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REPORT 1.1

LUTI – LAND USE AND TRANSPORT SUSTAINABLE INTEGRATED STRATEGIES

Sommario

1 Introduction

The relationship between the spatial organization of society and the mobility system is complex, dynamic and not yet fully analyzed, but in outline its main features are clear: the distribution of human activities influence mobility behaviors and vice versa (Boarnet and Crane, 2001; Handy,1996).

Land use and transport are interlinked: land use affects and is affected by transport policy Land use is affected by transport in the sense that the distribution of accessibility in space co-determines location decisions: travel behavior and accessibility has shaped the nature of our cities throughout urban history (Newman and Kenworthy, 1999). On the other hand distribution of human activities in space requires spatial interactions or trips in the transport system to overcome the distance between the locations of activities (Banister, 2008; Bertolini and LeClerq, 2003). At the same time, by modifying travel times and costs, transport planning can help orienting a desired urban activities distribution. by shaping the pattern of development and by influencing the location, scale, density, design and mix of land uses, land use planning can help to reduce the need to travel, reduce the length of journeys and make it safer and easier for people to access jobs, shopping, leisure facilities and services by public transport, walking and cycling.

Starting from this very simple assumption is clear how integrating strategies and measures across land use and transportation and environment sectors is crucial for sustainable development (Wegener and Furst, 1999) Sustainability requires that policy-making for urban travel be viewed in a holistic sense, that planning for transport, land-use and the environment are no longer be undertaken in isolation one from the other (Levinson, 2008).

The phenomena of the interactions between activities location, accessibility, travel behavior has been widely studied and modeled (Muller, 2004) Furthermore in academic filed a new and renovated interested is sprawling with the birth of new master programs, new journals and publication on the LUTI theme.

In the last decade the EU has significantly increased the actions oriented towards the sustainability of urban mobility systems. The CIVITAS Initiative launched in 2002, helped 60 European cities in implementing and sharing pilots and Best Practices initiatives for sustainable urban mobility. The Environment DG launched SUMP (Sustainable Urban Mobility Plans) in 2006-2007 to provide a planning approach for urban managing strategies to improve urban transports and mobility patterns, in order to face environmental challenges. In 2009 The Commission adopted The Action Plan as a milestone in the path towards the vision defined in EU 2020 targets. (COM/2009/490 final), where a specific recommendation was given in order to both strengthen funding and optimizing the use of resources for the improvement of urban mobility.

In practice many conditions relevant to spatial and mobility systems are changing, such as the depletion of fossil fuels, the economic crisis, climate change, and public concern with sustainability also implying lifestyle modifications. The shifting circumstances necessitate new approaches and paradigms to study the interrelations within spatial planning and mobility, that need to be considered strictly interrelated and interdependent. Innovative spatial, and mobility planning measures are required, and new approaches and instruments have to be elaborated and applied. A much more intensive and critical interaction between the two domains of mobility studies, spatial analysis and planning is necessary.

In fact in planning practice only some more innovative planning tools and examples are based on a real “policy integration” approach with the aim of creating synergies between transport and land use policies (win–win situations) and the use of the same goals to formulate policy.

The main causes of this separation can be attributed mainly at the lack of common language between spatial and mobility planning. The lack of shared language means not only the use of different terms, grammar and vocabulary, but also different methods used for substantiation and evaluation of intervention in sector-specific policy. In order to fill this gap we focus on the planning practices related to the potential interactions between transport and land-use planning and in this Report a classification of integrated transport-land use measure is proposed, with the aim of creating shared knowledge between the two disciplines.

Other studies already have proposed different classifications of LUTI measures (Wee et al., 2014). In particular, within the theoretical literature, Stead et al. (2004) proposed a classification of LUTI measures according to the level of policy integration.

Another classification has been defined in literature according to the way to integrate transport and land use policies:

- vertical integration - policy integration between different levels of government;
- horizontal integration - policy integration between sectors or professions within one organization (i.e. inter-sectorial); inter-territorial—policy integration between neighbor authorities or authorities with some shared interest in infrastructure and/or resources;
- intra-sectorial—policy integration between different sections or professions within one department (integration between different environmental sectors such as air quality and noise or biodiversity, for example, or integration between different transport sectors such as roads, public transport, cycling or walking).

In this study we propose a hierarchy of LUTI measures according to three main categories (Bertolini et al, 2000):

- **hardware** measure: in spatial terms the word is commonly used to describe physical infrastructure, but actually it is meant as the whole physical, built and grown environment, including houses, offices, trees and bodies.
- **software** measure: the programmed use of hardware. In an urban context the use is the actual movements and occupation of the physical space (hardware) by people, goods and information. The control of the software is done through orgware.
- **orgware** measure: (including financing) term to focus on the process of politics and organizations next to the physical structures (hardware) and the use of it (software)

This choice has the specific aim of producing a simple guide for policy maker in order to choose and adapt the category into an applicable measure in specific context according to the financial capacity and the term impacts expected.

2 Sustainable Land-Use and Mobility integrated strategies

The method for the classification of sustainable LUTI measures starts with the definition of land use and transport sustainable measures analyzed in a separated way. In a second time an "integration matrix" has been constructed in order to confirm the potential synergies and integration.

2.1 Sustainable strategies for mobility

Sustainable strategies for mobility includes three clusters of measures:

1. "hardware" mobility measures: these include the development of new infrastructures for the different transport modes, for example new road infrastructure, of new lines and station for transit, or cycling and walking paths.
2. "software" mobility measure: those regards measure for the use of the infrastructure, for example development of specific transit services, restriction of street use, parking policies. Sustainable vehicle use, traffic system regulation, CT services applied to the mobility system.
3. organization and management strategies: those regards all the organization and management intervention including financing and stakeholders enrollment, innovative procurement, sustainable business models.

category	strategies	examples
Orgware (Organization and management)	Communication and marketing (travel awareness)	Public awareness campaign, education and motivation
		Mobility marketing
		Transport-related products and services
		PTA – personalised travel assistance
	Mobility pricing and fiscal measures	PT fare systems
		Freight mobility pricing
		Parking management
		Access management (congestion and road pricing)
		Incentives and fiscal benefits
		Pollution pricing
	Mobility infrastructure management	Mobility organization and co-ordination / partnerships
	MAAS – Mobility as a Service management	ITC for the management of an integrated mobility service
		Mobility shared systems
	Mobility laws and regulation and organization	Mobility plan
		Mobility coordinator and consulting
		Mobility center and mobility office
Software (Use of transport infrastructures)	ICT for mobility	Users information system
		Freight information system
	Park services	Parking spaces uses
	Traffic regulation system	Speed limits
		Traffic calming
		Signalling
		Restriction of street use for vehicles categories
		Restricted use lanes control
	Freight traffic	Commercial vehicle paths
	Sustainable vehicle use	PT Energy efficient and green vehicle
		LEZ low emissions zones
	Public transport services	PT timetables integration
		PT services
		PT multimodal integration
Hardware (Transport supply and infrastructures)	Road system and parking infrastructures	Road infrastructures
		Parking infrastructures
	Walking and cycling infrastructures	Walking and cycling paths
	Public transport infrastructures	Metro / rail /tram lines and stations
		Bus terminal
	Freight infrastructures	Urban distribution centers
		Transit point

Table 1 – Sustainable mobility strategies

2.2 Sustainable spatial strategies

Sustainable spatial strategy for mobility regard all the intervention for the spatial transformation based on sustainability principles. Also in this case, we can group the measure into three clusters:

1. "hardware" spatial measures: these include the development of urbanized areas for different land use and at different spatial scales (for example new residential development, community facilities, commercial or tertiary activities, mixed used areas), requalification of existing areas or environmental and cultural heritage protection.
2. "software" spatial measure: those regards measure for the use of the space, for example definition of time plan, changes of the use of urbanized areas in term of land use typology and in terms of the use in time.
3. "orgware" spatial measure: spatial organization and management strategies, that include all the organization and management intervention including financing and stakeholders enrollment, innovative procurement, sustainable business models.

