Sustainable Urban Mobility. Efficient movement of people and goods

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Abstract:

Since the 20th century, the solutions offered by planners, utopists and architects to address people's mobility issues and manage traffic were predominantly concerned with the main symptom of traffic, the 'car', neglecting to consider the actual disease, which was 'unlivable and alienating cities'. For the past two centuries many architects, planners, and politicians dealing with mobility and transport attempted to offer solutions based on spatial differentiation of transportation means and on infrastructural layering, separating the realm for cars, public transportation and pedestrians. This article intends to offer a new way of approaching transport issues, reviewing and exploring strategies to endorse soft mobility, and an accessible, integrated and regenerative transport network.

Fig. 1 Top: Highway #5 Los Angeles, California, 2009. Chromogenic Colour Print. ©Edward Burtynsky. (source: https://jholland58.wordpress.com/level-2/photography-edward-burtynsky/ Bottom: road sign on asphalt.)

Premise

'Mobility' is the ability of people and goods to move or be transported, this mobility can be considered sustainable when it is organized in a way that respects safety and the environment, ensures the provision of life's material needs and guarantees fairness among individuals[1].

In this paper I will use the term 'Soft mobility' to identify all forms of non-motorized transport (NMT) that use only the "human energy" (Human Powered Mobility) and can therefore be considered "zero-impact" transport. The term refers mostly to pedestrian, bicycle, roller skate and skateboard transfers, alternative to cars. 'Soft mobility' can be defined as a special form of 'Sustainable mobility' able to optimize urban livability, by keeping the individual right to move (LaRocca, 2010, pp. 85). However, the latter is only one of the strategies to guarantee 'Sustainable mobility'. Moreover, since transportation is considered as one of the ways to allow the movement of people and goods (mobility), I will consider transportation issues as one of the multiple aspects related to mobility; in this sense, although the terms 'Sustainable mobility' and 'Sustainable transportation' are not interchangeable, the first one incorporates the second.

"While there is no standard definition for transportation system sustainability", most of the definitions used so far are in some way extracted or based on the definition of 'Sustainable Development' by the Burdtland Commission[2]. Therefore sustainable transportation "is largely being defined through impacts of the system on the economy, environment, and general social wellbeing; and measured by system effectiveness and efficiency, and the impacts of the system on the natural environment" (Christi & Amerkuzi, 2005, pp. 31). Richardson gives one of the definitions based on the above-mentioned assumptions: "A sustainable transportation system is one in which fuel consumption, vehicle emissions, safety, congestion, and social and economic access are of such levels that they can be sustained into the indefinite future without causing great or irreparable harm to future generations of people throughout the world" (Richardson, 1999).

Introducing a complex topic

Often planners and architects who attempted to address the topic of urban mobility in the nineteenth and twentieth century, were concentrated on a single aspects related to such issue, like transport system dysfunctions and negative consequences (ie. traffic congestion and pollution), and were only able to offer partial solutions. Although the attention of contemporary researchers and experts has shifted more toward soft mobility and the needs of people, there is still a partial understanding of the interrelated aspects that can influence mobility and make it sustainable. Given the complexity of the issue, concentrating strategies only around the improvement of traffic congestion or solely on the environmental impact of vehicles – in other words, being 'less-bad' – is not enough to guarantee people's safety, health and quality of life while

1. *http://en.forumviesmobiles.org/video/2013/02/12/sustainable-mobility-definitions-concepts-and-indicators-622*

2. *"Our Common Future", also known as the Brundtland Report, October 1987.*

Fig. 2 Skanderbeg Square, Tirana. The images show the main square of the city in three different periods, highlighting the influence of the invasion of private motorized vehicles on public space. Top: 1920 circa; middle:– 1988 circa; bottom: 2000 circa.

respecting the environment. I believe that several interrelated aspect need to be considered first, and I identify four (+1) aspects and relative questions that ought to be addressed before offering solutions, and formulating strategies aimed at guaranteeing sustainability of transport systems and infrastructures from a social, economic and environmental point of view. After analyzing the main causes of the negative impact of transportation on mobility's efficiency and setting the premises of the paradigms related to transportation, I expand upon each one of the five aspects concerning mobility, highlighting a set of comprehensive strategies towards a more efficient, less impacting, and therefore sustainable, mobility. The hypothesis is that to support sustainability we need to expand the scope of analysis and redefine performance evaluation indicators. Following this assumption, the solution to traffic is not simply to expand the capacity of the roads, but rather to reduce the distance between destinations, propose alternative transportation modes, and improve road connectivity and telecommunications; similarly, infrastructures are no longer seen as scars on the planet, but as multifunctional hubs and potential sources of environmental regeneration.

The WHO – WHY – HOW – WHERE & HOW FAST of Mobility (WWHW+HF)

"The simple needs of automobiles are more easily understood and satisfied than the complex needs of cities, and a growing number of planners and designers have come to believe that if they can only solve the problems of traffic, they will thereby have solved the major problem of cities. Cities have much more intricate economic and social concerns than automobile traffic" (Jacobs, 1961, pp. 7).

