Urban mobility and transportation

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URBAN MOBILITY AND TRANSPORTATION

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Definitions

TRANSPORTATION is the integration of physical and organizational elements with the aim of producing displacement opportunities and demand. Demand is driven by social and economic activities in a target area. Infrastructures, services, control settings, pricing, vehicles and performances – taken together – make up Transportation Systems Engineering.

URBAN MOBILITY is divided into collective, individual and freight transportation. While people's movements are the outcome of individual decisions, freight movements depend on both the cargo owners and transportation service providers.

SUSTAINABLE MOBILITY is the ability to meet the needs to move freely, access, communicate, trade, establish relationships without sacrificing present and future human and ecological values. The traditional definition of Mobility has been enriched within the framework of Sustainability (declined into Economy, Society and Environment). When Technology is added to this framework, the concept of SMART MOBILITY is introduced. Although the two concepts have not been born together, they cannot be treated separately. The concept of smart might sound better and more practical as it entails tangible intervention and development, whereas sustainable is more pertaining to policy, research and effort towards the promotion of behavioural changes. SUMP is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. EU SUMP's approach is different from a traditional mobility plan as it focuses on people's interest in terms of mobility and promotes active involvement of citizens and stakeholders from earliest phases, enhancing acceptance and support. SULP is the counterpart of SUMP as far as logistics is involved aiming at reducing the energy consumption and environmental impacts of urban freight logistics.

MAAS offers a dynamic multimodal solution of transportation provided by several suppliers on a single interface. MaaS typically consists of fixed monthly subscription for the unlimited use of public transportation (with a tariff slightly higher than a monthly pass) and discounted rates for the use of on-demand services such as car sharing, bike sharing and taxis, or tailored subscription schemes allowing the user to choose in advance the modal alternatives that best meet his needs. According to Hensher (2017) MaaS is not the Panacea of collective transport services, but it opens up opportunities for better customer service and modernization of public transportation services and their regulation.

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Introduction

Urban areas are developing quickly, innovative technologies grant enlarged scope for mobility management. According to literature, 50% of world population and as much as 75% of EU population live in cities, where the majority of GDP is generated. CO2 is responsible of 75% GHG worldwide and transportation is worth around 20% of this share and the contribution is rising, in particular in urban areas. Besides pollution and noise, also collisions (70% of which in urban areas) and congestion - which is worth around 1% of EU GDP in terms of time lost due to delay suffered - are negative externalities. Finally, due to urban sprawl induced by car-centric cultural regimen under the justification of cheaper land costs, the need to travel has been growing notwithstanding economic downturns, resulting in an increased threat of social exclusion for those who cannot afford a car.

The attitude towards urban transportation has shifted from laissez-faire to deep concern: as far as EU is concerned, the Action plan on Urban Mobility (2009) recommended the adoption of Sustainable Urban Mobility Plans (SUMPs), the 2011 White Paper envisaged SUMPs to become mandatory for cities over 100,000 inhabitants and a base requisite to access to EU Funds. The 2013 Guidelines and the 2015 EC Urban Mobility Package have further established the SUMP policy. In 2015, UN adopted the "Agenda for sustainable development 2030" (7 out of 17 objectives deal with transportation) and a new worldwide agreement on climate has been signed in Paris. Finally, the funding foreseen by EU research project H2020 (8,2% of the total budget allocated on transportation) will further encourage the investigation of new strategies and technologies.

SUMPs emphasize long term vision, the active involvement of citizen and stakeholders (Priester et al., 2014), the setting of targets, measures and a radical reform of regulatory and funding framework to avoid start-and-stop approach (Hickman et al., 2013; Stephenson et al., 2018). Nevertheless, the commitment level is different: developing countries would rather urge to build more and modern infrastructures, leaving the environment as a secondary priority. SUMPs are expected to find solution to road congestion and policy fragmentation between documents (Baidan, 2016). According to EU CIVITAS project's outcomes, the implementation of SUMPs can be hindered by pro-car & infrastructure building lobbyism, inefficient planning - monitoring – dissemination, lack of stakeholder involvement and support, excessive outsourcing, fluctuation of political commitment over time (Ibeas et al., 2011; Persia et al., 2016), inadequate coordination among policy tiers and plans (Stephenson et al., 2018), unsupportive or inappropriate regulation and financial structures, poor or missing data and reliance to business-as-usual scenarios. The topics facing less acceptance have been accessibility, logistic, traffic control, cycling and walking measures (Bruhova Foltynova & Jordova, 2014).

