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ID 1631 | TECHNOLOGY USE AND ITS INFLUENCE IN TRAVEL BEHAVIOUR AND URBAN FORM

Mayara Moraes Monteiro¹; João de Abreu e Silva²; Jorge Pinho de Sousa¹

¹Faculdade de Engenharia da Universidade do Porto; ²Instituto Superior Técnico - Universidade de Lisboa
mayara.monteiro@fe.up.pt; joao.abreu.silva@tecnico.ulisboa.pt; jorge.p.sousa@inesctec.pt

1 INTRODUCTION

It is likely that the current generation that is growing up immersed in a technology filled world can perceive space and distances from a different perspective than those that come before. The speed by which technology is evolving increases day by day and, moreover, people and companies are discovering and consolidating different ways to take advantage of the current available possibilities that the devices with internet connection can offer.

In this context, an important concept is the “mobile ecosystem”, that in accordance with Berger et al. (2016) is composed of a set of tools that can be used while people are moving around to communicate and obtain information online independent of the person's location, i.e. devices that can easily be carried anywhere and have the ability of staying online at any time. The mobile ecosystem has changed the way by which people set about in their daily activities and interact.

According to Inman (2012), despite of the already existing literature on digital consumer, the growing diffusion of smartphones expands the possibilities of studies through researches on how an “always connected” environment can influence consumer cognitions and choices.

Kuhnimhof et al. (2012) highlights that the impact of Information and Communication Technologies (ICT) on travel behaviour is not clear and so, it should be studied focusing on those young adults who grew up with ICT and developed their mobility habits in the presence of such technology.

In this context, the mobile device with internet connection is re-defining, in some extent, the space, when activities are detached from specific places. The consequences of these changes have a high potential of impact in a city's layout and mobility patterns for the current and next generations. According to Castells (2000), the format of the cities is changing, having the network of communication as a guide, where the technological infrastructure that builds up the network defines the new space, very like railways defined

“economic regions” in the industrial economy. The distance intra and inter cities might be considered in a different way due to internet connection/access, making people, nowadays, ponder living in places that are not well connected by transit because the increase in easiness of obtaining reliable and real-time information about the services (including transport services) and buying products without the need of travelling.

As for companies, beyond the transport connection, that is highly important particularly in cases where its product should be delivered, the quality of internet connection available is a factor that is being taken into account when defining where the companies should be installed, aiming to lessen the risk of losses of data or laboring interruptions due to connection problems.

In this sense, this study sought to examine prospects for the future related to possible changes in mobility and living patterns due to technology for the current and next generations and what could be its implications in city’s layout and mobility patterns. To achieve it, a literature review was developed aiming to identify tendencies and changes that have occurred during the last decades which affect the way people move around and choose places to stay. This work contributes to the knowledge by studying the links existent between these concepts and the evolution/variations in their relationships.

2 CITIES, TRANSPORT AND TECHNOLOGY

Since the beginning, the cities and transportation systems had a close connection, where their mutualism could be observed through their interaction: the development of one tended to lead to the progress of the other. If in earlier times the urban form was limited to what was considered suitable for mobility by walking or animal powered vehicles, after the introduction of motorized transport, accompanied by its infrastructures, this radius increased considerably, favouring the expansion of cities. It is also true that the opposite occurred: changes in the spaces and land uses have a significant impact on transportation, as such changes in the use of land or buildings, renovation of areas or deployment of new buildings that attract large flows of people (Trip generation hubs). As the functioning of a city is extremely influenced by the networks that compose it, Banister and Hickman (2013) highlight that the transport system in a city should be carefully analyzed and implemented as an integral part of city design, because it can generate adverse impact on the quality of the city.