American journalist and author Jane Jacobs was making this statement in her seminal book The Death and Life of Great American Cities back in 1961. Fifty-five years later, we still fall in the easy misconception that traffic congestion is predominantly a result of the introduction of cars. Motorized vehicles in general are but one of the causes of inefficient transportation systems. It is enough to think that even before the invasion of cars and trucks – when, apart from walking, the movement of people and

goods was based on horses, carriages, boats, and of course, trains - streets were chaotic places dominated by mud, smell and noise. Thousands of horse-drawn vehicles resulted in horse manure on the streets, a hammering noise of iron heels on the stone pavers and the stinging smell of live-cattle driven, through the streets, to the local markets. The "[...] streets of eighteenth- and nineteenth- century cities [...] were miserably adapted, as streets, to horse traffic", "this in turn made them poorly adapted in many ways to foot traffic too". As Donald Appleyard observed in Livable Streets, "in the twentieth century streets [were] cleaner that they used to be. They [were] better paved too. But the paving [...] encouraged the introduction of a new menace – the motorized vehicle." (Appleyard, et al., 1981, pp. 3) In effect replacing horses with mechanized vehicles - which are far more efficient and faster than horses and, paradoxically, quieter – had the potential to reconcile "great concentration of people with efficient movement of people and goods", even more than railroads which had less freedom to reach places (Jacobs, 1961, pp. 340-343). But as traffic and its by-products started "steadily and inexorably invading the streets of our cities" (Appleyard, et al., 1981,pp. 3), it was the overabundance of private motorized vehicles and the inefficiency of the existing and planned infrastructures, which transformed cars into cities' number one enemy (Fig. 2).

Before understanding what the implications of people, energy and goods mobility are, we need to acknowledge the complexity of the topic and the fact that its related phenomena (like traffic congestion, pollution and inefficiency of transport networks) are not easily predictable, because they results from the interaction of several interrelated aspects. Just like offering palliative solutions to one of the symptoms will not annihilate a disease, building roads, as a strategy to relieve congestion is very reductive, if not counterproductive – in fact, it will increase total traffic instead of reducing it (Gehl, 2010, pp. 8,9). Before addressing the broad topic of 'sustainable mobility', we need to set some premises and define the aspects that contextualize it. I have identified four (+1) aspects and relative questions that need to be addressed before suggesting solutions and strategies. First, we need to understand:

'WHO' – is moving: people, animals, goods, matter, energy, information?

'WHY' – are people or goods moving? For instance, if people are moving for necessity (work, study) or voluntarily/ for recreation purposes (i.e. leisure activities and sports)[3].

'HOW' - are people or goods moving: the modes of transportation?

'WHERE' – are the people or goods travelling? Which are the infrastructures that house the traffic?

And **'HOW FAST'** – are people and goods travelling?[4]

Throughout history the 'WHO' and

3. Jan Gehl operates a classification of activities that take place in outdoor public space based on the reason 'why' people engage public space. He observes that activities can be 'necessary' or 'voluntary': necessary activities are more or less indispensable activities, like going to work or to school, buying groceries, running errands, waiting at the bus stop. On the other hand, voluntary activities are activities people engage into only if they wish to, and if the weather and the place of engagement are suitable - strolling, sitting in the sun, contemplating the urban landscape, are activities that fall in this category. (GEHL, 1991)

4. As I will discuss later, speed of transportation can have great influence on economy and efficiency.

Fig. 3 Regent Street, London, 19th-20th century. © Peter Berthoud (source:https://tempisque13.wordpress.com/2012/12/04/london-how-streets-were-used-in-the-19th-and-20th-century-3/)

Fig. 4 (Planning 'from above') "Attack of the 50 foot man": model of downtown Los Angeles displayed at Museum of Natural History, 1940. (source: i.imgur.com)

the 'WHY' have substantially staid the same: mainly people, animals, goods and energy need to move, or to be transported, from one geographical location to another, and the reason why they need to move – or to be moved – has been changing based on the historical period, influenced by economy, local resources, culture and traditions. On the other hand, the 'HOW' has been subject to significant changes in human history, especially after the beginning of the 19th century, when the means of transportation and, consequently, the infrastructures (the 'WHERE'), were revolutionized by one of the main products of the Industrial Revolution: the introduction of steam engines and, later, the introduction of motorized vehicles (cars, trucks and airplanes). It's also important to point out that the infrastructures did not always change based on the mode of transportation: so at first cars were circulating on dirt roads or stone paved roads originally built for carriages, and in turn, carriages had been using the roads that were initially built only for pedestrians and animals[5] (Fig. 3). As I mentioned at the beginning of the article, this incapacity of the infrastructures to respond to the very different needs of motor vehicles, animals and people, resulted in congestion, noise and, more general, hostility to pedestrians. Lastly we should consider the aspect of speed ('HOW FAST' are people, energy and goods travelling), as this aspect gained great importance for modern capitalist societies governed by an economy based on profit and exponential growth, "whose only goal is growth for the sake of growth" (Latiuche, 2009,pp. 3).

