transport. It complements obviously work done on the integration of the urban mobility system and in better understanding the road user behaviour.

2. Background on Land Use and Transport Interaction (LUTI)

Several European projects, like TRANSLAND, CLOSER, SPARTACUS, PROPOLIS, SESAME, STRAR-TRANS, PROSPECT etc. have already investigated in many dimensions the complex and reciprocal interactions between land use and transport. The former international network ISGLUTI was also dedicated to this topic. In addition, non-European research, especially from North-American countries, has also contributed to the understanding of the land-use transport interactions. International research in this field has demonstrated the importance of a better coordination between land use and transport to achieve sustainable cities and especially sustainable mobility behaviour (Geerlings and Stead, 2003).

2.1. A brief overview of previous research

Research projects have investigated many complementary dimensions regarding firstly the relationship between land use patterns in metropolitan areas at different spatial scales (a neighbourhood, a municipality, the whole metropolitan area), the transport infrastructures and the travel behaviour of inhabitants; secondly the impact of transport (reciprocally land use) policies on land use patterns (reciprocally travel behaviour), like residential location; and thirdly LUTI modelling has been an important topic with the implementation of several models (e.g. UrbanSim or MARS). Important results have been demonstrated.

International research has now clearly highlighted some of the reciprocal interactions between land use, especially urban sprawl and polycentrism, and transport. On the one hand, land use patterns influences the need for transport infrastructures and also mobility behaviour of the inhabitants. For instance, the sprawl of metropolitan areas and the development of polycentric

patterns has contributed to lengthen average trip distance (Schwanen et al., 2004a). On the other hand, and reciprocally, transport infrastructures and conditions (prices, accessibility) influence spatial patterns: for instance sprawl and the development of employment subscenters outside the Central Business District have been made possible by the car (Wegener and Fürst, 1999).

Many empirical studies have analyzed the links between several dimensions of land use, especially density (Newmann and Kenworthy, 1999), diversity and design (Ewing and Cervero, 2010) and the mobility behaviour of inhabitants: average number/length/duration of daily trips, modal choice, energy consumption and GHG emissions. In addition, the links between monocentrism, polycentrism and travel behaviour has been an important research topic (Aguiléra, 2005; Cervero and Wu, 1997; Schwanen et al., 2004a).

While land use and transport are in close interaction, past research in the field of LUTI has also demonstrated that the relationships between land use and transport are difficult to isolate empirically because of the multitude of concurrent changes of other factors, including socio-economic factors (like income) and attitudinal factors (like preferences for residential locations and travel behaviour) (Van Wee et al., 2002).

Research has also underlined that a better coordination is needed between land use and transport policies to achieve sustainable travel behaviour in metropolitan areas (Bulkeley and Betsill, 2005; Geerlings and Stead, 2003; Halden 2002). Several LUTI policies, like the ABC in the Netherlands (Schwanen et al., 2004b) and Transit Oriented Development (TOD) (Cervero, 2003) have been analyzed and evaluated.

Finally LUTI modelling has been an important research field both in Europe and beyond. The Oregon Department of Transportation's "Transportation and Land Use Model Integration Project" (TLUMIP, 1996) and the State of Utah's Quality Growth Enhancement Tools (QGET) are some of the international efforts that paved the way to the development of new integrated models that would evaluate the interactions between transportation and land use. UrbanSim was developed as a component of TLUMIP and constituted a new metropolitan-scale land use model for integration with transportation models (Waddell and Evans). A non-exhaustive list of operational land use models that support interaction with travel models includes the DRAM/EMPAL model developed by Putman (1983), the TRANUS transport and land-use model and MEPLAN integrated modelling package developed respectively by de la Barra (1989) and Echenique et al. (1990), the STASA master-equation based transport and urban/regional model developed for the metropolitan area of Stuttgard by Haag (1990), the DELTA land-use/economic modelling package by Davids Simmonds Consultancy, Cambridge, UK (Simmonds and Still, 1998; Simmonds, 2001), MARS metropolitan Activity Relocation Simulator by Professor Paul Pfaffenbichler in his doctoral thesis for the European project PROSPECT (Pfaffenbichler, 2003) and more (Wegener, 2004).