Planning for Sustainable Urban Mobility – SUMP

Traditional territorial planning foresaw urban centres surrounded by residential areas according to the importance of the activities at the core. Sprawl in activities and residences made car displacement the only feasible alternative to reach work places and commercial areas located on the outskirts. From the sustainability point of view what at first sight seemed to be living close to nature involved waste of energy, higher costs for growing and moving goods, alteration of bio-diversity, inequalities and isolation for those who cannot travel long distances (Shore, 2006).

As transportation systems are complex, effective strategies have to be cross-disciplinary. First, a clear vision is required not to lose the focus between strategy and short term measures (Stephenson et al., 2018). In the context of urban transportation, incremental approaches will not achieve the expected impact reduction in due time, while too radical changes are likely to face opposition (Vagnoni & Moradi, 2018). SUMPs often have conflicting aims and scope with existing laws. This "layering policy making" (Rayner & Howlett, 2009) results in a complex and costly mechanism of inconsistent policies (Isaksson et al., 2017). Cultural gaps and negligible cooperation between administrations and stakeholders are often found at the local level, in addition productive layers and citizenship are rarely involved into the process. Further, there is less concern and awareness on the existence of EU regional development funds (Vagnoni & Moradi, 2018).

The major threat to success of SUMPs is ignoring the larger plot in which transportation is framed (Goldman and Gorham, 2006) and implementing spot-solutions such as new infrastructures built to reduce congestion which will experiment congestion themselves in a shorter than expected time (Mantecchini and Paganelli, 2016), policies aiming at promoting safety that result in drivers' riskier behaviour in the long time and – finally - research in technology that improve emission performance but - by reducing the cost of travel - make road transportation even more convenient.

Urban planning, investment, land use and environment shall frame the transition to sustainable mobility in order to reach a balance between externalities and accessibility. The relationship between land use and transportation relied traditionally on the two concepts of "travel as a derived demand" and "travel cost minimization", by which the predominance of transportation solutions and the continual upgrading of the road network to allow faster displacement were justified. The advent of the internet and urban design can both reduce the need to travel, the average distance (Banister & Kickman, 2006) and encourage modal shift. Furthermore, the apparent inconsistency between the necessity to speed things up for business and slow traffic down for safety and environmental reasons introduced the concept of a desirable - although limited - degree of congestion. In conclusion, travel time reliability is more crucial than its minimization (Noland & Polak, 2002). Since accessibility and land-use/transportation systems are strictly related, Straatemeier (2008) suggested that accessibility measures can serve to assess the feasibility of alternative transportation scenarios.

The concept of accessibility has been widely dealt with in scientific literature (Hansen, 1959; Ben-Akiva & Lerman, 1979, Geurs & van Wee, 2004). Planning for accessibility rather than for demand accomplishment needs a new approach and a change in people's habits: demonstration can help in making reluctant users prone to accept that they should pay the external costs they generate (by issuing taxation schemes linked to vehicles' pollution profile and age or incentives to those buying electric cars). All those concepts – in addition to making the best use of transportation system and technologies available - are rebated by the EU Commission (Banister, 2008; Priester et al., 2014).

As local authorities have little influence, funding, staff and technical skills to promote sustainability, conflicting messages between short term, volatile and vague national views and the local level is traceable. In general, while consensus on targets is shared, the public opinion favours bottom-up "pull" strategies while expert opt for top-down "push" measures.

Market-based solutions such as shared mobility and increased competition on costs can encourage sustainable transportation systems (Stephenson et al., 2018) while ITC can provide information on competing alternatives along urban arterials, at public transportation stops and parking garages. Integrated mobility allows people to travel on a multimodal public transportation chain with a single payment platform and multiple providers; when car and bike rental services are added Mobility as a Service (MaaS) is provided. Shared mobility typologies vary on the time duration of the reservation and location of the pick-up/return points within the territory.

EC has also proposed traffic management measures, which have been introduced in a scattered way mainly in EU capitals and main cities: Low Emission Zones (LEZ) are common in Germany, north of Italy and Denmark; Congestion Charge are applied in London and Milan (plus several cities in Sweden and Norway), while Access Regulation schemes (to particular vehicle categories and at specific time period) are the most adopted solution in Italy. Pollution cap and road pricing - finally – are a monetary fee to "purchase the right to pollute" which aim at adjusting the costs of private car transportation by adding a penalty linked to the detrimental effects introduced by congestion. A similar scheme is scrutinized also for air transportation, in particular in cities with large regional and hub airports (Postorino and Mantecchini, 2014; Lantieri et al., 2015; Xu et al., 2016; Postorino et al., 2017; Paganelli et al., 2018).