Infrastructures, Mobility & Paradigm Shifts

Infrastructures and mobility were always an integrated aspect of city building. To measure land and define colonial properties the Romans used to lay out the centuriatio (or limitatio)[6], which often materialized their morphological persistence as road grids; the cardo and decumano laid the foundation of new cities, and generated the road network for the movement of goods, animals and people, and the access of the latter to civic and religious buildings. Up until medieval times western cities were developed spontaneously, with no predetermined plan, gradually adapting urban functions to the physical environment. Roads and infrastructures were forged by use and not by theories on what the ideal city shape, and its infrastructural network, should look like – a common trend during the Renaissance. Nor were cities planned by privileging functionalist aspects of buildings (physical and materialistic), and ignoring social and psychological aspects

5. For example, asphalt was introduced on viable roads to prevent the dust from the carriages from soiling the people strolling along the roads, and therefore with in mind the priority of the needs of people, not carriages! (CIORRA, 2013,pp. 82)

6. Centuriation was characterized by the regular layout of a square grid traced using surveyor's instruments. It may have appeared in the form of roads, canals and agricultural plots.

linked to the design of public spaces, like during the Functionalism of the 1930's, when squares and pedestrian roads started disappearing from new city plans. The 'Dystopia' was a consequence of the separation of infrastructure planning and people's needs. In fact, after 1960, because of the unprecedented urban growth phenomena and the introduction of cars, city development was turned over to professional planners and traffic planners, who came on the scene with their ideas and theories on how to guarantee the best urban conditions[7] (Gehl, 2010,pp. X). Ultimately, the beginning of orthodox city planning theories also marked the end of people-oriented mobility (Fig. 4).

Therefore, in terms of identifying the moment when mobility started becoming a serious issue – one which required the establishment of a special class of professionals – we could identify in 1960 the year that marks a divide and a paradigm shift in the relationship between cities, mobility and people. As Jan Gehl – one of the main supporters of people-oriented city planning - rightly points out in his numerous studies centered around people and public spaces, the major paradigm shift in city planning history can be attributed to the introduction, and large scale production-line manufacturing, of affordable cars and the consequent possibility of scattering functions in space, on one hand, and the need to plan new intricate infrastructural systems to house motor vehicles, on the other, putting aside for a long time the scale and needs of people (Gehl, 2010) (Fig. 5).

7. *Unfortunately, they intended the best urban condition for car traffic, not people.*

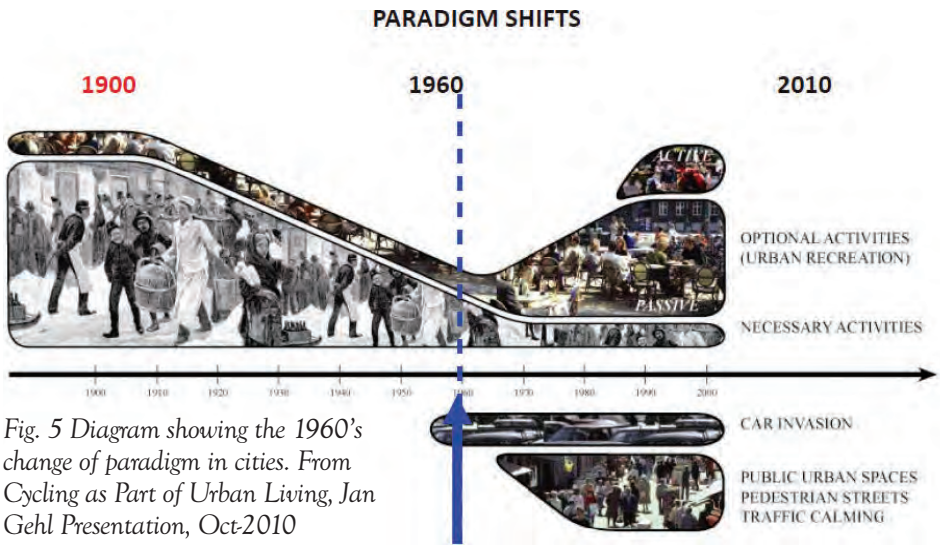


Fig. 5 Diagram showing the 1960's change of paradigm in cities. From Cycling as Part of Urban Living, Jan Gehl Presentation, Oct-2010

Fig. 6 Residential development, Markham (Ontario). The suburb is residential only, and cars are the only means of transport. Photo © IDuke, November 2005.