Mok et al. (2010) discussed about these intrinsic relationships, adding the advent of the internet to the equation. They discuss the possibility of the cities and, the concept that they carry (physically concentrated networked area) lost their importance due to the internet. They expose that, in past, while cars, public transport and telephones had extended the possibilities of interaction to outside the metropolitan area, people remained restricted by the speed of transport modes or the level of interaction (only voice in case of telephones) and, in both case, had budget constraints to access it. However, for them, the popularization of the internet introduced the high speed of connection combined with the small cost that made such a revolution, only remaining time-zone differences to generate some constraints for immediate communication.

It means that, to certain extent, the space as a barrier has had its influence diminished along the years and only time constraints are still making difficult the real-time interaction between people physically apart.

Including the technologies and, more specifically, mobile technologies in this scenario, what we have nowadays is the possibility of an “always connected” environment, where people have smartphones working as “pocket computers” that can easily be carried anywhere, have access to internet at all times. It is clear to see that mobile technology has an impact on people on a daily basis.

The integration of technology allows cities to keep their character of “interaction maximizer”, but in an adapted way. The combination of local interaction with long-distance connectivity, dissolved the boundaries of cities, turning them into hubs (Mok et al., 2010). At the same time that spatial mobility is decreasing due to telecommunications, the telecommunication produces the desire for more personal face-to-face contact and hence physical mobility (Wegener, 2013).

In this sense, it could be said that the distance ends being re-signified for the new generation, as the concept of human extensibility developed by Janelle (1973) who presented the idea of lessen the distance

between places not through the travel in the space, but using the technology and communication to do it, i.e. virtually projecting/presenting/interacting as they and their ideas were physically present. It is about to expand the opportunity for human interaction, but dissociated from the space.

Due to its intrinsic features, this revolution has the potential to produce some effects in both urban form and mobility patterns. Janelle and Gillespie (2004) comment on “space-adjusting technologies”, arguing that when they are combined in different configurations, huge effects on patterns of human settlement, production, and trade can be achieved. The integration of ICT with the transportation systems, according to them, have impact on two areas of human social dynamics, beyond the transportation systems itself: individual mobility and urban form dynamics/development.

Knowing that, the following topics will approach new possibilities for daily life generated by advances in technology, as well as its present and future/expected changes and its existing/potential impacts in urban form and mobility patterns.

2.1 E-WORK AND E-LEARNING

Many studies have approached the subject of E-work (a.k.a telework) that consists in allowing the workers to develop its paid activities from their own home instead of commute to their workplace (Mokhtarian et al., 2004). For Dal Fiore et al. (2014) nowadays only a small amount of workers needs to be at their workplace, because the technology that provides the opportunity for individuals to choose where they want to be and access work and information from there, removing place-based constraints and consequently lessening the need of traveling. As some professions are being renovated and many are emerging due to technology advances, there is a strong belief that this trend of allowing employees to telework should continue to expand in the future.

Moreover, the positive results found in some studies (Dutcher, 2012; Pearce II, 2009; Hill et al., 2003) related to teleworking reinforce this believe. Golden (2006) found that the extent of telework (proportion of an average workweek that workers spend teleworking) is positively related to organizational commitment of the worker, and a negatively related to turnover intentions (the rate at which employees leave a company and are replaced by new employees). The author highlights also that not having to commute means accumulation of extra time and savings in energy resources: both are interesting products that teleworkers can allocate for work and/or family needs, improving their well-being and outputs.

The possibility of telecommuting has a huge potential of impact urban form and mobility patterns, because once commuting to work is no longer necessary (or, at least, not on a daily basis), people will travel less for mandatory work purpose and will have less constraints in choosing a place to live; without the need to consider the constraint of good connection between home and work places, the residence location choice becomes in some sense disassociated from the work-place and the effect in the urban dynamic is the decrease/mitigation of over demand for housing close to working related/concentrated areas.