Since high share of public transportation coupled with soft mobility infrastructures result in an improvement of sustainability (less pollution), anti-cyclic policies such as the reduction of parking stalls and the increase of parking tariffs are deemed likely to support public transportation demand, especially in big cities where robust public transportation networks are present (Persia et al., 2016).

Finally, relevant contributors to pollution and congestion are logistic players due to the growing importance of e-commerce. Solutions to reduce the increasing number of trucks running below capacity, such as concentration of trips and efficient scheduling of pick-up/deliveries, are framed in a context of scattered providers and goods. While waiting for a clear regulation on RPAS (Remote Piloted Aircraft Systems – i.e. drones) in urban context, logistic operators and municipalities are required to find solutions to ease congestion, such as neighbourhood drop-off points, small scale voluntary programs of delivery coordination and promotion of green fleets in exchange of customized loading areas, subsidies or less stringent access restriction schemes.

Instruments to assess of sustainable policies

Sustainable transportation is no longer the exclusive domain of transportation engineers but an interdisciplinary process with a long-term vision; thus, monitoring is necessary to develop appropriate policies and qualitatively or quantitatively describe the progress made.

Several methods to appraise mobility projects are present in literature. Usually, indicators are chosen by means of literature review, surveys and roundtables according to criteria such as relevance, transparency, standardization, validity, sensitivity, lack of ambiguity and availability-measurability-reliability (Lopez-Carreiro and Monzon, 2018); possibility to derive time series, comprehensiveness, coherence, context specificity and speed of collection (Jain and Tiwari, 2017). The weak point is the availability/affordability in terms of time and cost, mainly due to faulting local authorities, lack of reliable archives and data collection mechanisms. Further uncertainty exists on the amount of indicators to take into account and on the relative weight: too large sets often require significant sampling costs, while a small set hinders the risk of failing to illustrate the reality (Perra et al., 2017). Finally, transferability is not always viable (Macedo et al., 2017).

Indicators are usually grouped according to the three pillars of sustainability: environment, society and economy. Environmental indicators assess the impacts of different modes of transportation on pollution, social and economic aspects (i.e. environmental sustainability is negatively correlated with motorization rate and positively related with public transportation demand, frequency and modal share) (Persia et al., 2016; De Olivera-Cavalcanti et al., 2017). Social indicators are positively related with urban density, GDP, accessibility to public transportation and its performance, and negatively linked to the number of accidents; finally, economic indicators are negatively correlated with the modal share of public transportation because investing in quality is costly for both authorities and users (Lopez-Carreiro and Monzon, 2018).

Sustainable Mobility Indexes (SMI) help planners in assessing mobility scenarios, making comparison and monitoring efficiency over time (Lima et al., 2014). Bulckaen et al. (2016)'s SMI consists in 16 indicators chosen after literature review, pilot project assessment, survey and discussion with stakeholders from 5 EU countries. In Brazil, Lima et al. (2014) and De Olivera Cavalcanti et al. (2017) proposed SMI referring to mobility measures chosen by the government upon the appointment of Olympic Games and football World Cup: the former is derived by a weighted linear combination of indicators from 9 domains and a matrix expressing implementation time and quality, while the latter is the arithmetic mean of 17 indicators (7 for Environment, 8 for Society and 2 for Economy) in a 4-steps scale [0; 0,33; 0,66; 1] expressing the degree of innovation of each project.

Macedo et al. (2017), Awasti et al. (2018) and Lopez-Carreiro & Monzon (2018) proposed the introduction of a fourth pillar within sustainability. The first aims at including also cultural contexts other than western world's; the other contributions include technology into the assessment of sustainability. Awasti et al.'s assessment consist of 31 indicators whose values have been derived by means of verbal scales ranging from "very good" to "very poor", while Lopez-Carreiro & Monzon (2018) make use of 16 indicators (4 for each pillar) standardized on a scale (0-100) and compute SMI by a formula that equally weighs global sustainability and the degree of innovation.