Around 1995, the affirmation of the private car as the preferred and privileged mean of transportation, not only permitted the sprawling phenomena, but also moved the attention of city planners away from the needs of people and toward the needs of motor vehicles. The key issues were primarily related to cars, and they were 'affordability', 'accessibility', 'safety' and 'speed'. Speed in particular started becoming an important aspect of mobility because it allowed for the optimization of profit - by making people and goods travel 'faster'. Moreover, availability of private car, Interstate Highway System and Planning codes that promoted separation of land uses encouraged suburban sprawl and favored the American dream of suburban home ownership. Of course, all the above resulted in a fuel dependent

Fig. 7 Top: Electric car battery switch; Middle: Proposal for a self-driving concept car proposed by Californian studio Mike and Maaikee; Bottom: Carpool lanes in LA.

society (Fig. 6). An important shift of paradigm occurred in the 1960's: because of social and economic factors, urban recreation activities increased in respect to necessary activities, strongly effecting the movement of people. As cars started invading cities -causing congestion, pollution and severe consequences on health and environment – the main concern became how to find solutions for 'getting away' from the traffic. Solving the car circulation and parking problems became the priority. However, since the solutions offered by traffic planners were addressed to the cars and motorists, and not to people in general, instead of reducing traffic congestion, the traffic measures were welcoming an even greater number of cars and, consequently, more traffic. As a result cars, the mobile fortress, ended up determining the street corners and the shapes and surfaces of public spaces[8].

Cars, were, and still are, responsible for the erosion of quality of public spaces and, indirectly, for the alienation of people. Consequently in the first decade of the 21st century a new trend started appearing in Northern European countries such as The Netherlands and Switzerland, where the attention of planners and politicians moved back to people, pushing cars away from city centers, and welcoming back in public spaces people and their social activities. The new paradigm points the attention to public spaces, placing the human dimension back on the table of urban planners, prioritizing "public space, pedestrianism and the role of city space as a meeting place". The new key priorities are: 'Lively city', 'Attractive city', 'Safe city', 'Sustainable city', 'Healthy city', and 'Accessible city' (GEHL, 2010, pp. 3-6).

The Task of the Century – Towards SOFT MOBILITY & an ACCESSIBLE, INTEGRATED, REGENERATIVE TRANSPORT NETWORK

We have come a long way from horse driven carriages and we have materialized most of the utopian infrastructural projects imagined by engineers, writers and artists since the late 18th century. Ultimately, what experts and common people have come to understand in the last decade is that the solution does not lie only in technology – in hybrid or electric cars and buses, or in bio-fuel or hydrogen powered vehicles. In fact, the problem cannot be solved in the detail and technology we use for transportation, but rather in the "interface between technology and behavior, this is how sustainable thinking should proceed" [quoted from the symposium (Banister, 2011)].

The fundamental issue with cars in fact, is not just the fossil fuel consumption and the atmospheric pollution; the problem is also that they "enable, and perpetuate, patterns of land use, transport intensity, and the separation of functions in space and time, that render the whole way we live unsupportable" (Thackara, 2009). The task of this century is solving the problem (the illness) - the alienation of people, health and air pollution - not the symptoms – like overabundance of cars. Being 'less-bad' by: using (less

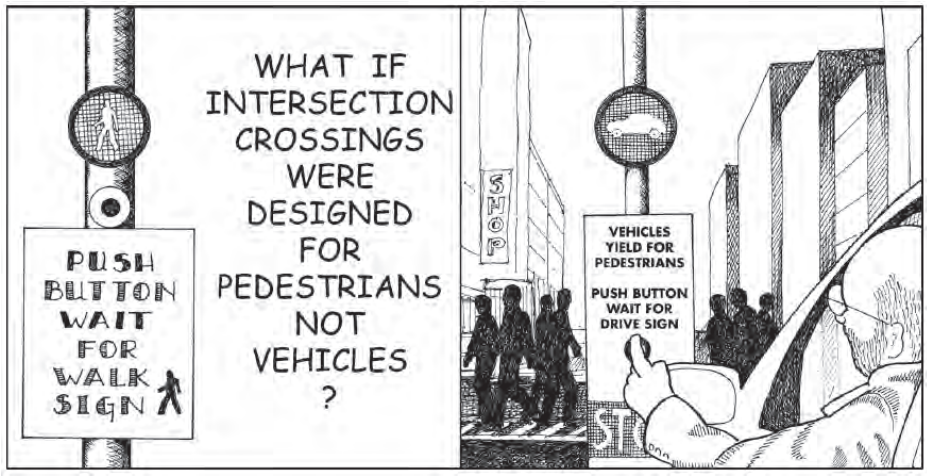
8. It is enough to note that a parking space takes over 20 m², which is more than the minimum standard for a bedroom in most countries.

pollutant) Hybrid Buses, Electric Cars, Hydrogen Cars, or even 'Self Driving' cars; imposing traffic limitations according to even and odd numbers of license plates; or simply limiting the number of cars by incentivizing people to share car rides[9]; can indeed reduce pollution and limit natural resource depletion, but it's not going to significantly improve traffic congestion, health and quality of life (Fig. 7).

In my view, the comprehensive strategies towards a more efficient and sustainable mobility from social, economic and environmental point of view, one that takes into closer consideration the WWHW+HF (the four+1 aspects concerning mobility), which I noted at the beginning of the article, could be summarized as follows:

1. (WHO) Privileging pedestrians, the human dimension and soft, carbon-free, means of transportation (bike, cable, etc.) (Fig. 8).