Category	Strategies	Example
Orgware (Organization and management)	Participation and communication and marketing	Public awareness campaign, education and motivation
		Sustainable living marketing
		Public participation
	Financing and business models	Owning price
		Public services taxes
		Energy and pollution incentives for private and public
Software (Use of the space)	Change of use in time	Time plan
	Changes of use typology	Temporary uses
		Changes of urbanized areas
Hardware (spatial transformation)	environmental and cultural heritage protection	preservation and protection of environment habitat
		green network
		preservation cultural habitat
	Requalification and redevelopment	dismissed area
		historical center
		open spaces
	urban grow / land use development	new residential development
		Mixed used developemnt
		community facilities
		commercial or terziary activities

Table 2 – Sustainable mobility measure

2.3 The spatial and mobility intervention matrix

The spatial and mobility intervention matrix is obtained by the combination of the "sustainable mobility strategies" and the "sustainable spatial strategies", as showed in table 3.

	'Hardware' (supply-oriented)	**'Software'** (demand-oriented)	**'Orgware'** (process-oriented)
Space	**Space supply** i.e. development of urbanized areas and density distribution	**Space use** i.e. use of private and public spaces	**Space management** i.e. spatial planning processes, type of stakeholder cooperation, financial tools
Mobility	**Mobility supply** i.e. development of mobility infrastructure (whether temporarily or not)	**Mobility networks use** i.e. use of mobility infrastructures	**Mobility management** i.e. mobility planning processes, type of stakeholder cooperation, financial tools

Table 3 – Space and mobility intervention matrix

Local authorities should seek to ensure that strategies in the development plan and the local transport plan are complementary: consideration of development plan allocations and local transport priorities and investment should be closely linked. Local authorities should also ensure that their strategies on parking, traffic and demand management are consistent with their overall strategy on planning and transport. In developing the overall strategy, local authorities should:

1. focus land uses which are major generators of travel demand in city, town and district centers and near to major public transport interchanges. City, town and district centers should generally be preferred over out of center transport interchanges. Out-of-town interchanges should not be a focus for land uses which are major generators of travel demand;
2. actively manage the pattern of urban growth and the location of major travel generating development to make the fullest use of public transport. This may require the phasing of sites being released for development, in order to co-ordinate growth with public transport improvements, and ensure it is well related to the existing pattern of development;
3. take into account the potential for changing overall travel patterns, for instance by improving the sustainability of existing developments through a fully coordinated approach of development plan allocations and transport improvements; and
4. locate day to day facilities which need to be near their clients in local and rural service centers, and adopt measures to ensure safe and easy access, particularly by walking and cycling. Such facilities include primary schools, health centers, convenience shops, branch libraries and local offices of the local authority and other local service providers.

Starting from these principles and from the categorization derived from the intervention matrix, in the following paragraphs, we will describe the single integrated strategies in more details.

Some concrete example of integrated strategies are then showed in table 4 and described in detail in the following paragraphs. For each strategy, one or more study case are then described in Report 1_2.

	'Hardware' (supply-oriented)	**'Software'** (demand-oriented)	**'Orgware'** (process-oriented)
Space + mobility	– Accessibility planning – Transit - oriented Development TOD – New Urbanism and smart growth – Smart Growth – Location Efficient Development – Infill development – …	– TDM – Travel minimizing – Access management – Car free planning – Active transportation planning – Urban time policies – Social inclusion and equity planning – CSD – context sensitive design DM – …	– Smart mobility – MaaS – Mobility as a Service – Sustainable financing – …

Table 4 – Examples of space and mobility integrated interventions

3 "Hardware" LUTI strategies

3.1 Accessibility Planning

Conventional planning tends to evaluate transport based on mobility (physical travel), using indicators such as traffic speed and roadway level-of-service. However, mobility is seldom an end in itself, the ultimate goal of most transport activity is accessibility, which refers to people's ability to reach desired services and activities. Various factors can affect accessibility including mobility, transport network connectivity and affordability, the geographic distribution of activities, and mobility substitutes such as telecommunications and delivery services (Litman 2003).

Accessibility is a fundamental concept in transport planning and over time it has been defined and measured in numerous ways but is generally understood to be the ability for people to reach destinations (Curl et al. 2015). Accessibility is a concept central to integrated transport and land use planning. The goal of improving accessibility for all modes, for all people, has made its way into mainstream transport policy and planning in communities worldwide (Handy, 2002).

Accessibility Planning regards a specific approach to mobility and spatial planning related to the integrated development of transport infrastructure and development of urbanized area, with the main aim of increase and better distributes accessibility. This approach has been developed a particular focus on individuals' barriers to accessing services, and (in)equality and disadvantage in levels of accessibility.

Although accessibility planning had been suggested within the academic literature since the 1950s, it was the emergence of the sustainable development debate that provided the initial momentum for the emergence of current practices. The Accessibility Planning process has developed slightly differently in different countries.

In particular it was formalized in England through the requirement of "Accessibility Strategies" to accompany the second round of Local Transport Plans (LTPs) submitted by Local Transport Authorities (LTAs). In the UK considerable progress has been made in mainstreaming accessibility into transport planning through the local transport planning process and the development of national core indicators for accessibility against which local authorities in England can benchmark. The origins of developing Accessibility Planning in the UK lie in the discussion on social exclusion. Therefore "the primary purpose of accessibility planning is to promote social inclusion by improving the ability of disadvantaged groups and areas to access the job opportunities and essential public services that they need. It should be based on an improved assessment of accessibility problems and the joined-up planning and delivery of transport and other services." (DfT 2004) With "Accessibility Planning Guidance", the DfT has documented the approach that local actors are supposed to pursue, providing information and assistance on the process as a whole, the use of accessibility indicators and the integration of different stakeholders into the planning procedure. The guidance recommends that Accessibility Planning should be organized as a continuous process consisting of 5 stages: Strategic Accessibility Assessments; Local Accessibility Assessments; Option Appraisal; Accessibility Plan Preparation; Performance Monitoring and Evaluation. The DfT calculates a variety of core accessibility indicators that are available on a small geographic scale for the whole country. It recommends the additional calculation of local accessibility indicators to be used for assessment and monitoring purposes.

Another application in Europe of Accessibility planning are the "Accessibility Standards in German Planning Law". The transport related legislation in Germany defines certain standards of accessibility that should be met with regard to the accessibility of these central places and thus to the services provided by them. These standards are defined in terms of travel time. A binding network planning guideline provides some fundamental standards with regard to the System of Central Places is the "Richtline für Integrierte Netzgestaltung" (RIN).

In the United States, the use of accessibility measures is used within "Equity analysis" and in particular as part of "regional equity atlas" by diverse partnership of organizations supporting just and sustainable communities. Many interesting application regards measure and policies to ensure the quality of a person or group's access determines their opportunity to engage in economic and social activities.

The key aims for accessibility planning are to ensure that local decision-makers have improved information on the areas where accessibility is poorest and the barriers to accessibility from the perspective of the people who are living there. It is also designed to create a more transparent, integrated and equitable process for transport and land use decisions. Transport planners are being encouraged to 'think out of the box' and work more collaboratively with their partner agencies, so that a wider range of solutions to accessibility problems can be identified and greater value for money achieved through their combined and synchronised efforts (Lucas, 2006).

The guidance identifies that the process of accessibility planning should entail:

- Assessments of local need against a set of predefined national indicators to identify and analyse accessibility to the key services;
- Option appraisal and identification of existing and potential financial and other resources across the partnership agencies (e.g. land, staff time, information, etc.) that may be available to address the problems that are identified;
- A joint action plan which sets out how transport and land-use planners, those involved in the location and delivery of other local services, and other relevant local bodies will improve the gaps in accessibility identified by the needs audit

3.2 Transit-oriented development

Transit Oriented Development (TOD) refers to high-quality transit supports the development of higher-density urban centers, which can provide accessibility and agglomeration benefits (efficiencies that result when many activities are physically close together), while automobile-oriented transportation conflicts with urban density because it is space intensive, requiring large amounts of land for roads and parking facilities.

Transit Oriented Development can consist of new urban transit lines and stations, new suburban neighborhoods designed around public transit stations, and incremental changes to existing urban neighborhoods that have public transit. Supporting transit and transit-oriented development yields benefits for the transportation system as a whole, for the environment, and for compact, walkable, mixed-use communities. Successful Transit Oriented Development can significantly reduce per capita motor vehicle travel (Cervero, et al. 2004).