Outside the three-pillars classification, Priester et al. (2014) classified 29 indicators into (i) active, (ii) passive, (iii) negligible, and (iv) critical according to the reciprocal influence by means of a matrix scoring values from 0 - no influence to 3 - maximum influence. Bruhova Foltynova & Jordova (2014) proposed an Index of Policy Environment composed of 10 indicators to assess whether and to which extent policy, strategies, communication and stakeholders influence measure implementation; the existence of transportation policies resulted the most important indicator, followed by long term planning and allocation of financial resources, while political stability, the regular use of transportation model and the revision of strategies were deemed of less importance. Persia et al. (2016) proposed a city clustering to Italian context to investigate the opportunity for policy transferability according to context (territorial variables, vehicle fleet, urban mobility and commuting), sustainability (road accidents, pollution, public transportation demand, modal share) and policy indicators (supply, traffic management measures, regulation, road space allocation). Perra et al. (2017) split 32 indicators into five target areas (integrated transportation planning, traffic and parking management, promotion of soft mobility, collective transportation and green technologies) to evaluate mobility in Thessaloniki. Finally, Tafidis et al. (2017) identified 8 sustainable mobility objectives and classified as much as 80 indicators according to a scale from 1 - minimum to 5 – maximum, rebating the urgency of urban observatories in charge of data collection and management.

A review of the tools available to policy makers to prioritize actions mentions (i) Life Cycle Assessment (LCA), (ii) Cost-Benefit or Cost-Effectiveness Analysis (CBA / CEA), (iii) Multi Criteria Analysis (MCA) which allows ranking the alternatives according to conflicting attributes, (iv) Multi Actor Multi Criteria Analysis (MAMCA) which enables the simultaneous evaluation of alternative policy measures allowing the possibility to include explicitly stakeholders' opinions from the earliest stage of the decision-making process, and (v) SWOT analysis.

Sustainable versus Smart Mobility

Sustainable mobility conceived by Banister foresaw the reduction of the need to travel and of the average distance by promoting efficiency and modal change. At first, the focus on the ecological dimension appeared prevalent but later on literature framed the concept of sustainability into a three pillar concept and the focus shifted to human rights, governance, health and equity. Nowadays the definition of sustainable development has embraced also fields relative to building (i.e. ZEB and NZEB) and quality of life.

As for transportation, literature claims that (i) impacts shall not threaten long-term ecological sustainability, (ii) basic transportation needs shall be satisfied and (iii) intra and inter-generation transportation equity shall be pursued. The EU project SUMMA declined the expected outcomes of sustainable mobility: accessibility, affordability, safety, security, better air quality, reduced noise, liveability, amenity, equity, social cohesion and fair working conditions for mobility sector workers (Jeekel, 2017). Smart mobility covers topics such as users' behaviour, use of big data, ICT and - in the next future - communication between vehicles and diffusion of electric vehicles (EV). Lyons (2016) belongs to the literature stream claiming that smart mobility keeps together technology with social, economic and environmental aspects. Indeed, smart mobility concept was in the beginning all about technology (alternative fuel, electric mobility, autonomous driving, adaptive cruise control), ITC (real time information, intelligent traffic management, platooning, big data) and innovative mobility solutions (i.e. on-demand services).

A relevant number of mobile apps and websites promoting sustainable behaviour already exist, but those that allow users a higher degree of interactivity and the possibility to share on social networks with selected contacts the progress made show higher degrees of success and fidelity (Gabrielli et al., 2014).

Smart mobility initiatives in cities are either led by industrial groups or financed by European funds. A review performed by Battarra et al. (2018) on Italian metropolitan cities found that the large majority of initiatives concerns ICT, while only 2% involves interventions on the territory. As for location, 75% of the actions were concentrated in the northern and central Italy, while the actions in the south were mostly sporadic and pilot projects on accessibility. The largest metropolitan cities implemented solutions to strengthen public transportation (new urban railway lines, parking lots, traffic regulation systems, investment on public transportation fleet) while others developed cycle mobility, ITC services, shared mobility and congestion charge schemes. The authors concluded that effective ICT and smart transportation solutions should be implemented within a mature framework of infrastructures and mobility systems.

In conclusion, the relationship between sustainability and smart mobility can result into two opposite directions: technology can either make the car alternative even more attractive than now, thus worsening congestion, sprawl and equity, or it will favour shared mobility thus reducing the number of cars and trips.