"People have always lived on streets" but the latter have also been the scene of a conflict, "between living ad access, between resident and traveler, between street life and the threat of death" (Appleyard, et al., 1981,pp. 1). Back in the Sixties Jane Jacobs called for the return of life to the streets (JACOBS, 1961); in the Eighties Donald Appleyard surveyed the streets of San Francisco in search for strategies to create Livable Streets[10] (Appleyard, et al., 1981) and, more recently, Jan Gehl outlind strategies to design Cities for People in the 21st century (Gehl, 2010)(Fig. 9).The common ground of these researches is the aim of making the streets for people and not cars. The most important scale of all is 'People scale', the city at eye level and at 5 Km/h. Strategies on a broader scale are to increase the public spaces where social interaction and physical activities can take place, and to separate or mediate between soft mobility and motor traffic. Of course returning cities to people also means limiting the space reserved for cars[11]. In this sense, very effective awareness campaigns and urban action initiatives are taking place all around the world. For example, the Pavement to Parks program in San Francisco temporarily or semi-permanently reclaims sidewalks and parking lots and inexpensively turns them into new public spaces, public seating areas equipped with bike racks and landscaping[12]. The street art By Joana Pinheiro De Magalhaes, Árvores Estacionadas[13] [Paredes Porto, 2013], operated a temporary invasion of streetcar parking by occupying them for a limited



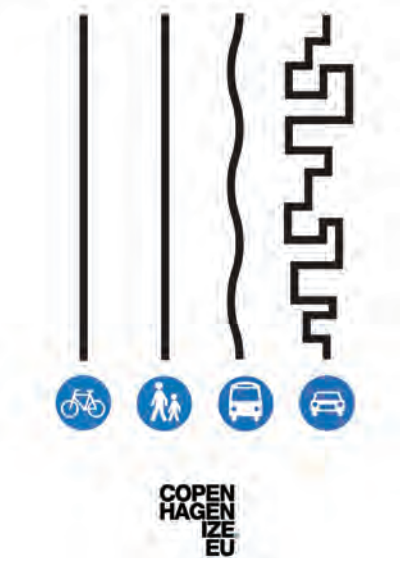


Fig. 8 Top: Comic by Dhiru Thadani; Middle: Poster Copenhagenize Traffic Planning Guide illustration, 2012. Bottom: Poster "Día Mundial del Medio Ambiente", Murcia (Spain), 2009.

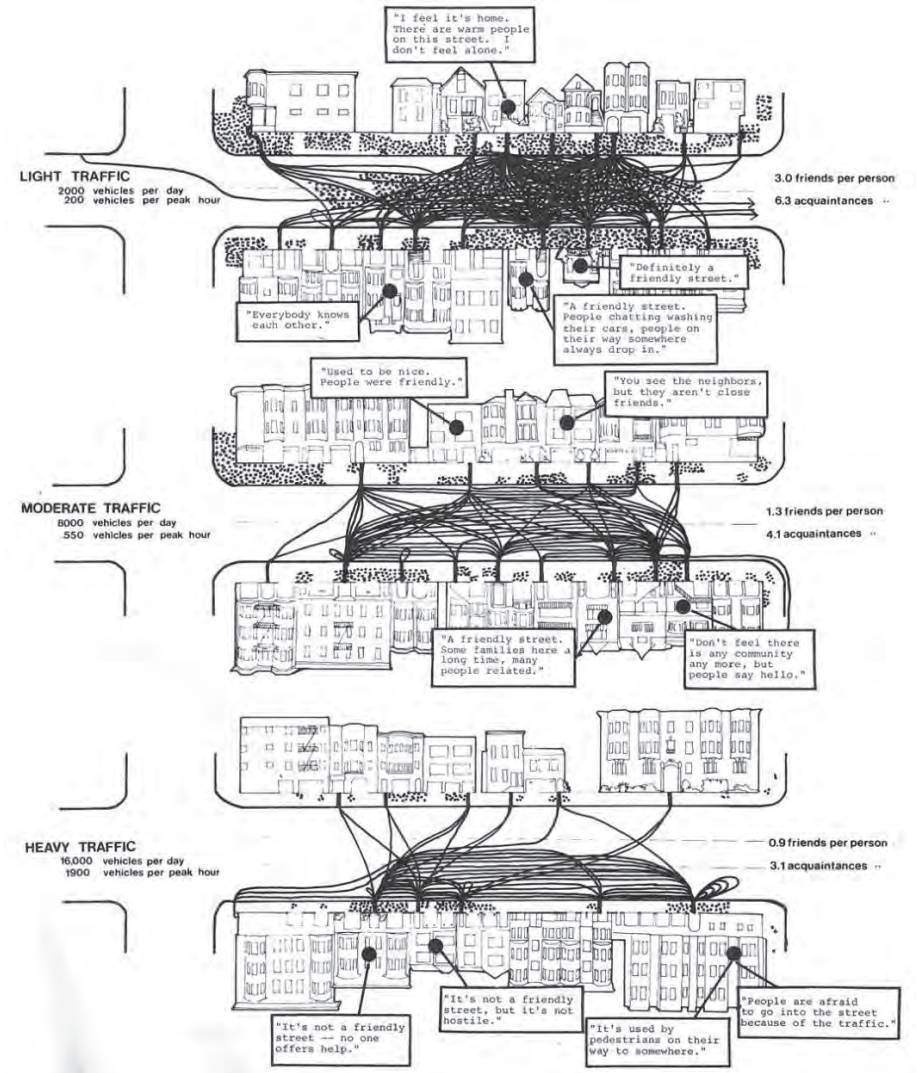
9. See the Carpool lanes in the USA. These lanes are reserved for cars driving with at least two passengers.