Transit oriented development does much more than just shift automobile trips to transit. People who live or work in communities with high quality public transit tend to own fewer automobiles and drive fewer annual miles than they otherwise would. In Automobile-Dependent communities households use automobiles for most trips. In Transit Oriented Communities they rely on a mix of modes.

Transit Oriented Development reduces transportation costs and externalities, increased travel choice, and reduced land paved per capita (Transit Evaluation). TOD can increase transit service the efficiency, resulting in improved performance and cost effectiveness. It can help create more Livable Communities, meaning that neighborhoods are physically and socially more desirable places to live.

Transit Oriented Developments can benefit virtually all groups of people, although some may benefit more than others. TODs can significantly benefit lower income people and non-drivers by improving income and racial diversity and household affordability. In other words, TOD means to plan and implement public transport infrastructure and services in conjunction with land use strategies to maximize access along corridors, and to and from centers.

Correct location and design of new transport infrastructure — road, rail, transit ways, bus and other forms of transit, walkways and cycle ways — should help achieve the goals of maximizing transport choice and managing travel demand by minimizing the need for, and distance of, travel. Planning for new infrastructure should be integrated into corridor and regional land use strategies. These will influence housing and employment location, densities and other factors that maximize the infrastructure catchment.

Similarly, planning for new public transport services, on new and existing infrastructure, should be closely aligned with land use planning, corridor development and new development projects. In particular, services should facilitate access to transport nodes and centers in major corridors.

Best practice is achieved when:

- new and upgraded arterial and orbital roads are designed to provide for trunk public transport services between centers — this includes providing for stops and interchange with feeder services
- new public transport routes link two or more primary attractors — such as railway stations and town centers — with secondary attractors — such as schools, hospitals, post offices and leisure/entertainment centers — located along the route
- a mix of trip purposes at nodes or stops — such as shops, childcare centers, post offices and homes — provides two-way passenger loads on public transport services, maximizing asset utilization and reducing empty return trips
- priority is given to improving services to major centers containing employment opportunities and community facilities
- a balance is achieved between fast, direct services to major centers and frequent stopping services that provide local access
- bus stops are located to maximize the patronage catchment and to consider personal safety, lighting and traffic management
- innovative servicing strategies are provided, such as hail and ride/demand responsive bus services, which best meet local needs.

Actively manage the pattern of urban growth to make the fullest use of public transport, and focus major generators of travel demand in city, town and district centers and near to major public transport interchanges.

At the local level Transit Oriented Development (TOD) refers to residential and Commercial Centers designed to maximize access by Transit and No motorized transportation, and with other features to Encourage Transit Ridership. A typical TOD has a rail or bus station at its center, surrounded by relatively high-density development, with progressively lower-density spreading outwards one-quarter to one-half mile, which represents pedestrian scale distances. It includes these design features.

3.3 New Urbanism / New Community Design / Neotraditional Design /Traditional Neighborhood Development / Urban village

New Urbanism (also called New Community Design) is an urban design movement which promotes walkable neighborhoods containing a range of housing and job types. It arose in the United States in the early 1980s, and has gradually influenced many aspects of real estate development, urban planning, and municipal land-use strategies. It is a set of design practices to create more attractive, efficient and livable communities. These can significantly improve accessibility and reduce per-capita automobile travel.

Within the concept of New Urbanism today, there are four key ideas. The first of these is to ensure that a city is walkable. This means that no resident should need a car to get anywhere in the community and they should be no more than a five minute walk from any basic good or service. To achieve this, communities should invest in sidewalks and narrow streets.

In addition to actively promoting walking, cities should also de-emphasize the car by placing garages behind homes or in alleys. There should also only be on-street parking, instead of large parking lots.

Another core idea of New Urbanism is that buildings should be mixed both in their style, size, price and function. For example, a small townhouse can be placed next to a larger, single family home. Mixed-use buildings such as those containing commercial spaces with apartments over them are also ideal in this setting.

Finally, a New Urbanist city should have a strong emphasis on the community. This means maintaining connections between people with high density, parks, open spaces and community gathering centers like a plaza or neighborhood square.

This category is also referred to neighborhood design, according to which altering the spatial relationships through changes in zoning and transportation systems, automobile use is expected to be reduced. NTND requires the close proximity of residential and nonresidential uses connected with a straight, interconnecting street system and a network of bicycle paths and pedestrian walkways. Changes to the geometric design of streets reduce vehicular speeds.

3.4 Smart Growth

Smart Growth has been defined in many different ways but generally emphasizes environmental preservation, compact development patterns, alternative transportation, and social equity. "Smart growth" covers a range of development and conservation strategies that help protect our natural environment and make our communities more attractive, economically stronger, and more socially diverse. Our About Smart Growth page explains the basic issues addressed by smart growth approaches.

This policies tend to correct the sprawl tendency, and can help achieve various planning objectives including reduced external costs (such as automobile traffic congestion, accident risk and pollution emissions), benefits to disadvantaged people (for example, by improving accessibility for non-drivers), public service cost saving (for example, reducing unit costs for providing emergency services, mail delivery and schools), consumer cost savings, open space preservation, and the creation of more livable communities (Litman, 2004). Many Smart Growth reforms reflect consumer and preferences; market research indicates that many consumers prefer more compact, mixed, multi-modal neighborhoods, provided they have other desirable features such as personal security, quality public services, stable property values and prestige.

It also advocates compact, transit-oriented, walkable, bicycle-friendly land use, including neighborhood schools, complete streets, and mixed-use development with a range of housing choices. The term 'smart growth' is particularly used in North America. In Europe and particularly the UK, the terms 'Compact City' or 'urban intensification' have often been used to describe similar concepts, which have influenced government planning policies in the UK, the Netherlands and several other European countries.

Smart growth values long-range, regional considerations of sustainability over a short-term focus. Its sustainable development goals are to achieve a unique sense of community and place; expand the range of transportation, employment, and housing choices; equitably distribute the costs and benefits of development; preserve and enhance natural and cultural resources; and promote public health.

Because their impacts tend to be synergistic (total impacts are greater than the sum of their individual impacts) Smart Growth does not involve just one single change, it requires a number of integrated changes. For example, more compact development, improved walkability or increased transit service quality by themselves cannot be considered Smart Growth; rather, a Smart Growth program might involve more compact development, improved walkability and increased transit service quality.

Smart Growth emphasizes Accessibility, meaning that the activities people use frequently are located close together. For this reason, the basic unit of planning is the local community, neighborhood or “village,” that is, a mixed-use, Walkable area, one-half to one mile in diameter, with commonly-used public services (shops, schools, parks, etc.). This is in contrast to conventional planning, which tends to emphasize mobility as a solution to transport problems, and so tends to plan communities at a larger scale which relies primarily on motor vehicle travel, with little consideration to pedestrian access.

Smart Growth strives to provide the best of all possible worlds: adequate automobile mobility with good alternative Transport Options (as opposed to Automobile Dependent development which provides poor no motorized and transit travel, or Car-Free Planning which prohibits automobile use under certain circumstances), and Accessible, mixed-use, resource-efficient Land Use patterns that offer residents and employers a range of urban development density and price options, while preserving greenspace and community Livability as much as possible. Smart Growth results in modest reductions in per capita motor vehicle travel, typically reducing private automobile trips from the current 90-95% to 60-80% of trips by shifting a portion of local trips to no motorized modes, and regional trips to Ridesharing and Transit.

There is growing convergence of support for Smart Growth among a variety of professions and interest groups, ranging from transportation planners concerned with a variety of economic, social and environmental issues. For example transportation planners increasingly support Smart Growth as a way to improve Accessibility (ITE 2002), public officials support it as a way to reduce public infrastructure and service costs (Hirschhorn 2001), some people support it as a way to reduce environmental impacts, and others as a way to create more Livable communities.

Smart Growth includes a number of individual policies and practices, such as those listed in the box below. Which are implemented and how they are applied depends on the specific situation. Smart Growth is a relatively recent concept (although many of its practices are old), and so is developing and evolving as practitioners gain experience.

Although clustering of activities (such as locating commonly-used retail and public services near residential areas, and grouping worksites and retail together into Commercial Centers) and increased density are important Smart Growth strategies, it does not require a particular level of density to be effective, it simply requires more clustering and density than would otherwise occur. Objectives and strategies tend to differ depending on whether an area is urban, suburban and exurban (JHK Associates 1995).