Review of the main fields of innovation in transportation

The economic crisis, the change of context and attitude towards transportation are changing the way we travel. Digitalisation is opening up new opportunities that can better meet new users' needs. Emerging technologies can disrupt collective and individual mobility. It is important to clarify how the transition process will be governed and how both the benefits and the externalities will be managed. Public transportation authorities would increase their traffic share, so MaaS is not simply a new sale channel of collective transportation but an overall reform that may require new forms of public-private partnership (Smith et al., 2018).

The EC recommendations on Sustainable Development contains 169 objectives, of which 87% require strong digital innovation. Initiatives have been already implemented but information is scarce due to the fact that each administration develops ad hoc solutions. In addition, governments reports are cryptic to readers and information about pilot tests are usually erased quickly from agencies' websites in case of failure. A brief outline of each scheme is proposed in the following subsections.

- Shared mobility

  The advent of GPS & smartphones made shared mobility accessible, attractive and convenient. Shared mobility focus on utilization rather than mainstream car. The different cost structure makes it quantitative evident running costs, while avoiding ownership and maintenance costs. In terms of performance, the term flexibility highlights the wide range of choice, tailored solution and pay-as-you-use scheme.

- Integrated mobility

  Many transportation agencies have been investing to transform themselves into integrated providers. Network integration ensures a system of travel alternatives, time integration returns synchronized services allowing users to transfer in combination with physical integration of terminals and integrated information system. Finally, the integration of tolls and ticketing systems allows no additional costs and a single ticket for the whole displacement. Ticketing is the most basic and renowned form of integration, applied in Hong Kong, London and Paris. Users appreciate the speed and ease of payment, the schedule coordination, the shorter waiting time and the perception of saving time and money. Kamargianni (2016) proposed a classification of innovative mobility services according to number of integrated alternatives and features such as payment opportunities, trip planning tool, reservation system and mobility package.

Frequent users and planners believe integrated ticket to be the most important attribute; frequent travellers add preference to network integration and the wide range of solutions. Planners are concerned on economic sustainability and don’t deem important schedule coordination. None realizes the importance of the physical integration and information, maybe due to smartphone offering the same information. Minimization of transit time at the most common transit nodes is advisable (Chowdhury et al., 2018).

- MaaS - Mobility as a Service

MaaS offers a dynamic multimodal solution provided by several suppliers - not only public transportation alternatives - on a single interface. The main features shall be summarized as follows (Docherty et al., 2018):

- users purchase the right to access a package of interoperable mobility services owned by other subjects (taxi, bus, bike / car sharing, train);
- the demand and the supply are balanced in real time using data mining techniques;
- information is real time, user-generated and user-centric;
- intelligent infrastructures and interconnected vehicles exchange information to influence the behaviour of other users and optimize system performance;
- EV, hybrid vehicles and new network technologies are adopted;
- automatic drive allows the occupants to concentrate on other activities

MaaS, then, is made of both car-based peer-to-peer services like BlaBlaCar and collective smart solutions bookable via mobile, performed either by traditional road/rail vehicles or private vehicles shared by users. Traditional private mobility and public transportation services will survive where there is no scope for the implementation of a MaaS (i.e. school service and feeder service from small villages).

This hybrid situation entails a deep change in contracts’ regulation now based on separate providers for each mode of transportation, protected areas of influence and under-exploited capacity. Transportation suppliers would be bound by an agreement but each one keeps its personnel, resources and data. Today, privately owned vehicles, State-financed infrastructure and collective transportation system operating under Public Service Obligations (the State grants concession and partially subsidizes the operator) exist; the transition to the mobility of the future implies a necessary evolution to public-private partnerships, with integrators in charge of matching demand and supply. The presence of an efficient and high capacity public transportation is a prerequisite for the development of MaaS with other modes feeding to less densely populated areas. The role of the State in MaaS is controversial: some argue a fairly passive role (i.e. facilitate regulatory innovation, issue remedy to the flaws and provide economic resources) whereas nowadays third-part State intervention is not infrequent; in other cases, the State would play the role of the integrator to keep the power to regulate access and competition and influence the tariffs so as to guarantee equity and the contribution to infrastructure maintenance (Docherty et al., 2018; Smith et al., 2018).