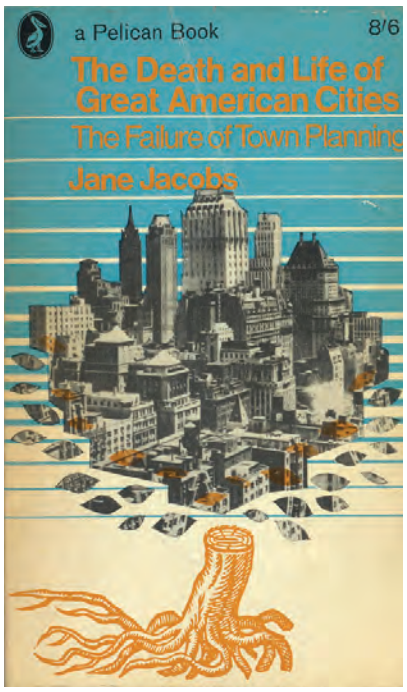
10. His 1981 book Livable Streets contained a comparison of three streets of similar morphology in San Francisco, which had different levels of car traffic: one with 2,000 vehicles për day, the others with 8,000 respectively 16,000 vehicles për day. His empirical research demonstrated that residents of the street with low car traffic volume had three times more friends than those living on the street with high car traffic.

11. "Six bicycles can typically fit into the road space used by one car. [...] 20 bicycles occupy the space required to park a car" (BROWN, 2009,pp. 151).

12. The Parklet Program provides a path for merchants, community organizations, business owners, and residents to take individual actions in the development and beautification of the City's public realm repurposing part of the street into a space for people (http://pavementtoparks.org/)

13. http://cultureurbanspace.interartive.org/joana-pinheiro-de-magalhaes/





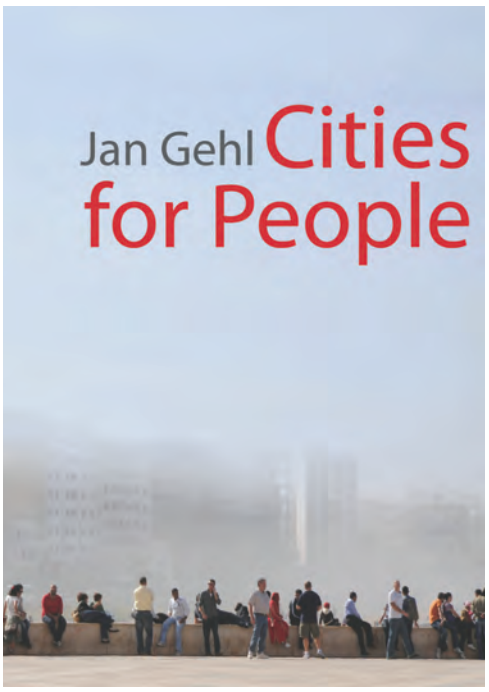


Fig. 9. Book covers & comparison of three streets of similar morphology in San Francisco by Donald Appleyard.

amount of time with red seating areas and incorporated flowerbeds shaped like cars. Also the interactive bus stops devised by the Italian group Orizzontale[14] with their Crucivurbe project [Rome, 2011] belongs to these kind of initiatives (Fig. 10).

Low car and car free developments are surely one way of privileging pedestrians, by reserving the streets exclusively to pedestrians and bikes. They are residential, or mixed-use developments, which normally provide a traffic free immediate environment, offer no parking or limited parking separated from the residence, and are designed to enable residents to live without owning a car.

Always in relation to the strategy of allowing or restricting movement of people or vehicles in different directions, Steve Melia – senior lecturer in transport and planning in the UK – coined the term "Filtered permeability[15] to indicate a "traffic layout strategy that separates sustainable modes from private motor traffic", in order to give to the first an advantage in terms of speed, distance, convenience and ease of movement (Melia, 2012, pp. 6-7). This can be done by separating cycling and pedestrian paths, bus lanes, and reserving bridges and tunnels solely for sustainable modes of transpiration; and it can strongly encourage the use of public transit systems, walking and cycling[16]. The term "Permeability or connectivity" is used by Melia to differentiate this layout from traditional types of road layout characterized by 'unfiltered permeability' – providing equal

14. http://www.orizzontale.org/progetti/crucivurbe

15. The term 'filtered permeability' was coined by Melia (2008) and subsequently defined in guidance prepared for the Department of Communities and Local Government in the UK as follows: "Filtered permeability means separating the Sustainable modes from private motor traffic in order to give them an advantage in terms of speed, distance and convenience."(TCPA and CLG, 2008). (MELIA, 2012, pp. 6-7)

16. Urban forms, which lack permeability, e.g. those, severed by arterial roads, or with many long cul-de-sac, are considered to discourage movement on foot and encourage longer journeys by car.