- Urban: In urban areas it emphasizes redevelopment and infill of existing urban neighborhoods, improving mixed-use design features (such as Traffic Calming of urban streets and Location Efficient Development), and enhancing multi-modal transport systems, particularly walking and public transit.
- Suburban: In suburban areas it creates medium-density, mixed-use, multi-modal centers (sometimes called Transit Villages), either by incrementally developing existing suburban communities or by master-plan developments that reflect Smart Growth principles. It encourages more complete suburban communities (more local services and employment in suburban jurisdictions), and improved regional travel options such as Ridesharing and Transit Improvements. It supports greenspace preservation.
- Rural: In rural areas Smart Growth involves policies that help channel development and public services into accessible, mixed-use villages (for example, having schools, stores and affordable housing located close together and well connected by good walking facilities), and implementation of Rural Community TDM.

Smart Growth can help achieve strategic land use objectives, including increased Accessibility and Transportation Options, more cost effective infrastructure, reduced impervious surface, and greenspace and historic preservation (Land Use Evaluation).

Smart Growth does not eliminate urban expansion or suburban development but it changes such development to help achieve resource efficiency and community Livability goals. Smart Growth reflects Sustainable Development objectives. Smart Growth incorporates many efficiency and amenity features private developers apply to “master planned” communities, such as incremental expansion of development to minimize infrastructure costs, and coordination between land uses to maximize access. It allows such features be implemented in existing communities and in new communities with multiple developers.

There is considerable debate concerning the desirability of Smart Growth (Litman 2003). Critics argue that Smart Growth provides little real benefits, increases congestion, makes residents worse off, and is unpopular

with consumers. Proponents counter that the total economic, social and environmental benefits are substantial and preferred by many households.

Smart Growth is usually implemented as a set of policies and programs. It can be incorporated into land use development according to one or more of the following strategies:

- Clustering of population and employment, which increases Accessibility (e.g., proximity to employment, shops and schools), and travel choice (better transit, ridesharing, and better pedestrian facilities).
- Land use mix, such as commercial and public services located within or adjacent to residential areas, which increases access and travel choice.
- Parking Management and Parking Pricing can reduce automobile travel, encourage use of alternative modes, and reduce the amount of land paved for parking facilities, creating accessible and pedestrian-friendly landscape.
- Traffic Calming and other measures that reduce automobile traffic speeds, which reduces driving and improves conditions for walking, cycling and transit use.
- A more Connected street network improves access.
- More attractive, safer streets, and pedestrian-oriented land use, encourages active travel travel.
- An effective transit system tends to reduce per capita automobile travel, particularly when integrated with supportive land use (high-density development with good pedestrian access within half-kilometer of transit stations).
- Other TDM strategies can be incorporated into Smart Growth, including Commute Trip Reduction, School and Campus Trip Reduction, Car sharing and Road Pricing, to further reduce per capita vehicle travel.

3.5 Location Efficient Development

Location Efficient Development consists of residential and commercial development located and designed to maximize Accessibility and overall Affordability. This usually means that it is close to good transit service and public services, has good walking and cycling conditions and other features that reduce Automobile Dependency. It often involves urban infill, such as projects to redevelop inner-city neighborhoods or converting older industrial buildings to loft apartments. Location Efficient Development can also include efforts to cluster activities and services together into Commercial Centers, and to redevelop older downtowns. Residents and employees in such areas tend to drive less, rely more on alternative forms of transportation, and enjoy better transportation options than those who live or work in less accessible areas.

3.6 Infill development / compact development / density and clustering

In the urban planning and development industries, infill is the use of land within a built-up area for further construction, especially as part of a community redevelopment or growth management program or as part of smart growth. It focuses on the reuse and repositioning of obsolete or underutilized buildings and sites. This type of development is essential to renewing blighted neighborhoods and knitting them back together with more prosperous communities. Redevelopment or land recycling is development that occurs on previously developed land. Infill buildings are constructed on vacant or underutilized property or between existing buildings. Accommodate housing principally within existing urban areas, planning for increased intensity of

development for both housing and other uses at locations which are highly accessible by public transport, walking and cycling;

Density refers to the number of people or jobs in a given area. Clustering (also called Compact Development) refers to Land Use patterns in which related activities are located close together, usually within convenient walking distance. Clustering improves Accessibility by reducing travel distances and improving Transportation Options. It is an important part of land use management strategies including Access Management, Location Efficient Development, New Urbanism, Smart Growth and Transit Oriented Development. Density and Clustering are somewhat different concepts. Density refers to the number of people or jobs per unit of land (acre, hectare, square kilometer or square mile), while Clustering to the location and mix of activities in an area. For example, simply increasing population densities in a residential-only area may do less to improve accessibility than clustering destinations such as schools and shops in the center of the development. Rural and suburban areas have low densities, but common destinations such as schools, shops and other public services can be clustered in villages and towns. This increases accessibility by making it easier to run several errands at the same time, increases opportunities to interact with neighbors, and creates transportation nodes (rideshare stops, bus stops, etc.).

4 "Software" LUTI strategies

4.1 TDM

Transportation Demand Management (TDM) is a general term for strategies that result in more efficient use of transportation resources. Transportation demand management, traffic demand management or travel demand management is the application of strategies and policies to reduce travel demand (specifically that of single-occupancy private vehicles), or to redistribute this demand in space or in time

There are many different TDM strategies with a variety of impacts. Some improve the transportation options available to consumers. Some provide incentives to change trip scheduling, route, mode or destination. Others reduce the need for physical travel through more efficient land use, or transportation substitutes. Although most individual TDM strategies only affect a small portion of total travel, the cumulative impacts of a comprehensive TDM program can be significant. In transport, as in any network, managing demand can be a cost-effective alternative to increasing capacity. A demand management approach to transport also has the potential to deliver better environmental outcomes, improved public health, stronger communities, and more prosperous and livable cities.

Transportation Demand Management is increasingly used to address a variety of problems. Several trends are increasing the value of TDM, particularly as an alternative to expanding roads and parking facilities.

TDM can provide flexible solutions. TDM greatly expands the range of solutions that can be considered for addressing transportation problems, and allows solutions to be tailored to a particular situation. It can often be implemented quickly, and target a particular location, time period or user group. For example, TDM can reduce congestion problems during Special Events, road construction or emergencies. It may allow new development in areas where road and parking capacity is constrained, it can help protection particularly sensitive environments, and it can provide access to groups with special mobility needs.

Crucial to the delivery of a sustainable urban transport system is integrating the TDM approach into urban transport planning, as well as the daily management and operation of transport services and infrastructure. It appears that managing travel demand has largely been compartmentalized as a set of "soft measures" to promote sustainable travel options or programs to promote and offer shared ride arrangements. Demand management means different things to different disciplines. For example: to Information Technology (IT) specialists, managing demand is new technology to provide information; to operations managers, managing demand is controlling the flow onto highways; to economists, it is pricing the system to find equilibrium with capacity; to marketers, it is promoting innovative campaigns; and to many policymakers TDM remains a largely unknown entity.

Some example within the range of TDM measures, include:

- leverage public and private funds to increase the use of ridesharing and other commuting options that reduce traffic congestion and improve air quality
- Requiring users of parking to pay the costs directly, as opposed to sharing the costs indirectly with others through increased rents and tax subsidies.
- Subsidizing transit costs for employees or residents.
- Flex-time work schedules with employers to reduce congestion at peak times
- Road pricing tolls during peak hours.

- Road space rationing by restricting travel based on license plate number, at certain times and places.
- Workplace travel plans
- Road space reallocation, aiming to re-balance provision between private cars which often predominate due to high spatial allocations for roadside parking, and for sustainable modes.
- Time, distance and place (TDP) road pricing, where road users are charged based on when, where and how much it drive. Some transportation experts believe TDP pricing is an integral part of the next generation in transportation demand management.