Mokhtarian et al. (2004) found in their study that investigated ten-year data about telecommuting and residential/job changes of 218 workers in California that the residential location of telecommuters is much more probable to be in peripheral areas than in the city center. The authors were not able (based on the available data) to determine whether longer commute distances boost telecommuting or, telecommuting allows for residential relocation, allowing people to move away from their work locations. However, they believe that the supremacy is related to the second possibility of causality, because to moving towards distant locations were actions more likely to be avoid if they have to commute to their workplace rather than telecommute (Mokhtarian et al., 2004). According to Shen (2000), the flexibility in residential location can lead to a decentralization of the population; unregulated urban sprawl and polarization in residential location. The author also argue that the coverage of public transport will still characterizes a restriction on location flexibility for some population groups, as the city and the transportation network are strongly related and will still influence the remain activities need.

Similarly, to what occur with workers, it is happening also with students, that already have the opportunity of attending some courses without having to be in a specific classroom. As the easiness in dealing with technology and take the maximum advantage of it is a remarkable characteristic of the current young generation, this model of learning is a very interesting option to them. Leaving aside the discussion about

gains and losses in this model of study, what it allows is access to education without borders, which leaves the cost and time availability as the only constraints. As for University students, that sometimes no longer live with their parents, it means that they can choose the place where they want to live without having the university location as main driver and then choose for better benefit vs. cost deals around the city. In this sense, Zhou (2012) found that the greater the commute distance for university students, the higher are the utility of both carpool and telecommuting.

As for mobility patterns, knowing that these travels are not an end in itself, but rather happen because of the need to perform a mandatory activity at the destination, both cases are related to frequent travels that will no longer occur (totally or partially), meaning that travel patterns will change, with potential impacts on congestion, pollution, mode choice and more productivity in urban areas. Julsrud and Priya Uteng (2015), found that there is a strong belief between Norwegian experts that the distribution of commuting traffic (over the course of the day) will be possible due to the combination of the increasing trend of flexibility of the workplace and imposition of congestion charges.

Regarding urban form, without having to consider that much the distances for working places or studies, living place choices ends up being influenced primarily by budget, personal preferences and land use restrictions defined by local authorities. Being the budget, in general, the main definer of where to live, sprawl might arise. The differences of location will have less negative impact in mandatory activities regarding the accessibility to transport due the possibility of telework.

It is noteworthy that this does not mean that some places will no longer remain as the most desirable (as city centres and already consolidated areas that carries special meaning for the people -related to culture and subjective thoughts/norms established by the society) and some people will still choose these however, but the negative impacts of living outside the most desirable areas might have less of an effect on the daily mandatory activities of its residents due to technology. The higher the level of technological integration a city has, the higher the possibility of mitigation of negative impacts generated by low accessibility on its residents.

2.2 E-COMMERCE

E-commerce (a.k.a. online shopping) consists of a type of trade where products are made available online and purchased by people to be delivered at a specific place (usually the buyer's home). According to Zhou and Wang (2014) it is rational to expect that this technological form of acquisition of goods could lead to a reduction in the need of shopping trips, since the goods are accessible via door-to-door deliveries. However, one can argue that despite the decrease in personal trips, this process generates substituted trips that are the freight trips to deliver tangible products (Mokhtarian, 2004).

According to a research conducted by Weltevreden and Rotem-Mindali (2009) in the Netherlands, the business to consumer (b2c) e-commerce led to a decrease in the net number of personal trips for shopping related purposes and also lessened the distance travelled by consumers. However, they highlight that the effect on mobility could be positive or negative depending on the form of e-commerce, the trip-chains, modal split and the kind of products purchased.

Zhou and Wang (2014) found that e-commerce reinforces shopping trips while the opposite is not true, i.e. shopping trips lean towards the suppression of online shopping tendency. The study conducted by Ding and Lu (2017) had similar results, finding that people who frequently buy products online tends to perform more trips to shopping, making e-commerce complementary to in-store shopping rather than a competitor. They added that a change was visualized in mobility pattern related to "when to shop", because people who buy online, usually go in-stores shopping on weekends rather than weekdays, which may affect the distribution along the time of travel demand (Ding and Lu, 2017).