Main concerns about MaaS entail high rates, fleet ownership and maintenance (Uber and similar companies do not own their cars), actual capability to reduce traffic and congestion, the threat of unfair system without regulation (the service provider would create as much demand as possible to maximize the return on investment, raise tariffs to prevent the entry of new subjects, introduce discrimination). MaaS is potentially vulnerable: from the operation side, drivers are both monitored by the GPs and capable of compromising the reliability of real time information by disabling on-board GPs devices; from the security point of view, business intelligence units, users' preferences, movements, sensitive information and users' bank account data can be hacked, manipulated, disclosed, sold to competitors, altered or removed (Callegati et al., 2018).

- Mobility budget

In some countries work-related travel cost are remunerated, commuting costs compensated (tax-free bike allowance, public transportation seasonal ticket, beneficial treatment of car expenses) and company cars are part of remuneration package so that users don't perceive the costs and tend to opt for more equipped cars they would not opt for had they to pay for the car themselves (Zijlstra and Vanoutrive, 2018). A mobility budget is a sum of money provided by the employer to cover workers' travel expenses. Video conferences and tele-working are also recommended to reduce unnecessary trips, as well as the use of non-motorized transportation modes such as walking and cycling. Mobility plans tailored to employees' needs (i.e. shift workers) have been established at Barcelona and Paris airports.

Most disagreement exists on the amount of the budget and on the categories to involve: a sum capable of covering all transportation-related costs based on the commuting distance has been proposed. User friendly tools to provide transparent information to users is needed (Zijlstra and Vanoutrive, 2018). Simultaneously, software and online surveys are used to measure and model employees' mobility habits.

- Electric and automated vehicles

Electric Vehicles (EV) are all but cheaper and low performing alternatives to traditional solutions which cannot solve the issues of congestion and scarcity of parking but can provide reduced cost and – when connected to the grid – pollute less. Bluntly claiming that EVs are cleaner than traditional vehicles without including lifecycle and energy production is misleading. In the future, the cost of procurement of perishable raw materials will become more critical than energy costs.

Autonomous and green supplied EV, together with shared mobility, can disrupt contemporary mobility, making car ownership less convenient, reducing emissions and making transportation system more efficient. As a result, car use and congestion can increase rather than decrease due to reduced energy costs and eased accessibility. Industry research has developed a variety of models and technologies which are here summarized.

Vehicle-to-grid (V2G) describes a system in which plug-in Battery (BEV), Plug-in Hybrids (PHEV) or hydrogen Fuel Cell (FCEV) Electric Vehicles exchange energy with the distribution network. This can potentially introduce relevant monetary savings (a fleet of garbage trucks would be capable to replace a few power plants) once the issue of battery longevity is solved. Future development will likely allow Vehicle-to-Home transmission (V2H) and juxtaposition to renewable power resources such as wind or solar electric. Scepticism still exists on the actual V2G range and potential since the cost of a battery is as much as 1/3 of the cost of a new EV.

Through Internet / WLAN, cars can connect to other devices both inside and outside the vehicle. The first tool of this kind – OnStar - allowed automated phone emergency call from the vehicle in case of an accident; remote diagnostics followed in 2001 and Wi-Fi internet connection in 2014. Technology can involve single vehicles (traffic information, diagnostic, way-finding tools) or platoons (forward collision alert, blind spot warning, notification of crashes – road workings …) permitting to increase the safety and efficiency, once standards and regulation issues are overcome. Today, V2I (Vehicle to Infrastructure), V2V (Vehicle to Vehicle), V2C (Vehicle to Cloud), V2P (Vehicle to Pedestrian) and V2X (Vehicle to Everything) connections are possible. In-car features include also e-commerce, vehicle management, entertainment, driving assistance (i.e. parking assistant, autopilot) and functions involving the driver's comfort and status (i.e. fatigue detection). Increasingly, Connected Cars are taking advantage of the rise of smartphones: by means of an app, users can unlock their cars, check the status of EV batteries, locate the car or remotely activate the climate control system.

Finally, privacy and security have to be ensured: the continuous monitoring of drivers' ability and attitude as well as vehicle's telematics will impact the car insurance industry (i.e. fraudulent claims, vehicle tampering, improve client profiling). Despite positive features, factors which have prevented the breakthrough of connected cars are reluctance to pay the extra-costs associated with embedded connectivity, the potential hackability of the car, the reliability of the sensor system and, lastly, the behaviour of Autonomous vehicles in case of detection of potential crashes with pedestrian – cycle – other vehicles.