4.2 Travel-minimizing

Land use density and clustering: Density refers to the number of people or jobs in a given area, while clustering refers to common destinations located close together. Density and clustering can be measured at various scales: region, county level, municipal jurisdiction, neighborhood, census tract, city bocks or individual campuses and buildings. Density and clustering can have significant impacts on travel patterns through the following mechanisms:

- Land use accessibility: the number of potential destinations located within a geographic area tends to increase with population and employment density, reducing travel distances and the need for individual automobile travel.
- Transport choice: increased density tends to increase the number of transportation options available in an area due to economies of scale.
- Land use mix: Mixed land use (such as locating appropriate businesses and public services in or adjacent to residential areas) can reduce per capita vehicle travel. It tends to reduce the distances that residents must travel for some services, and allows more use of walking and cycling for such trips.
- Public transport-orientated development: Households living in neighbourhoods orientated to public transport tend to own fewer cars, and people working in such areas are more likely to commute by alternative modes because they do not need a car to run lunchtime errands.
- Site design and building orientation: People tend to walk more and drive less in areas with traditional pedestrian-oriented commercial districts where building entrances connect directly to the sidewalk than in areas with car-orientated commercial strips where buildings are set back and separated by large parking areas.

4.3 Access Management

Access Management is a term used by transportation professionals for coordination between roadway design and land use to improve transportation. It is defined as, “the process that provides access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity, and speed.”.

Access management is the “systematic control of the location, spacing, design and operation of driveways, median openings, interchanges and street connections to a roadway. Benefits include:

- Safety. The implementation of good access management practices on a corridor can reduce vehicle crashes by 50 percent or more.
- Mobility. Spacing traffic signals at appropriate distances permits signals to be coordinated for optimized operation. Optimal signal spacing can reduce the need to increase a roadway's capacity by widening intersections and corridors.
- Reduction of conflicts with non-motorized modes. Controlling the number and width of driveways reduces areas of exposure for pedestrians and bicyclists along a roadway.
- Aesthetics. By providing raised medians and reducing the width of driveways, more room can be used for landscaped beds or decorative hardscape surfaces.

Access Management involves changing land use planning and roadway design practices to limit the number of driveways and intersections on arterials and highways, constructing medians to control turning movements, encouraging Clustered development, creating more pedestrian-oriented Streetscapes, improved Connectivity, and Road Space Reallocation to encourage efficiency. Although Access Management is primarily intended to improve motor vehicle traffic flow, it can support TDM by integrating transportation and land use planning, and by improving Transportation Options. It can help convert automobile-oriented strip development into more Accessible land use patterns that are better suited to walking, cycling and public transit. Below are ten access management strategies (CUTR, 1998).

- Lay the foundation for access management in your local comprehensive plan.
- Limit the number of driveways per lot (generally, one per parcel).
- Locate driveways away from intersections.
- Connect parking lots and consolidate driveways (so vehicles can travel between parcels without reentering an arterial).
- Provide residential access through neighborhood streets (residential driveways should generally not connect directly to arterials).
- Increase minimum lot frontage on major streets (minimum lot sizes on major arterials should be larger than on minor streets).
- Promote a Connected street system (avoid street networks that force all local traffic onto arterials).
- Encourage internal access to outparcels (i.e., locations in shopping centers located on arterial streets).
- Regulate the location, spacing and design of driveways.
- Coordinate with the Department of Transportation.

4.4 Car free planning or less car planning

Within the TDM approach a specific measure regard the use of road not for cars: the car-Free Planning, which involves designing particular areas for minimal automobile use.

- Developing urban districts (such as a downtown or residential neighborhood) where personal automobiles are unnecessary and automobile traffic is restricted. Such restrictions can be part- or full-time, and often include exceptions for delivery vehicles, taxis, and vehicles for people with disabilities.
- Housing developments where residents are discouraged from owning private cars.
- Pedestrian-oriented commercial streets where driving is discouraged or prohibited.

- Resorts and parks that encourage or require non-automotive access.
- Car-free days and car-free events.
- Temporary restrictions on driving, such as during an air pollution emergencies or a major sport event that would otherwise create excessive traffic problems.

Comprehensive Car-Free Planning that reduces total automobile travel can provide many benefits, including increased community Livability, reduced congestion, road and parking facility cost savings, reduced pollution, increased road safety, increased consumer savings and transportation options, more Accessible land use and increased local economic development

Costs include administrative expenses (e.g., posting signs, installing barricades, enforcing rules), increased travel costs for motorists, and reduced convenience for people who are forced to shift from driving to other modes. Ineffective pedestrianized commercial streets (i.e., those that do not attract sufficient visitors) can reduce business activity. Car-Free Planning may result in some customers, residents and businesses moving to areas that do not have such restrictions.

At the citywide scale this strategy is connected with the idea of the car free city. A car free city is a population center that relies primarily on public transport, walking, or cycling for transport within the urban area. Carfree cities greatly improve petroleum dependency, air pollution, pedestrian safety, greenhouse gas emissions, automobile crashes, noise pollution, and traffic congestion. Some cities have one or more districts where motorized vehicles are prohibited, referred to as car-free zones. Many older cities in Europe, Asia, and Africa were founded centuries before the advent of the automobile, and some continue to have carfree areas in the oldest parts of the city -- especially in areas where it is impossible for cars to fit, e.g. in narrow alleys.

At the local level this strategy is referred to pedestrianized districts. They can help create a lively and friendly environment that attracts residents and visitors.

4.5 Active transportation planning

Non-motorized Transportation (also known as Active Transportation and Human Powered Transportation) includes Walking and Bicycling, and variants such as Small-Wheeled Transport (skates, skateboards, push scooters and hand carts) and Wheelchair travel. These modes provide both recreation (they are an end in themselves) and transportation (they provide access to goods and activities), although users may consider a particular trip to serve both objectives. For example, some people will choose to walk or bicycle rather than drive because they enjoy the activity, although it takes longer.

Pedestrian and cycling improvements are usually implemented by local governments, sometimes with funding and technical support of regional or state/provincial transportation agencies. It usually begins with a pedestrian and bicycle plan to identify problems and prioritize projects. Implementation may require special funds, either shifting funds within existing transportation, a new budget allocation, or grants. It is useful to develop Multi-Modal Level-of-Service rating systems which indicate the convenience and comfort of walking and cycling conditions.

Complete Streets means that roadways are designed to accommodate all modes, including walking and cycling. It involves Streetscaping and Road Space Reallocation in appropriate roadway projects. It can also involve planning and field surveys to identify where barriers exist to non-motorized travel and funding to

correct these problems. It often requires new relationships between different levels of government, such as match funding and maintenance agreements between state/provincial transportation agencies and local governments.

Potential travel impacts are much greater if walking and cycling are integrated with public transit, and with Smart Growth development practices that reduce travel requirements, for example, by locating schools and shops within residential neighborhoods. Pedestrian improvements around worksites can increase transit and rideshare use, because without these employees may feel the need to have a car to run errands during breaks.

4.5.1 Pedestrian planning

Walkability reflects overall walking conditions in an area. Walkability takes into account the quality of pedestrian facilities, roadway conditions, land use patterns, community support, security and comfort for walking. Walkability can be evaluated at various scales. At a site scale, walkability is affected by the quality of pathways, building accessways and related facilities. At a street or neighborhood level, it is affected by the existence of sidewalks and crosswalks, and roadway conditions (road widths, traffic volumes and speeds). At the community level it is also affected by land use Accessibility, such as the relative location of common destinations and the quality of connections between them.

Walkability improvements can substitute directly for automobile trips. Walking improvements also support Public Transit and Ridesharing. A relatively short active trip often substitutes for a longer car trip. For example, a shopper might choose between walking to a small local store, and driving a longer distance to shop at a supermarket. Walkability improvements are critical to Smart Growth, New Urbanism, and Transit Oriented Development, which can result in significant reductions in per-capita motor vehicle trips.

Effects of pedestrian improvements and encouragement programs on travel activity could ghave direct impact on communities in term os an increases in nonmotorized travel and reductions in vehicle travel. One study found that residents in a pedestrian friendly community walked, bicycled, or rode transit for 49% of work trips and 15% of their non-work trips, 18- and 11-percentage points more than residents of a comparable automobile oriented community (Cervero and Radisch 1995).