Farag et al. (2006) found that the group that are more likely to buy online are composed by people that live in very urbanized areas. Moreover, people who have relatively low accessibility to in-store shopping buy more products online. This way, as presented in the discussion about the impacts of telework, people who live in those areas end up facing less problems to develop their daily activities, as the E-commerce increases their accessibility. Wee et al. (2013) argue that some groups of people have a potential of be

more likely than average to use ICT as a substitute for physical accessibility (e.g.: online shopping, social media communication).

Rotem-Mindali and Weltevreden (2013) conclude that the existing academic literature suggests diverse inferences about how the e-commerce influences mobility. For them, it is important to pay attention in the respondents' sample, because choosing, for example, only respondents that potentially have affinity with internet use can impact the results in an undesirable way. Moreover, if both personal and freight trips generated/attracted are not analyzed the resultant scenario cannot be entirely constructed and then, the remaining aspects not included in the study should be exposed. They also argue that product type should also be taken into account when analyzing this subject.

As e-commerce is a relatively recent option, the entire picture contemplating all the factors that have influence and all the consequences generated by it on travel patterns and urban form remain unclear. Mokhtarian (2004) believes that online shopping will substitute in-store shopping in a limited way, nevertheless both trade forms will probably continue to increase and co-exist. Despite it, Rotem-Mindali and Weltevreden (2013) believe that considering a long term perspective, the freight transport resultant from e-commerce may act positively towards sustainability, through the optimization of distribution that overcomes the avoided trips.

As for urban impacts, it could be said that the E-commerce (including frequently deliver needs, e.g. groceries, personal products) and online services (e.g.: access to Social security, health care system for schedule appointments, bank account) are also contributing to lessen the constraints when deciding where to live. Products and services could be accessed and scheduled or purchased without the need of traveling. The desired mixed land use place could be replaced to some extent by the online environment, almost without borders.

Moreover, the time concept ends being put into a different perspective as the online world turns some products possible to be bought 24 hours per day, making some services/activities detached from both space and time. For the distributors, the E-commerce also have consequences in generating the necessity of restructuring and relocation (stores and/or warehouses) of some companies, as well as development of appropriated logistics for freight delivery travels and analysis of location of parcel lockers for last mile deliveries. Thus, the results of E-commerce in a city might mitigate the problems associated with living in not well connected places that have low accessibility to shops. (Mokhtarian, 2004) defends that the use of ICT allows the spatial and temporal fragmentation followed by their recombination.

As for trends in E-commerce, Ding and Lu (2017) found that age is a significant explanatory variable, related to individual socio demographic characteristics, being the younger adults the ones that are more likely to buy products online. This tendency may be related to the fact that those groups are more familiar with technological tools and therefore that as the population is being renovated, the E-commerce will increase, having more potential new customers each year.

It is important to highlight that the expansion or more rapidly growth of this form of trade is more likely to happen for some kinds of products that are not so dependent on visual assessment or experimentation or that have not much time constraints related to its delivery (e.g.: electronic goods, airplane's or event's tickets).

2.3 ICT FOR COMPANIES

For some companies that are immersed in a "fully connected globalized" world, beyond a good transport connection, it is essential the quality of internet and telecommunications available -Information and Communication Technologies (ICT). Yazar et al. (2016) argue that companies may require using fully fiber optical wire, which allows for high speed Internet connections. Thus, it could be said that optical fiber availability is nowadays a constraint for choosing the location of some businesses, being taken into account when defining where the companies should be installed, aiming to have faster interaction possibilities, less risk of interruptions in the work or videoconferences due to connection problems.