2.2. New research needs in the field of LUTI

Yet, LUTI interactions are far from being well understood. In addition, fundamental societal challenges like climate change, the increase in energy prices, and the necessity to reduce emissions, environmental pressure and social inequalities, together with the development of new transport systems (in particular cleaner and more integrated systems) and information and communication systems, make it necessary to investigate several new topics in the field of the complex relations between land use, transport, energy, pollution and more broadly sustainable development. In addition, the economic crisis makes it necessary to re-evaluate some of the relationships between land use and transport. For example, the lower income of employees may influence the choice of residence and therefore the travel choices and patterns, while the reduction of public funding or private investment for large transport infrastructures may influence the location of residency and commuting.

Hence research is still needed to provide elements of decision for policy makers at the different spatial scales in the fields of land use and transport planning. This section gives a quick overview of the research needs that will be further developed.

Firstly, the increase of energy prices and the rise of environmental concerns could lead to a change in location strategies of both households and economic activities, and also to a change regarding travel behaviour (modal choice, etc.). Hence this could change the land use transport interactions and especially the links between density, diversity, design and transport as well as the link between monocentrism, polycentrism and transport. Thus, important questions remain regarding the strategies (particularly integrated policy packages) that planners have to develop in terms of spatial planning and especially urban structure design.

Secondly questions remain regarding the influence of land use and non-work travel (Boarnet and Sarmiento, 1998), while the impact on work trips seems more established (Aguiléra, 2005). In addition, research is also needed in the field of the link between urban form, energy consumption and GHG emissions because previous research has focused on distance travelled, travel duration and modal choice. Moreover, the links between land use and transport safety and security needs to be better investigated.

Thirdly, important questions remain regarding the strategies that policy makers have to develop in terms of spatial planning and especially urban structure design according to the spatial scale: a neighbourhood (at this scale mixity, density, compacity seem important) or the whole metropolitan area: for instance, must polycentrism be promoted, and what type of polycentrism? Is TOD a good solution? An additional challenge for policies is that land uses and transport services have a very different time scale. Transport networks and services could change in a short term (3-10 years), while land uses need 10-20 years to experiment significant changes. Research is also needed regarding the governance issues between public actors and also between public and private actors. In addition, research must better investigate the relationship between LUTI and the financial cost of transport. All these topics are also related to the acceptability of LUTI policies which has to be better understood.

Fourthly, research is needed regarding the relationships between land use and each of the three dimensions of sustainability (i.e. environment, social and economic), including the potential synergetic and conflicting issues between these dimensions. Fifthly, there is a need to better understand the relationship between land use and freight transport and in particular city logistics (Vieria et al., 2007). Issues such as the spatial allocation of delivery points, the transport routes followed by delivery trucks and other need to be investigated.

Finally, research is needed in the field of LUTI modelling. Specific issues that fall under this topic include the development of models with: sufficient spatial resolution, state-of-the-art activity-based modelling techniques, ability to link to advanced environmental sub-models (Wegener, 2004), dynamic and more disaggregate, high degree of transparency, sufficient behavioural and empirical validity, easiness of use, high computational performance, flexibility to adapt to different user's needs (high transferability), and sufficient data quality (Waddell, 2011).

3. Research topics to be investigated in the field of LUTI

Based on the above previous research experience and research needs, the research priorities that need to be examined have been identified and categorized in four major topics:

- ***Provide understandable actions and policies for horizontal and vertical coordination of land use and transport planning***: this topic mainly investigates the coordinated and integrated elements of spatial and traffic planning needed in order to achieve the societal challenge of sustainability.
- ***Develop new tools to evaluate the impact of LUTI on the performance of the passenger and freight transport system***: this topic aims at developing instruments, such as tools, methods, quantified data repositories etc., which will enable the assessment of the influence of LUTI to the various transport systems and services.
- ***Develop new methods and tools to help planners evaluate the synergies and conflicts between environmental, social and economic issues of LUTI***: this topic addresses the three dimensions of sustainability (environmental, social and economic) and aims to develop tools that will facilitate to better understand the synergies and conflicts between these dimensions and LUTI.
- ***Development of integrated LUTI models to contribute to design and assessment of policies***: this topic concentrates on the modeling aspect of LUTI and its contribution to policy making by relevant stakeholders.