Soft mobility

Regional and urban planning can influence people's transportation habits, fight isolation by replacing soil consumption and urban sprawl with deconstruction (selective dismantlement of building, which produces less ruins to send to the waste), encourage high performance building, maintenance and green attitudes. Context-sensitive design, traffic calming and enhanced permeability of public transportation concur in redesigning cities to provide residents with social places to enjoy quality time outside working hours (Goldman and Gorham, 2006; Banister, 2013).

Walking aptitude is encouraged by spatial factors such as typology and density of activities, land use, accessibility and average displacement, connectivity (the number of destinations), presence of sidewalks, perceived safety and aesthetic factors (Conticelli et al., 2018). Technology-based solutions provide useful insight on the routes and other systems' schedule (GIS and GPS), allow identification (RFID), tracking of the trip chain (Bluetooth) and the exchange of information (Wi-Fi).

Also cycling provides societal positive outcomes (i.e. reduction of pollution, noise and congestion). However cyclists are usually regarded to as vulnerable or – even more - minority road users as they lack physical protection, are less visible, less stable and more affected by road surface irregularities. This assumption is enforced by the high figures of road crashes involving cyclists. According to the attitude towards bike mobility, the perception towards cyclists varies from tolerance to hostility. In countries where cycling culture is less spread, both cyclists and other road users feel a reciprocal sense of un-easiness: while cyclists are perceived as irresponsible, risk-takers and unpredictable - in particular due to random misbehaviour at intersections (Prati et al., 2017) - cyclists complain about missing education and bike culture, scarce safety and bad morphologic condition. Despite guidelines on bike facilities, usually design and location are poor in urban contexts: lack of space, obstacles, undesirable path and interruptions are the main causes that drive bikers away from bike lanes. Average speed, speed reduction and the frequency of interactions influence bike lanes' level of service. Prati et al. (2018) evaluated the influence on cyclists' behaviour of an on-bike device capable of warning about potential collisions, finding that users were more likely to reduce speed after receiving the warning signal (which then enhances the perception of the threat).

Road design shall respect functional hierarchy and the correct provision of space for bike lanes, parking and pedestrian paths. Inadequate funding and lack of space are the main causes of misdesign, lack of clarity, disobedience to traffic rules and lower safety. Straight path design would allow public transportation to be a valid competitor to car. Segregation of pedestrian and bike flows is preferred in case of heavy traffic volumes, high speed and at intersections, while shared circulation can be applied in traffic calmed and residential zones.

Urban Logistics

The topic of urban goods transportation is rooted in modern society. Policy makers require well-designed plans, often involving consultations due to the complexity of issues and interests involved (social, economic, legislative and technical). The EC's Directorate General for Mobility and Transportation fostered the creation of guidelines involving literature, scientific publications, pilot projects and stakeholder consultation. An online stakeholder consultation among government/company institutions, individual firms and stakeholder representative associations ranked emissions and road congestion as the two most important challenges posed by freight transportation and logistics in urban areas, followed by the lack of parking areas for loading and unloading, sprawl, regulation, noise, poor liveability in urban areas, costs for logistics suppliers, energy costs and infrastructure wear and tear. Greater focus was placed on issues such as access restrictions, low emission vehicles (LEV) and e-commerce.

SUMPs and Sustainable Urban Logistic Plan (SULP) propose a set of measures and actions that, collectively, contribute to reducing the energy consumption and environmental impacts of urban freight logistics, enabling its economic sustainability.

ICT is suggested at the EU level (ITS Directive 2010/40/EU, 2015 Digital Single Market strategy) as a mean to provide better access for consumers and businesses across Europe and to encourage the deployment of Intelligent Transportation Systems and interoperability. The Platform for the Deployment of Cooperative ITS allows data exchange through wireless technologies between freight vehicles, road and road users. The major challenges, strategies, pro&cons and impacts of each alternative are listed together with policy approach and mitigation solutions. The main recommendations on this topic have been (i) investigate the city's challenges and the contribution of urban freight logistics; (ii) stakeholders support; (iii) interoperability.

Urban Vehicle Access Regulation (UVAR) schemes aim at regulating vehicular access to urban centres to decrease road congestion and emissions. Classic UVAR schemes take into account emissions and vehicle weight; Low Emission Zones (LEZ) and Congestion Charges (CC) are either used together or separately. Besides, LEZ or CC can in addition provide a measure of the contribution of freight vehicles to congestion and pollution. Different criteria might be linked also to the time of the day, vehicle characteristics (tonnage, dimensions, age, emission category) and load factor. Finally, charging each access by camera and toll portals is also an opportunity. To properly implement UVAR, some tasks need to be addressed: (i) ensure freight vehicles access to retail locations; (ii) ensure that any changes in traffic flows caused by the scheme do not create problems outside the UVAR zone, (iii) spread the negative impacts across stakeholders, and (iv) providing benefits to companies which are willing to acquire cleaner vehicles. Pilot tests and careful CBA are envisaged before implementation.