Best practice is achieved when:

- pedestrian audits of centers and public transport nodes are undertaken as part of a pedestrian plan, and provide the basis for a capital improvement program
- local street and footpath networks provide a choice of routes and are easily understood
- routes from houses to local facilities, such as shops, schools and bus stops, are direct and pleasant, avoiding steep slopes, and enjoying good lighting and natural surveillance from adjacent uses
- every development has convenient and prominent pedestrian entrances, in terms of design, signage, lighting and gradient
- expanses of ground level blank walls along street frontages, and large driveways and entrances to car parks, are avoided
- a feeling of security is assisted by buildings and active uses, such as cafes and front verandahs, being oriented to the street

- safety from traffic is provided by traffic calming and appropriate road crossing facilities — these should cater for all pedestrians, including older people, children and the mobility and vision impaired
- intersections on public transport routes are designed to facilitate vehicle movements and good pedestrian access
- pedestrian-only links are short, well lit and offer surveillance from adjacent uses
- pedestrian crossing distances in town centres and local streets are reduced through kerb extensions and tight turning radii, to slow traffic, while still allowing buses to turn slowly and easily
- footpaths are provided and maintained as a connected network
- street furniture is attractive but does not obstruct footpaths, and footpaths do not have blind spots and are of adequate width.

4.5.2 Cycling planning

Creating an effective policy for cycling is an essential part of developing a sustainable transport strategy and is becoming an increasingly important part of urban planning. Successful cycling planning depends on combining improvements to infrastructure with education about the benefits of increasing cycle usage.

There are many specific ways to improve bicycle transportation (Ogilvie, 2004 ; Litman, et al., 2000). These include (McClintock, 2002).

- Improved paths and bike lanes.
- Correcting specific roadway hazards (potholes, cracks, narrow lanes, etc.).
- Improved road, road shoulder and path Management and Maintenance.
- Improved Bike Parking.
- Develop a more Connected street network and clustered development (New Urbanism).
- Establish Public Bike Systems that provide convenient rental bicycles for short utilitarian trips.
- Traffic Calming, Speed Reductions, Vehicle Restrictions, and Road Space Reallocation.
- Safety education, law enforcement and encouragement programs.
- Integration with transit (Bike/Transit Integration and Transit Oriented Development).
- Create a Multi-Modal Access Guide, which includes maps and other information on how to cycle to a particular destination.
- Provide Public Bike Systems and bicycle rental services.
- Address Security Concerns of cyclists.

Cycling improvements are usually implemented by local governments, sometimes with funding and technical support of regional or state/provincial transportation agencies Implementation may require special funds, either shifting funds within existing transportation, a new budget allocation, or grants.

Bicycling can substitute directly for automobile trips. Communities that improve cycling conditions often experience significant increases in bicycle travel and related reductions in vehicle travel (Clifton, et al. 2012). Each mile of bikeway per 100,000 residents increases bicycle commuting 0.075 percent, all else being equal (Nelson and Allen 1997). Rietveld and Daniel (2004) find that bicycle transportation increases in cities where cycling is relatively easier (fewer hindrances along cycling routes) and safer, and as cycling is faster and cheaper relative to automobile travel. Topp (2008) argues that a system of integrated cycling facilities and rental services, high quality public transportation and car sharing can significantly reduce automobile travel, particularly for shorter urban trips.

4.6 Urban time policies

Urban time policies are public policies that intervene in the time schedules and time organization that regulate human relationships at the urban level. Urban time policies were launched in Italy at the end of the 1980s. Within a span of 10 to 15 years, 170 municipalities have been involved in time-oriented projects or timetable plans, or in studies of urban social time. There has also been diffusion into several countries of the European Union, especially in Germany and France. Now the diffusion is starting in Spain, the Netherlands and Belgium. Urban time policies can regard direct action that directly impacts the use of the city with the relative mobility impact.

Intervention ban be clustered into two main classes. The first that include top-down project managed by the public sector include: timetable for the spare time and tourists i.e. opening time of museums, public libraries, sport facilities; multi uses of spaces and services i.e. «save time» services, waiting times, open schools, flexible working hours in public offices; new time for sustainable mobility i.e. desynchronization hours of high school, home-to-school paths for children, night public transport services, freight distribution timetables.

The other group of measure includes bottom-up interventions, as co-working, night supermarket, and flexible working hours in private agencies.

4.7 Social inclusion and equity planning

Social inclusion is one of a collection of related concepts that have proliferated in recent years in a number of areas of public policy. These concepts include ‘social exclusion’ and ‘transport poverty’, ‘environmental justice’ and ‘just transport’. Although each of these concepts has a distinct provenance and a specific institutional and political locus, they share the perception that there are aspects of wellbeing that are of relevance to public policy and that are not adequately captured by traditional measures of poverty (which are largely based on concept of relative wealth) (MacDonald, 2001). In the context of transport, these are two key aspects that are emphasized:

- Inadequacies in transport provision (either in terms of access to the system itself or the level of service provided by the system) may create barriers limiting certain individuals and groups from fully participating in the normal range of actives, including key activities such as employment, education, health care and shopping. This concern focuses attention on the link between transport provision and activity participation and the role of accessibility, issues that have long been the focus of activity-based transport analysis.
- The transport system itself may generate disbenefits (in the form of environmental and social externalities) that bear disproportionately on certain individuals and groups. This concern focuses attention on the partial and socio-economic disaggregation of transport system externalities.

Starting from this issue, “access to opportunity” and “equity transportation planning” has the goal to ensure that the needs transport system users are taken into account in the implementation of planning policies and traffic management schemes, and in the design of individual developments.

Equity in more details refers to the distribution of impacts (benefits and costs) and whether that distribution is considered fair and appropriate. Transportation planning decisions can have significant and diverse equity impacts. Two main cluster of evaluation can be distinguished: horizontal or vertical equity

Horizontal equity concerns the distribution of impacts between individuals and groups considered equal in ability and need. According to this definition, equal individuals and groups should receive equal shares of resources, bear equal costs, and in other ways be treated the same.

Vertical equity is concerned with the distribution of impacts between individuals and groups that differ in abilities and needs, in this case, by income or social class. By this definition, transport policies are equitable if they favor economically and socially disadvantaged groups, therefore compensating for overall inequities.

4.8 Context Sensitive Design CSD

Context Sensitive Design CSD is "a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist." A crucial point of CSD is to understand the context; plan and design within the context (Douglass et al., 2002).

CDS is an approach to planning and designing transportation projects based on active and early partnerships with communities and it refers to roadway standards and development practices that are flexible and sensitive to community values. CSD allows roadway design decisions to better balance economic, social and environmental objectives. It integrates projects into the context or setting in a sensitive manner through careful planning, consideration of different perspectives, and tailoring designs to particular project circumstances. The CDS approach uses a collaborative, interdisciplinary practices that includes early involvement of key stakeholders to ensure that transportation projects are not only "moving safely and efficiently," but are also in harmony with the natural, social, economic, and cultural environment.

This approach requires an early and continuous commitment to public involvement, flexibility in exploring new solutions, and an openness to new ideas. Community members play an important role in identifying local and regional problems and solutions that may better meet and balance the needs of all stakeholders. Early public involvement can help reduce expensive and time-consuming rework later on and thus contributes to more efficient project development. Context Sensitive Design promotes six key principles:

1. Balance safety, mobility, community, and environmental goals in all projects.
2. Involve the public and affected agencies early and continuously.
3. Use an interdisciplinary team tailored to project needs.
4. Address all modes of travel.
5. Apply flexibility inherent in design standards.
6. Incorporate aesthetics as an integral part of good design.

Context-sensitive solutions emphasize the role of streets as a part of the community rather than just as conduits for moving cars. This approach is also a way of doing business that begins with long-range planning and is carried through project implementation. It encourages transportation engineers to use creativity and flexibility in project design. Innovative examples from around the country demonstrate how such an

approach to designing transportation projects can improve traffic flow while preserving community character and supporting walkable places that are more easily served by transit. Additionally, experience in states that employ context-sensitive solutions illustrates how such an approach can produce projects that are embraced rather than fought by communities. By avoiding the costs associated with long delays, aborted projects, and bitter public battles, a context-sensitive approach can help states more effectively use limited transportation funds. Context-sensitive solutions represent a fundamental shift in the way most state departments of transportation do business. Producing results therefore requires sustained leadership from senior-level officials. New guidance might be required to change current practices and existing design standards may need to be revised, although in most instances the desired results can be obtained within existing standards.

5 "Orgware" LUTI strategies

5.1 Smart mobility

The smart mobility refers to the potential of optimizing existing city infrastructure, networks, and urban behavior through the deployment and utilization of information and communication technology (ICT). It is in fact mostly based on the application of new information technology for the innovation of transportation systems and it has been quite fashionable in urban and transport planning domains and in the policy arena in the last decade.