Each of the above research topics includes a series of research priorities. These are elaborated in the following paragraphs.

3.1. Provide understandable actions and policies for horizontal and vertical coordination of land use and transport planning

Land use and transport have long been considered separately by public policies and also by private actors, and sometimes they are clearly in conflict. However, it is now recognized that an integrated (or coordinated) approach of spatial and traffic planning is needed in order to achieve the societal challenge of sustainability, especially the decarbonisation of transport, and also in order to decrease the costs associated with the development and maintenance of transport infrastructures and with mobility behaviours.

In general terms, research about LUTI has to face the contradiction between the need for addressing complexity in LUTI dynamics and the need to produce understandable actions and policies, including governance issues.

Research should contribute to produce recommendations on how to deal with this complexity. Good practices identification (key success factors) are needed having in mind the issue of transferability.

Thus, research on this topic could focus on the following indicative aspects:

- Integrate spatial and traffic planning (i.e. influence densification of activities in locations with high accessibility to public transport; limit low accessibility developments and to foster new developments in places with good accessibility; promote effective transport choices, avoiding long distance trips, to daily destinations: schools, shopping, etc.);
- Collection and analysis of best practices available on LUTI and disseminate their quantified benefits through targeted actions;
- governance issues (i.e. identify the conditions for multi-level governance that favors the better integration of transport and land use; identify the stakeholders involved);
- trade-offs and relationships between land use public policies and real estate private development.

One specific result that could be derived from the research work in this topic could be a comprehensive database of best practices derived from EU, regional or national R&D programmes and initiatives. This database would be a collection of a large number of best practices providing a variety of information per practice, such as location, description, LUTI attributes, cost, benefits gained, success factors, contact details etc. The strong element of this database would be the quantified benefits derived from the identified best practices implemented in certain cases in order to convince any interesting policy maker about the expected gains from the use of these practices and therefore motivate them to invest in similar actions. Lessons learnt from failure cases are also of equal importance. This result could be accessible over Internet by

any public body and requires strong dissemination actions in order to make it widely known and thus increase its future use.

3.2. Develop new tools to evaluate the impact of LUTI on the performance of the passenger and freight transport system

There is a need for a comprehensive evaluation, including energy consumption and GHG emissions of the relations between land use, the transport system and the different characteristics of mobility within metropolitan areas, like trip length, modal share, etc. both for passengers and for freight.

One important objective is to develop tools to measure the footprint of urban developments in relation with their associated mobility patterns, in order to understand to what extent a better coordination between land use and transport can help metropolitan areas reduce greenhouse gas emissions, enhance air quality and contribute to mitigate climate change. In particular, one should analyse what are the most favourable configurations of both land use and transport systems in terms of energy minimization. For instance, is TOD (Transit Oriented Development) positively contributing to optimising energy consumption?

Research is also needed in the field of local environmental impacts of the road system (air pollution, noise, consumption of space, barrier effect of infrastructure, and to a lesser extent loss of biodiversity) in relationship with land use. In addition, one should understand to which extent LUTI can contribute to reduce GHG emissions and favour land use configurations (urban form and buildings) that help to mitigate climate change impacts and how to save energy by better coordinating land use and transport.

There is also the need to better understand the influence of the transport system on location decisions of both people and economic activities at different spatial scales, especially when energy becomes more and more expensive. Reciprocally, a better understanding of how formal and functional land use influences mobility: car ownership and car use, mobility forms, multimodality, safety, transport efficiency, and the “area of relevance” of each mode and the integration of modes both at the intra- and the inter-urban level is necessary.

Finally, research is needed to understand how can land use help making the transport system more flexible, more adaptable, and what are the implications of land use on the safety and security of travel.