Fig. 10 Top left:- Street art By Joana Pinheiro De Magalhaes, Árvores Estacionadas, Paredes Porto, 2013. (source: http://cultureurbanspace.interartive.org/joana-pinheiro-de-magalhaes/ Top right: Parklets, "Pavement to Parks" program, San Francisco.Bottom: Crucivurbe project, Orizzontale, Rome, 2011. Source: http://www.orizzontale.org/progetti/crucivurbe)

permeability for all modes of transportation (i.e. the rectilinear grid – with streets open to all traffic, typical of North American cities) (Melia, 2012, pp. 6-7).

According to Appleyard, devices and strategies to control traffic can be "hard" or "soft"[17]. A "hard" approach includes the definition of areas where the access and circulation of motor vehicles is physically restricted – like in the limited access model of residential areas and/or historical centers (Car free – pedestrianized centers), where car parks are located towards the edge of the protected areas and the access beyond certain points is forbidden. On the other hand, similar results in terms of keeping cars away can be achieved with a "soft" approach, without any physical barriers to the penetration of motor vehicles (Appleyard, et al., 1981,pp. 10). A very good contemporary example of this strategy is the Vauban model where vehicles are in fact allowed down the streets of the residential area at walking pace to pick up and deliver but not to park; car owners must purchase a place in one of the multistory car parks on the periphery of the residential area. Another "soft" dissuading device to reduce traffic congestion and air pollution is charging cars to enter the city center. Singapore, three Norwegian cities (Oslo, Begen, Trondheim), London[18] ('Congestion Charge', activated in 2003), Stockholm, and Milan ('Pollution Charge', activated in 2008) already tax vehicles entering the city center and other cities are now considering similar measures (Brown, 2009,pp. 148).

2. (WHY ... & HOW FAST) Reducing or eliminating the need to move people and goods in the first place.

This aspect related to mobility, mainly deals with accessibility and the need to bring things 'closer'. "Rather

17. Some devices [to control traffic] are "hard", preventing movement by physical barriers, and others are "soft", using more subtle or psychological means of influencing driver behavior." (APPLEYARD, et al., 1981)

18. The London 'Congestion Charge' is a fee charged on most motor vehicles operating within the Congestion Charge Zone (CCZ) in central London between 07:00 and 18:00 Monday to Friday. The fee is aimed at reducing congestion and raising investment funds for London's transport system.

Fig. 11 "Do the right mix", European Commission's Sustainable Urban Mobility campaign, launched in July 2012.

than tinkering with symptoms – such as inventing hydrogen-powered vehicles, or turning gas stations into battery stations – the more interesting design task is to re-think the way we use time and space" in the first place. This ultimately implies that we should also examine in depth the aspect of speed and its influence on mobility in general, and transportation in particular. In fact, the need to move people and goods across the planet fast is one of the main causes, not only of pollution, but also of loss of local identify and culture[19]. "There is an alternative way: reduce the movement of matter – whether goods or people – by changing the word faster, to closer." (Thackara, 2009) In terms of services' accessibility, this means exploiting to the full potential telecommunication, digital transmission and the internet; while in terms of goods' transportation it might imply supporting local economy and delocalization of production, re-evaluating the role and the importance of exponential economical 'growth' itself; in other words: embracing the concept of de-growth (Latouche, 2009).

The above-mentioned strategies both require a new underlying premise, a fundamental shift in the way we approach transport options and evaluate the performance of existing transport systems. According to accessibility-based planning theories by Todd Litman and his "Accessibility Versus Mobility-based Transport" concept (LITMAN, 2003), conventional planning often evaluates transport system performance based primarily on mobility (using indicators such as traffic speed and vehicle operating costs), and ignoring other 'accessibility'[20] factors and improvement options. Following this perspective, the solution to traffic is not simply to expand the capacity of the roads, but rather to reduce the distance between destinations, improve road connectivity, telecommunications and delivery services, and/or propose alternative transportation modes[21]. Ultimately, "accessibility-based transport planning tends to support sustainability by expanding the scope of analysis", redefining performance evaluation indicators (considering people's time, money, discomfort and risk required to reach opportunities), and "supporting more resource-efficient solutions" (Litman, 2003,pp. 6).

3. (HOW) Guaranteeing an integrated, diversified and efficient urban transport system - privileging mix and hierarchy of transportation means.

Urban transport systems based on a combination of rail lines, bus lines, bicycle pathways and pedestrian walkway, offer a low impact and cost efficient solution for mobility in cities. Back in July 2012 EU launched the European Commission's Sustainable Urban

19. For example, the export and the access of food and consumerist goods all around the world is inexorably flattening all local traditions and habits.