This original concept has evolved in time and now researchers and practitioners look innovative technologies not just for increasing the efficiency of infrastructure and places, but for better manage and also involve citizens. We refer in particular on the definition of smart city proposed by the British Standards Institution (PAS, 2014) which mentions "an effective integration of physical, digital and human systems in the built environment to deliver a sustainable, prosperous and inclusive future for its citizens". In this definition three aspects are crucial:

- the integration between physical and digital;
- the focus on the local context: the smart city is not described as a "perfect" end-state for cities, taking into account the importance of the specific local context: "all cities are different: the historical, cultural, political, economic, social and demographic context for each city is different; as is the legacy of business processes and technology implementation from which it starts".
- the centrality of "citizen" (including residents, businesses, visitors and commuters to the city) which are not just users of services, but have a specific and active role in the transition.

This approach combines the previous visions, looking at smart mobility as a system capable of using ICT in an extensive and intelligent way, in order to improve the overall urban performances and, above all, the quality of life of citizens.

Among the main elements that characterize the integrated approach to the Smart Mobility, it is the awareness that enhancing through ICT the performance of individual sectors (from transport to energy, from constructions to urban safety, etc.) does not necessarily result in the building up of a smart mobility: "a smart mobility should be viewed", indeed, "as an organic whole – as a network, as a linked system. In a smarter mobility system, attention is paid to the connections and not just to the parts". Furthermore, the idea that a smart mobility represents the final goal of a virtuous path – along which investments are addressed to achieve a sustainable growth, in economic and environmental terms – aimed at improving the quality of life of citizens and based on the involvement of settled communities – is currently more and more widespread.

The Smart City Framework - SCF (PAS, 2014) also refers to these concepts and distils current good practices into a set of consistent and repeatable patterns that city leaders can use to help them develop and deliver their own smart city strategies. The SCF indeed dedicates a specific focus on:

- make current and future citizen needs the driving force behind all city spaces and systems;
- integrate physical and digital planning;
- identify, anticipate and respond to emerging challenges in a systematic, agile and sustainable way;
- Create a step-change in the capacity for joined-up delivery and innovation across organizational boundaries within the city.

5.2 MAAS Mobility as a service

Mobility as a Service (MaaS) is an application of smart mobility, which also includes the management and financial aspects. In more detail, it is a mobility distribution model in which a customer's major transportation needs are met over one interface and are offered by a service provider. Typically, services are bundled in to a package – similar to mobile phone price-plan packages.

The vision is to see the whole transport sector as a co-operative, interconnected eco - system, providing services reflecting the needs of customers. The boundaries between different transport modes are blurred or disappear completely. The ecosystem consists of transport infrastructure, transportation services, transport information and payment services.

The idea starts from the issue that current organization of public transport provision does not sufficiently contribute to a functional and convenient mobility service ecosystem. It needs to be renewed, in order to achieve efficiency gains and sustainability in the mobility sector. In order to be competitive with private car, for-hire and public transportation need to be able to fulfill the individual mobility needs of citizens. The service provision needs to be contemplated with a number of additional multimodal services. Furthermore, services have to be provided conveniently through mobility service portals, which integrate and package services individually according to customers. These integrators should operate as interfaces between service producers and customers and manage the service supply and charging procedures (Heikkilä, 2014).

MaaS approach can have benefits for users, for the public sector and the private sector.

User-benefits include: developed, personalized and smart mobility services reflecting the users' diverse needs; seamless, well-functioning transport services and easy access to mobility.

For the public sector, benefits include: full deployment of ICT improves the effectiveness of the whole transport system; efficient allocation of resources (based on real needs of end-users); growth employment and vitality generated by new businesses (public sector as an enabler); and improved traffic incident management and a more reliable transport system through advanced data deployment.

For businesses, benefits include: profitable markets for new transport services; renewed opportunities for the traditional transport and infrastructure business sectors as part of innovative service concepts and co-operation; and smarter transport connections for all sectors.

6 References

Bertolini, L. and F.le Clercq (2003), Urban development without more mobility by car? Learning from Amsterdam, a multimodal urban region, In Environment and Planning A, Vol. 35, No. 4, pp. 575-589

Bertolini, L., F.le Clercq and E.de Niet (2000) Naar een VervoersPrestatie voor de Regio. Eindrapportage fase 1. Amsterdam: AME (Commissioned by NOVEM)

Boarnet, M. G., & Crane, R. (2001). Travel by design the influence of urban form on travel.

Cervero, R. (2004). Transit-oriented development in the United States: experiences, challenges, and prospects (Vol. 102). Transportation Research Board.

Derek Halden (2002), "Using Accessibility Measures to Integrate Land Use and Transport Policy In Edinburgh and Lothians," Transport Policy, Vol. 9, No. 4 (www.elsevier.com/locate/tranpol), Oct. 2002, pp. 313-324.

Banister, D. (2008) The sustainable mobility paradigm. In Transport Policy, Vol. 15, No. 2, pp. 73-80

British Standard Institution Smart City Framework (2014), Guide to establish strategies for smart cities and communities.

Douglass, R. D., McClelland, K., & Fitzgerald, W. (2000). Context-sensitive design. In 2nd International Symposium on Highway Geometric Design (No. FGSV 002/67).

Handy, S. (2002), Accessibility- vs. Mobility-Enhancing Strategies for Addressing Automobile Dependence in the U.S. Ongepubliceerde paper voor de European Conference of Ministers of Transport

Handy, S. (1996). Methodologies for exploring the link between urban form and travel behavior. Transportation Research Part D: Transport and Environment, 1(2), 151-165.

Heikkilä S. (2014) Mobility as a Service – A Proposal for Action for the Public Administration, Case Helsinki.

Karst T. Geurs (2006), Accessibility, Land Use and Transport: Accessibility Evaluation of Land-Use and Transport Developments and Policy Strategies, Eburon (www.eburon.nl); at www.eburon.nl/accessibility_land_use_and_transport.

Levinson, D.M., and K.J. Krizek (2008), Planning for Place and Plexus, London/New York: Routledge.

Levinson, D. (2008) Density and dispersion: the co-development of land use and rail in London, In Journal of Economic Geography, Vol. 8, No. 1, pp.55-77.

Litman, T. (2004). Rail transit in America: a comprehensive evaluation of benefits.

Lucas, K. (2006). Providing transport for social inclusion within a framework for environmental justice in the UK. Transportation Research Part A: Policy and Practice, 40(10), 801-809.

MacDonald, M. (2001). Social Inclusion: Transport Aspects (UG320).Chicago

McClintock, H. (Ed.). (2002). Planning for cycling: principles, practice and solutions for urban planners. Elsevier.

Mareggi, M. (2002). Innovation in urban policy: the experience of Italian urban time policies. Planning Theory & Practice, 3(2), 173-194.

Muller, P.O. (2004), Transportation and Urban Form. In S.Hanson en G.Giuliano (Eds.) The Geography of Urban Transportation. New York en London: The Guilford Press, 59-85

Newman, P., & Kenworthy, J. (1999). Sustainability and cities: overcoming automobile dependence. Island Press.

Ogilvie, D., Egan, M., Hamilton, V., & Petticrew, M. (2004). Promoting walking and cycling as an alternative to using cars: systematic review. Bmj, 329(7469), 763.