Summarizing the above mentioned, the key research needs to be addressed in this topic include:

- Contribution of LUTI to energy minimization and more environmentally friendly mobility patterns;
- Research on the evaluation of the relations between land use and the transport system (including the evaluation of energy consumption and GHG emissions);

- Research on the interaction between the transport system and the location decision;
- Research on the ways LUTI can promote the flexibility and adaptability of the transport systems;
- Research on the implication of land use on travel safety and security.

One key result that can be derived under this research topic is a tool capable of measuring the effects from the variation of travel patters (or O-D matrices) caused by new major transport infrastructures and new mobility services (e.g. new transit lines) in new land locations on energy consumption and environmental emissions (e.g. CO2 and NOx). This tool should be interfaced with GIS applications and LUTI models to ease visualization and analysis of the quantified impacts. Such a tool will be very useful to policy makers and transport planners.

3.3. Develop new methods and tools to help planners evaluate the synergies and conflicts between environmental, social and economic issues of LUTI

The spatial and functional organisation of housing and economic activities in relation with the transport system primarily determines the level and quality of accessibility and the transport costs for each territory (a municipality, a city, a region) and for each income group. Social equity in terms of open access to employment centres, educational opportunities and services is an important element for the economic competitiveness of an area and is highly depended on the provided housing and transport choices.

In addition, economic activities need to locate at a reasonable cost and with a sufficient level of accessibility to workers but also to customers and to other economic activities (agglomeration economies), which are located within the same municipality, the same urban area, the same region, etc.

Add to the above the effect that the environmental aspect of the transport and land use planning have both on the human health and the economy of tourism (attractiveness of regions), and one can easily understand the interdependencies between land use, transport planning and sustainability of the transport systems.

Based on the aforementioned, research on this topic could focus on the following indicative aspects:

- Research to strengthen accessibility for all categories of the population to economic agglomerations and markets;
- Land use and transport infrastructures to stimulate economic development in socio-spatial excluded areas;

- Investigation of the influence of LUTI on the activities of different market segments (e.g. low income commuters).
- Studies on the acceptability (social equity issue) of the LUTI strategies implementation, including public acceptance and political concerns.

3.4. Development of integrated LUTI models to contribute to design and assessment of policies

Several models of LUTI are available, especially in Europe (see Wegener, 2004 for an overview). LUTI models are a tool box: in particular, they are important simulation and then forecasting tools for the different stakeholders. Integrating land use and transport models is rather challenging and widespread use of these models is still hindered by several circumstances (cost, lack of input data, lack of research expertise). Integrated LUTI models are needed to help planners evaluate short term interactions/long term impacts of policies in terms of environmental, social and economic aspects.

There is a need for tools, which will determine the impacts in terms of reduction of car trips, of environmental impacts, of carbon footprint, of average trip distances, of car dependency, of accessibility to services on foot/cycling, etc. Another challenge is the integration of both passengers and freight mobility in the same LUTI model. In addition, research is needed regarding the availability of data and how can EU wide data collection improve the reliability of such models.

Since there has been a lot of research in this area (MARS, UrbanSim etc.), and quite useful positive results, but also weaknesses and gaps have been derived. The research on this field has to concentrate on the complexity of the LUTI subject and its mathematical constraints, and the reluctance or even inability of stakeholders to use these models due to data availability, workload, skills, capacity etc. The latter is of vital importance, since the LUTI modeling efforts and their results should give significant input for decision and policy making.

Based on the above, research on this topic could focus on the following indicative aspects:

- Research to identify and address the LUTI models technical weaknesses and gaps;
- Evaluation of data needs for LUTI models;
- Integrate LUTI models with other advanced sub-models (e.g., environmental model, social-economic model, etc).

One concrete result derived from future research on the above topic could be the expansion (add-on) of one of the existing models (e.g. UrbanSim) towards serving specific purposes and policy objectives. This could be an evaluation component (that is currently missing), which computes pre-defined indicators and supports cost-benefit analysis and least-cost planning, incorporating social and environmental externalities, energy efficiency aspects and equity considerations. Such

a component could be used by policy makers, land use and transport planners aiming to build and assess various scenarios related to infrastructure development. Visualization across multiple scenarios using the model's capabilities could give to policy makers useful indications about future investments.