As the globalization have a crescent impact in world, it is expected that companies become multinational and the already multinational companies expand themselves into different countries. To enable this

growth, it is essential to keep an easy, fast and accessible communication between the main office and its local branches. Videoconferences allow companies, especially multinational ones, to schedule meetings without the need of all people involved travel to a specific place, generating less mobility in a wider scale.

In this sense, if in the past for a city be attractive and competitive for the location of companies, it should have a good transportation network, nowadays the integration of a good information and communication network is also essential to create an environment favorable to the development of activities.

The impact of it is mainly related to the urban dynamic, that is defined according to the level of technological connection that each zone offers. The companies' location ends up being restricted or more desired towards determined areas that gathered the best quality of ICT infrastructure. Despite of being decisive nowadays and probably have more impact, this is not a new trend, as it could be seen in the work of Goddard and Pye (2007), who argue that the office functions should be relocated to centers in order to avoid communication problems, common for offices in the development areas. As for mobility, the ICT allows the decrease in business travels, that are substituted by videoconference.

2.4 INTEGRATION OF ICT IN TRANSPORT

About the impacts of technology in public transportation system, due to internet and mobile communication, people nowadays are facing less problems living in places that are not well connected by transit, because the increase in information quality and quantity and the improvements in the easiness to access them, notable reliable and real-time information about the services, i.e., the restriction of transit schedule could be mitigated by transit information access, although peripheral areas could have simpler systems, with less quality and quantity of information provided. Brakewood et al. (2014) conducted a before-after survey for evaluating the impacts of real-time transit information on bus riders in Tampa (Florida), and found a significant change in the waiting time and the feelings associated with the waiting time after the availability of real-time information.

Nowadays it is possible to access public transport information through applications that can use the GPS system in the device (e.g. smartphone) and deliver door-to-door real-time information according to the travelers' movements, facilitating the trip. According to Hwang et al. (2006), improvements in the tools of the Geographic Information System (GIS) have enabled transport agencies to provide a variety of different map views and tools for its customers to meet the different needs and preferences.

Julsrud and Priya Uteng (2015), said that new technologies are the main significant parameter for future mobility, being essential to analyze it. Using Delphi techniques, they developed a web based survey involving 280 Norwegian experts, and found suggestions that the next decades may witness changes in choices and preferences regarding urban mobility due to technologies (notably mobile ICTs), as people already have access to real-time information and suggestions for optimal travel routes based on personal preferences, and the operators are using the information for continuously improving the management of public transport. Today the possibility of full time anywhere connection can lessen the cognitive effort associated to perform a trip, reducing the barriers associated with the use of public transportation, making this mode more attractive.

According to Lyons and Harman (2002), the public transport users are concerned about the convenience from the origin to the destination of the trip. Therefore, providing this information can make the physiological effort generally made to find the directions and important points during the trip to be dramatically decreased, since it is only necessary to follow the steps as indicated in the tool. Wardman et al. (2001), argue that a trip is inconvenient when it involves unexpected or unwanted physical, cognitive (or mental) or emotional stress efforts. In this context, the provision of clear and reliable information influence in the way of decreasing the cognitive effort, since this relates to the effort required to collect and process information before and during the journey. On the other hand, if the trip requires search for information or interpretation of information, this effort is likely to increase.

The information is important not only for travels in public transport but also for trips made by private modes. Consulting traffic conditions for different possible routes makes the travel less uncertain and increase the sensation of controlling it.

Another important amplification of possibilities generated by technology is to broaden the options to active use the travel time during trips (Frei et al., 2015). Previously the travel time on public transport would have been used mainly to sleep or read a book/newspaper, today this time can be used for a wide range of activities, such as checking emails, buying something online, getting information about the weather, accessing social media and even to follow the current journey in real time, such as their current position and estimated arrival time. This increase in multitasking and fragmentation of activities can be considered as an advantage in opting for public transport trips compared to driving.

Combining these changes mentioned above, the way people perceive the system, experience the travel and take advantage of the travel time in public transport, may potentially have affected also the perception that people have about its service, making them more likely to perform more travels by public transport and altering their mobility patterns.