Stead, D., Geerlings, H., & Meijers, E. (Eds.). (2004). Policy integration in practice: the integration of land use planning, transport and environmental policy making in Denmark, England and Germany. Delft University Press

TCRP (2012) describes how to improve transit station access by various modes (walking, cycling and automobile),

Wee, B., W. Bohte, E. Molin, E. T. Arentze, T., and F. Liao (2014) Policies for synchronization in the transport–land-use system. In Transport Policy, Vol. 31, pp. 1–9

Wegener, M., and F. Fürst (1999) Land-Use Transport Interaction: State of the Art. Dortmund: Institut für Raumplanung

7 Useful resources and links

- Commission of the European Communities, 1990. Green Paper on Urban Environment [COM(90)218], Office for Official Publications of the European Communities, Luxembourg.
- Commission of the European Communities, 2001. European transport policy for 2020: time to decide [COM(2001)370], Office for Official Publications of the European Communities, Luxembourg, http://europa. eu.int/comm/off/white/index_en.htm.
- Commission of the European Communities, 2001b. A sustainable Europe for a Better World: a European Union Strategy for Sustainable Development. Communication of the European Commission [COM(2001)264], Office for Official Publications of the European Communities, Luxembourg, http://www.europa.eu.int/comm/environment/eussd/.
- Commission of the European Communities, 2001c. European governance: a white paper [COM(2001)428], Office for Official Publications of the European Communities, Luxembourg, http://europa.eu.int/comm/governance/white_paper/index_en.htm.
- Commission of the European Communities, 2002. Amended proposals for Council Decisions concerning the specific programmes implementing the Sixth Framework Programme of the European Community for research, technological development and demonstration activities [COM(2002)43], Office for Official Publications of the European Communities, Luxembourg, http://www.cordis.lu/rtd2002/fp-debate/ cec.htm.
- Committee on Spatial Development, 1999. European Spatial Development Perspective. Towards Balanced and Sustainable Development of the Territory of the European Union, Office for Official Publications of the European Communities, Luxembourg, http://europa.eu.int/comm/ regional_policy/sources/docoffic/official/repor_en.htm.
- European Conference of Ministers of Transport, 2001. Implementing Sustainable Urban Travel Policies. [Report CEMT/CM(2001)13], ECMT, Paris, http://www1.oecd.org/cem/UrbTrav.
- European Union, 2001. Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programmes on the environment. Official Journal of the European Communities L 197/30, 30–37.21/07/2001, http://www.europa.eu.int/ eur-lex/en/index.html.
- Expert Group on the Urban Environment, 1996. European Sustainable Cities. Report of the Expert Group on the Urban Environment. European Commission, DGXI, Environment, Nuclear Safety and Civil Protection, Brussels.
- European Conference of Ministers of Transport, 2001. Implementing Sustainable Urban Travel Policies. [Report CEMT/CM(2001)13],ECMT, Paris, http://www1.oecd.org/cem/UrbTrav
- ARTISTS, 'Arterial Streets towards Sustainability', Fifth Framework Programme Research Project www.ulb.ac.be/ceese/nouveau%20site%20ceese/versionen/research_domains/artists.htm
- ASI, 'Assess implementations in the frame of the Cities-of-Tomorrow programme', Fifth Framework Programme Research Project. 'Built environment variables influencing pedestrian trips: Guidelines for the design of pedestrian-oriented urban development: Towards a walkable city', research project under the 'CEDEX - Strategic Plan of Infrastructures and Transport' research programme, Spain. www.cedex.es/idipeit/Difusion/PT-2006-036-09ICPP/index.html
- 'Competition position and accessibility 'Randstad', research project under the 'CONNEKT - Public private innovation network for traffic and transport' research programme, the Netherlands.

- Commission of the European Communities (CEC) (1995) 'The Citizens' Network', Green Paper; COM(95)601, Brussels.
- Commission of the European Communities (CEC) (2001) 'White Paper – European transport policy for 2010: time to decide'. Luxembourg: Office for Official Publications of the European Communities.
- Commission of the European Communities (CEC) (2006a) 'Keep Europe Moving – Sustainable Mobility for Our Continent: Mid-term review of the European Commission's 2001 Transport White Paper'. Luxembourg: Office for Official Publications of the European Communities.
- Commission of the European Communities (CEC) (2006b) 'Thematic Strategy on th Urban Environment', COM(2005)718, Brussels.
- Commission of the European Communities (CEC) (2009a) 'Action Plan on Urban Mobility', COM(2009)490, Brussels. Thematic Research Summary: "Land Use Planning" Page: 28 of 35 Transport Research Knowledge Centre Commission of the European Communities (CEC) (2009b) 'A sustainable future for transport: Towards an integrated, technology-led and user friendly system', COM(2009)279, Brussels.
- European Economic and Social Committee (EESC) (2009) 'Integrating Transport and Land-use Policies for More Sustainable City Transport', exploratory opinion of the European Economic and Social Committee, Brussels. EXTR@Web (2006) 'Third Annual Thematic Research Summary – Land Use Planning', Deliverable D2.E-4.7 of the EXTR@Web project [online] www.transportresearch.info/Upload/Documents/200608/20060831_121310_49243_land-useplanning_ D2E_issue1-0.pdf (December 2009).
- Hall, P. and Marshall, S. (2002) The Land Use Effects of 'The 10 Year Plan'. Report for Independent Transport Commission, London.
- Marshall, S., Banister, D., Eds. (2007) Land Use and Transport: European Research towards Integrated Policies. London: Elsevier.
- May, A.D., Stantchev, D. (2006) Land Use and Regional Planning: Achieving Integration between Transport and Land Use. Brussels: European Commission.
- METKA, 'Sustainable Structure for the Metropolitan Area', research project under the 'EKOTULI - An Ecologically Efficient and Safe Transport System' research programme, Finland. www.metkaprojekti.info/
- SPATIAL EFFECTS 1, 'Spatial Effects of the Vereina Tunnel', research project under the 'OSD - Sustainable Mobility - Sustainable spatial development and mobility (internal research plan)' research programme, Switzerland.
- SPATIAL EFFECTS 2, 'Spatial Effects of the transport infrastructure in the Magadino Plain', research project under the 'OSD - Sustainable Mobility - Sustainable spatial development and mobility (internal research plan)' research programme, Switzerland.
- SPATIAL EFFECTS 3, 'Spatial Effects of the urban railway system in Zurich', research project under the 'OSD - Sustainable Mobility - Sustainable spatial development and mobility (internal research plan)' research programme, Switzerland. Thematic Research Summary: "Land Use Planning" Page: 29 of 35 Transport Research Knowledge Centre
- SPICYCLES, 'Sustainable Planning & Innovation for Bicycles', research project funded under the 'IEE – Intellige Energy Europe' research programme. http://spicycles.velo.info/
- STEPS, 'Scenarios for the Transport System and Energy Supply and their Potential Effects', Sixth Framework Programme Research Project. www.steps-eu.com/

- 'The Attractive City - Traffic integration or segregation for the sustainable city', research project funded under the 'SRA/Vägverket 2000-2009 - SRA Research and development programme 2000-2009' research programme, Finland.
- European Transport White Paper of 2001: need to integrate environmental considerations into transport policy
- 1990 Green Paper on the urban environment : integrated approach to policy
- 1996 report of the Expert Group on the Urban Environment the fundamental challenge is to achieve integration: integration between different levels (vertical) and between different actors in the policy process (horizontal)
- European Commission's communication on urban policy, 1997:
- European Spatial Development Perspective (ESDP), 1999: policy integration, recommendin for example that location policy must be compatible with transport policy
- European strategy for Sustainable Development, 2001:
- European Directive on strategic environmental assessment (SEA), 2001 'the integration of environmental considerations into the preparation and adoption of plans and programmes with a view
- European White Paper on Governance, 2001
- Regional policy for smart growth in Europe 2020, 2011:

As regard European Project the policy integration between land use planning and mobility policies is often a central theme: Land Use and Transport (LUTR) cluster of projects much less focus on institutional, organizational or implementation issues.

- COST-332 (transport and land-use policies) – 1996 – 2000 http://www.cordis.lu/cost-transport/src/cost-332.htm
- DANTE (designs against the need to travel in Europe) – 1997 – 1998
- ECOCITY (urban development towards appropriate structures for sustainable transport) 2002-2004
- PROPOLIS (planning and research for land use and transport for increasing urban sustainability)
- PROSPECTS (procedures for recommending optimal sustainable planning of european city transport systems)
- SPECTRA (sustainability, development and spatial planning)
- TRANSLAND (integration of transport and land-use planning)
- TRANSPLUS (transport planning, land use and sustainability)
- ARTISTS; ASI; Built environment variables influencing pedestrian trips: Guidelines for the design of pedestrian-oriented urban development: Towards a walkable city;
- SPICYCLES; The Attractive City – Traffic integration or segregation for the sustainable city;
- BAHN.VILLE; ECOCITY; HITRANS; IFPLUT; PLUME; SCATTER; TRANSECON; TRANSPLUS; VELO.INFO; ISHTAR; PROPOLIS; PROSPECTS; SUTRA; UG220