4. The way forward (next steps)

4.1. Actions to be taken

The aim of this integrated research initiative is to provide an overview and the basic directions for research in LUTI. This document aims to serve as input for the definition of concrete research topics to be addressed in future research programmes and for further implementation on this subject. In this respect, some indicative actions could take place from now on including the Definition of possible synergies between the LUTI research topics and research actions from other research fields (e.g. mobility, energy, ITS etc.)

4.2. Involvement of stakeholders

The involvement of stakeholders is critical for the implementation of this research initiative. Although this document has been the outcome of a thorough discussion and research exercise among experts , a constructive dialogue involving more research stakeholders and authorities could facilitate the implementation of research projects with high level of acceptance and associated with real societal, technological, legislative and environmental needs.

5. References

De la Barra, T. (1983) "Integrated Land Use and Transport Modelling, Cambridge University Press, Cambridge

Echenique, M. H., A.D. Flowerdey, J.D. Hunt, T.R. Mayo, I.J. Skidmore and D.C. Simmonds (1990) "The MEPLAN Models of Bilbao, Leeds and Dortmund", Transport Reviews, 10, pp. 309-322.

J.P. Rodrigue (2013) The geography of transport system,, to be published, June 25th 2013, Routledge.

Haag G. (1990) "Master equations", Urban Dynamics. Designing and Integrated Model, Routledge, London/New York pp. 69-83

Pfaffenbichler, P. (2003). The strategic, dynamic and integrated urban land use and transport model MARS (Metropolitan Activity Relocation Simulator). Institut für Verkehrsplanung und Verkehrstechnik der Technischen Universität Wien.

Putman S.H. (1983) “Integrated Urban Models”, London, Pion.

Schwanen, T., Dijst, M., & Dieleman, F. M. (2004). Policies for urban form and their impact on travel: the Netherlands experience. Urban studies, 41(3), 579-603.

Simmonds, D.C. and Still B.G. (1998) “DELTA/START: Adding land use analysis to integrated transport models”, 8th World Conference on Transport Research, Antwerpen.

Simmonds D. (2001) “The objectives and design of a new land-use modelling package: DELTA”, Regional Science in Business, Springer, Berlin/Heidelberg, pp. 159-188.

TSAI Y.(2005) « Quantifying Urban Form. Compacteness versus « Sprawl » », Urban Studies, 42, 1, pp. 141-161.

Vieira, J., Moura, F., & Manuel Viegas, J. (2007). Transport policy and environmental impacts: The importance of multi-instrumentality in policy integration. Transport Policy, 14(5), 421-432.

Wegener M. (2004) "Overview of land use transport models", in Hensher D.A., Button K.J., Haynes K.E., Stopher P.R. (eds), Handbook of Transport Geography and Spatial Systems, Elsevier, United Kingdom, pp.127-146.

Wegener, M. and Fürst, F. (1999) “Land-Use Transport Interaction: State of the Art”, Deliverable 2a of the project TRANSLAND (Integration of Transport and Land UsePlanning), http://www.inro.tno.nl/transland/Deliverable%202a.pdf.

Waddell P. (2011) “Integrated Land Use and Transportation Planning and Modelling: Addressing Challenges in Research and Practice”, Transport Reviews, 31: 2, pp. 209-229.

Waddell, P. and Evans, D.J. “UrbanSim: Modeling Urban Development for Land Use, Transportation and Environmental Planning”, University of Washington.

European Commission. (2001). White Paper—European Transport Policy for 2010: Time to Decide. European Communities, Brussels, 12.9.2001

European Commission. (2011). White Paper: Roadmap to a Single European Transport Area– Towards a competitive and resource efficient transport system. Brussels, 28.3.2011

European Metropolitan Institute. (2012). A Strategic Knowledge and Research Agenda on Sustainable Urban Mobility. The Hague

Transport Knowledge Research Centre. (2009) Land Use Planning Thematic research Summary. Brussels, 26.01.2009

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