It is important to mention the current observed flexibility in young adults' choice that show propensity to have a multimodal travel behavior that combined with integrated ICT on transport, potentialize this mobility trend. Figueroa et al. (2014) found that car use by young adults (18-64 years) in Denmark was transferred to other modes in high density settings. Kuhnimhof et al. (2012) discuss about "peak travel" in industrialized countries, highlighting that the decrease in automobile travel of young adults in Germany is due not only to changes in mode choice which thus reduce car ownership but also due the increase in multimodal travel behavior as reasons for this stagnation. It is worthy to reference that despite both countries cited being developed countries, one is well known for encourage soft modes (Denmark -walk, bicycle) and the other has a long tradition on car use (Germany), which evidence that this trend is not only due to local specificities, as such infrastructure and policies towards a specific mode. Wee (2015) defends the hypothesis that we are living a transition period that will led us to a more ICT-based activity pattern and accessibility; being the trend of decreasing in car use and the changes in travel behavior (in general) the signs of that.

Out there the traditional public transport system, the technology also allowed the conception and development of new forms to move around collectively. Systems of car sharing and bike sharing have been made available in several cities around the world. Through the GPS of mobile devices combined with internet access, it is possible to schedule a ride in few seconds choosing between total or shared expenses with other uses of the services (e.g.: Uber, Cabify, Lyft, Blablacar). These new travel options increase the physical accessibility of areas and constitute more affordable alternatives from a financial point of view.

Knowing that accessibility is an index that translates the relation between people, land-use and transportation, the urban dynamic becomes more homogeneously distributed due to the increase in the transport offer variety available. For Wee et al. (2013) ICT has the potential to impact on the awareness of activities' location at numerous locations.

Beyond the impacts in urban form and mobility patterns, Wegener (2013) highlights that it is possible to identify an increase in heterogeneity among urban lifestyles, mobility and location patterns and social networks, due to the increase in individualisation of society. He refers also that due to this dynamic, less emphasis should be put on preferences and choices and more on needs and constraints, that are more constant during time, when modelling.

2.5 TECHNOLOGY AND CARS

There is a crescent discussion about the negative impacts related to the intensive use of cars in cities. The climate changes and energy scarcity in the world are leading to the development of several policies to support sustainable choices, encouraging the decrease in car use and adoption of "more environmentally-friendly" vehicles combined with mixed land use design.

Mácario and Marques (2006) points the currently commercially available Hybrids cars as one existing option to cut consumption and carbon emissions (30% less), as these cars do not require specific supply infrastructure in urban environments.

In this context, thinking about the future and motorized vehicles, Wegener (2013) predicted a future with scarcity of fossil fuels and climate changes, so the energy for transport will be limited and expensive, which will affect mobility and location behaviour in cities through households moving closer to their workplaces and firms closer to their customers, suppliers and workers. Higher-density and mixed-use of land, according to him, are essential to it. Fermi and Fiorello (2006) found in their simulations, which considers scarcity of energy supply, that in all scenarios simulated there was a tendency of decrease in the average travel distances per capita and by car, returning to levels found in 1990s and 1980s, respectively; contrasting with the number of trips by public transport that more than doubled. For Fermi & Fiorello (2006) climate changes and scarcity of fossil fuels are interrelated through the need of decrease in the carbon fossil fuels/emissions and changes in mobility and location behaviour, i.e. the solution for the problems can be achieved by a combination of technological and behavioural changes.