Engagement of residents and stakeholders is increasingly recognised as fundamental to the success of a decision-making process due to their features, perspectives, objectives and/or strategies. Engagement enhances the transparency of the decision-making process, commitment, efficiency and acceptability of the measure.

The physical delivery of online purchased goods is one of the key elements of e-commerce. High costs of the first and last miles and the decreasing willingness of customers to pay for home delivery are pushing for the diffusion of delivery collection points (either automated or not).

Urban freight traffic is estimated to account for approximately 25% of urban transportation-related GHG emissions and 30-50% of other transportation-related pollutants (PM, NOX). EU documents and directives aim at cutting by 60% GHG emissions from transportation by 2050 and push for the exchange of best practices, integrated strategies and improved public procurement procedures of Environmentally Friendly road Freight Vehicles (EFFVs) to be included into the city's SUMP or SULP.

The availability of data on urban freight distribution in Europe is poor, since freight transportation is usually neglected in surveys and urban transportation models. Further, data collection methodologies are not homogenized. Schoemaker et al. (2006) split urban freight distribution into six topics: freight volumes and commodities, fleet, urban deliveries, and contributions to – respectively - the economy, the environment and safety. The data needed and the sample size depend on the specific situation, the current and future planning and policy framework and the availability of existing data. A trade-off must be made between the costs of data collection and having non-representative data.

A strategy to find appropriate solutions for an efficient urban freight policy foresees the identification of the city's Logistics Profile (LP) – i.e. (i) cluster of specialised shops; (ii) hotels, restaurants, small grocery stores, small neighbourhood markets; (iii) business centre; (iv) large commercial stores; (v) residential areas with local trade; (vi) e-commerce in residential areas. Selecting relevant solutions according to LP by means of evaluation tools (i.e. ex-ante analysis, CBA/CEA, MCA), definition of KPI according to the SMART approach (Specific – Measurable – Assignable – Realistic – Time-related indicators), and pilot project implementation for preliminary evaluation are determinant to success.

Accessibility and lack of space can be tackled either through access regulation by time, implementing ICT innovations and promoting alternatives to home deliveries. Cooperation between planners, stakeholders, e-commerce providers and green vehicle procurement can be beneficial to society and economic development.

Concluding remarks

While the conventional transportation planning approach was focused on optimizing traffic flows and increasing capacity and average speed by building new roads, sustainable planning sets accessibility and quality of life as primary objectives.

Local factors, stakeholders' contribution from all levels and an efficient local government capable of long term focus, technical expertise as well as feasible plans for allocation of human forces and funds have a deep influence on mobility.

The urban structure is a determinant of transportation, then urbanization without adequate planning results in longer trips, delay and congestion. Urban environment should be designed in order to let users think that car alternatives are viable, for example by providing scope for soft mobility.

In general, richer and densely populated cities have greater economic capacity, which makes it possible to invest more on the technological dimension and to score higher values of level of service of public transportation. Intervening on an existing public transportation system can be very expensive, which is why many cities and regions produce plans to implement step by step change. Comparing the needs of planners and users is important from the early stages of the project to reduce costs and difficulties. Smart solutions can be implemented only in presence of a solid infrastructure network.

The storytelling about Smart mobility frames an optimistic vision of the society with a benign mobility system which all users can access to without restrictions, waste of time, pollution and environmental degradation; however we don't know whether reality will be more positive than the current situation. The consequences of the absence of clear regulation could lead to a failure, thus rules should ensure fairness and active commitment towards sustainability, even by setting access or congestion-related charging schemes. The potential of MaaS will likely satisfy users' unmet needs, paradoxically conflicting with the promise to reduce demand and congestion by creating new demand. Given the fast growth trend of smart mobility, operators and regulators have short time to come to a clear operative and regulatory framework.

Cross-References

Bicycle lanes

Land management

Livable cities

Low carbon cities

Smart cities

Spatial planning

Sustainable urban planning

Urban planning, urban design and the creation of public goods

Urban pollution and emission reduction

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