On the other hand, according to Arbib and Seba (2017), these problems will be solved by technology, with the use of TaaS (transport-as-a-service) that will provide the availability of on-demand door-to-door transport autonomous (or self-driving) electric vehicles. They also believe that the shift is motivated by technology, not climate policies, expecting that TaaS will be cheaper than most forms of public transportation and 10 times cheaper to run than fossil-based cars (near-zero marginal cost of fuel and an expected lifespan of 1.6 million kilometres), being the more convenient form of transportation in a close future. This scenario is in agreement with the argued by Lyons (2014), who already drew attention to the fact that we are living a transition toward a phase that will have as main features the decrease in the importance of ownership and use of cars (as we have nowadays) and the incentive of shared use of mobility resources. This scenario tends to favour less congestion.

The searching for flexibility in travels, notably for youngies, could be evidenced in the work of Karlsson et al. (2016), who developed and tested in Sweden one service based on the concept of Mobility-as-a-Service (MaaS). It was offered for families personalized transport services appropriate to the needs and requirements of each individual traveler, including as options the use of the local PT authority, one taxi company, one car rental company, one car sharing company, and one bike sharing company. They found that the users value very much the flexibility resultant from having multiple options available to use, being possible to select a mode according to each trip requirement. Moreover, the users reported that owning a car, bicycle or transit pass make them feel as they have no choice rather than choose that mode regardless specific conditions of each trip (Karlsson et al., 2016).

The expected impacts on mobility and accessibility conform said by (Arbib & Seba, 2017) are the improvements in the mobility for people who cannot drive or afford cars and for the population who lives in suburbs and the low density of public transport infrastructure, what can favour more urban sprawl.

3 CONCLUSION

The table 1 synthetizes the topics discussed in this work. It can be noticed that the technology and its possibilities related to transport, city and people has potential to transform/impact, above all, areas with low accessibility to services and goods, because it can mitigate the negative effects inherent to living in those areas. Banister and Hickman (2013) argue that there is a strong belief that technological solutions will be developed to solve/mitigate what are essentially social problems.

Technology associated product	Trends	Impact on mobility patterns	Impact on urban form
E-work / E-learning	<p>Increase in percentage of employees that are allowed to telework: some professions are being renovated and other created by technological advances.</p> <p>Increase in e-learning possibilities: current and probably next generations have such a facility in dealing with technology and taking the maximum advantage of it.</p>	<p>Less frequent daily travels (that usually happen in peak hours)</p> <p>Public transport less crowded (more comfort in the trip – potential impact in mode choice).</p> <p>Sustainable derivate impacts: Less traffic congestion.</p> <p>Less air pollution and more productivity in urban areas.</p> <p>Decrease in energy consumption.</p>	<p>Residential location disassociated from the work-place/University.</p> <p>Coverage of public transport still as a restriction for some population groups on residential flexibility.</p> <p>Decrease of over demand for housing close to working/university related/concentrated areas.</p> <p>Unregulated urban sprawl might arise.</p> <p>Residential location influenced primarily by budget, personal preferences and land use restrictions.</p> <p>Less negative impact regarding the accessibility to transport in suburban places.</p>
E-commerce	<p>As the population is being renovated, the E-commerce will to increase, having more potential new customers each year.</p> <p>It is expected that online shopping will substitute in-store shopping in a limited way, nevertheless both trade forms will probably continue to increase and co-exist.</p>	<p>Reduction in the need of shopping trips and generation of freight trips.</p> <p>Mobility effect can be positive or negative, depending on the form of e-commerce, trip chains, modal split and kind of products.</p> <p>E-commerce reinforces shopping trips, but the opposite is not true.</p> <p>Change in mobility pattern: people who buy online, usually go in-stores shopping on weekends instead of weekdays.</p> <p>Long-term perspective: freight transport resultant may act positively towards sustainability: optimization of distribution, overcoming the travels avoided.</p>	<p>People who use to buy more online: live in very urbanized areas and/or have relatively low accessibility to in-store shopping.</p> <p>E-commerce increase their accessibility, contributing to lessen the constraints for people when deciding where to live (residential location).</p> <p>The desired mixed land use place could be replaced some extent by the online environment.</p> <p>Distributors need to restructure and/or relocate, as well as develop appropriated logistics for freight delivery travels and analysis of location of parcel lockers for last miles delivers.</p>

ICT for companies	<p>Globalization: companies become multinational or expand themselves through the countries. It is essential to keep good internal communication.</p>	<p>Decrease in business travels, that are substituted by videoconference.</p>	<p>Optical fiber availability: constraint for choosing the location of companies: more desired areas have good ICT infrastructure. The urban dynamic is defined by zone, according to the level of technological connection.</p> <p>To be attractive competitive for the establishment of companies, the city should a good ICT network.</p>
Integration of ICT in transport	<p>Access of real-time information and optimal travel routes based on personal preferences.</p> <p>Flexibility in young adults' travels: propensity to have a multimodal behavior potentialized by integrated ICT on transport.</p> <p>Transition period towards a more ICT-based activity pattern and accessibility, being the trend of decreasing in car use and the changes in travel behavior the signs of that.</p> <p>Development of new forms to move around collectively.</p>	<p>Consulting traffic conditions for different possible routes makes the travel less uncertain and increase the sensation of controlling the travel.</p> <p>Increase in multitasking and fragmentation of activities: + more and easier to find information, resulting in less cognitive effort = potentially change the way people perceive the public transport system, experience the travel and take advantage of the travel time in public transport, what may potentially affect the perception that people have about its service, making them more likely to perform more travels by public transport and altering their mobility patterns.</p>	<p>Increase in information quality and quantity and improvements in the easiness to access them, notable reliable and real-time information about the service: make people face less problems living in places that are not well connected by transit.</p> <p>The new travel options (car sharing, bike sharing, Uber, Cabify, Lyft, Blablacar) increase the physical accessibility of areas and constitute more affordable alternatives from a financial point of view.</p> <p>The urban dynamic becomes more homogeneously distributed due to the increase in the transport offer variety available</p>
Technology and cars	<p>Future: scarcity of fossil fuels and climate changes and/or presence of Saas.</p> <p>Availability of on-demand door-to-door transport autonomous electric vehicles.</p> <p>Searching for flexibility in travels, notably for youngsters: decrease in the importance of car ownership and use and the incentive of shared use of mobility resources.</p>	<p>Future with scarcity of fossil fuels and climate changes: Tendency of decrease in the average travel distance: per capita and by car, returning to levels found in 1990s and 1980s, respectively, contrasting with the number of trips by public transport that more than doubled</p> <p>Saas: improvements in the mobility for people who cannot drive or afford cars and/or lives in suburbs and the low density of public transport infrastructure.</p>	<p>Future with scarcity of fossil fuels and climate changes: households will move closer to their workplaces and firms closer to their customers, suppliers and workers. Higher-density and mixed-use of land use essential.</p> <p>Saas: improvements in the mobility for the population who lives in suburbs and the low density of public transport infrastructure, what can favour more urban sprawl.</p>

Table 1 – Summary of trends in technological solutions and its mobility and urban impacts

The relationship between transport and ICT, as discussed, seems to have a more complementary nature. However, Mokhtarian (2003) argues that it is necessary to study the longer-term complementarity effects of travels suppressed and generated, because for her all are happening simultaneously: substitution, complementarity, modification, and neutrality.

As for the urban impacts, Wegener (2013) believes that cycling and walking should be encouraged in cities and anti-sprawl legislation should be implemented and enforced. He also highlights the necessity of provide minimum standards of access to basic services (e.g.: health care, education) for the all strata of the population in urban, suburban and rural areas.

Shen (2000) argue that urban planners should take advantage of the moment and guide the metropolitan areas, conducting the possible growth to outside the ecologically complex sites and keep them spatially, economically and socially integrated.

The authors recommend further study on the spatial relationships between telecommunication and transportation. It is recommended also the development of empirical analyses in future in order to confirm or not the tendencies/forecasts presented and discussed.

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