20. Accessibility (or just access) refers to people's ability to reach desired goods, services, activities and destinations (together called opportunities). Access is the ultimate goal of most transportation, excepting the small portion of travel in which movement is an end in itself, (e.g., cruising, historic train rides, jogging, etc.) (Litman, 2003,pp. 5).

21. Many factors can affect accessibility, including mobility (physical movement), road and path connectivity, land use patterns (the location of activities), mobility substitutes (telecommunications and delivery services), affordability, information availability, and even the social acceptability of transport options. (Litman, 2003,pp. 5)

Mobility campaign, with the slogan "Do the right mix", and creating Eltis, a Urban Mobility portal aimed at facilitating the exchange of information, knowledge and experiences in the field of urban mobility in Europe[22] (Fig. 11).

In terms of innovative integrated and efficient public transpiration systems, some of the most successful examples can be found in Mexico (Mexico City), Colombia (Bogotá), Brazil (Curitiba) and China (Beijing, Guangzhou) – to mention just a few – which all have in common the introduction of the Bus Rapid Transit (BRT) systems. BRT are highly efficient modes of public transportation where a combination of express lanes for buses and organizational, structural, and technological advances[23], have radically changed the habits of citizens, who now choose public transportation because it has become a faster mode of moving around the city than private automobiles. Intelligent Transport Systems supported by ICT[24] & technology, combined with strategies like integrated ticket solutions and bus fare reduction according to miles on bike, can finally become a real alternative and compete against the appealing temptation of the car (Brown, 2009, pp. 147-154) (Fig. 12).

It goes without saying that in an efficient urban transport system should privilege soft-mobility, bicycles for example increase mobility while reducing congestion and the area of urban paved (waterproof) surfaces. In the Netherlands 27 percent of all trips are by bike (with an ownership rate of more than one bike për person), In Denmark 18 percent, in Germany 10 percent (Brown, 2009,pp. 153). To incentivize the use of bicycles, innovative initiatives have been launched in many European countries, like France, Denmark, Sweden and The Netherlands, through the establishment of bike sharing programs, and the concession of extensive rights-of way for cycling, "complemented by full integration with public transport, traffic education and training of cyclists and motorists" (Brown, 2009,pp. 153). Exemplary are the cases of Malmo (the most friendly bicycle city in Sweden) where the bike path network is so efficient that even kindergarten excursions and waste

Fig. 12 Top: Bus stops in Curitiba, Paraná, Brazil. ©Morio. (source: https://commons.wikimedia.org/wiki/File:Bus_Stops_3_curitiba_brasil.jpg https://urb3.wordpress.com/category/etude-de-cas/)
Bottom right: Handicapped accessible BRT station in Curitiba, Brazil.
(source: http://untappedcities.com/2013/07/31/why-nyc-select-bus-service-is-not-bus-rapid-transit-brt-system/)

22. *http://www.eltis.org/mobility-plans/project-partners/do-right-mix-sump-award*

23. *Traffic lights are delayed for oncoming buses, decreasing the amount of time between stops. A computer chip inside the bus signals sensors on the road, which then alert the passengers at the next station if the bus is running on time. In addition, fares are pre-paid, reducing waiting at bus stops, and waiting platforms are elevated to allow for quicker entry and exit to the bus.*

24. *Information and Communication Technologies - real-time passenger information (RTPI), mobile devices, substitution potential of ICT for travel, multimodal connectivity, electric vehicles, shared means of transport, adaptive traffic management, dynamic road pricing, privacy issues, green cars, cleaner vehicles, apps for more efficient travel, integrated (multimodal) journey planners.*

Fig. 13 Top: Bike spaces on BART (Bay Area Rapid Transit), San Francisco. Middle: Malmo (Sweden). Kindergarten excursions on bikes. Bottom: Malmo (Sweden). Cyclists' support services balancing rails at intersections.

collection around the city are done with bikes[25]; the Bicycle Master Plan in the Netherlands, which incorporates a vision of the role of bicycles in the country; and the National Cycle Network in the UK, a series of safe, traffic-free lanes and quiet on-road routes that connect to every major city and passes within a mile of 55 % of UK homes (Fig. 13).

4. (WHERE) Rethinking the use of existing infrastructures – green infrastructures, multiplicity of use and environmental regeneration.

Generally infrastructures that transport people, goods, matter, water and energy are "highly visible and they pervade large areas of the built and unbuilt environment"[26] (Ibelings, 2013,pp. 114), significantly impacting the landscape. Moreover, our perception of the landscape is strongly influenced by the means of transportation and by the infrastructures themselves[27]. The fact that for example, highways, aqueducts and sewage networks extend for thousands of Km and their ramifications spatially connect buildings and settlements makes them suitable for housing multiple functions simultaneously. In fact, apart from responding to our need to transport energy, matter and people, they could also contribute to ecosystem services, regenerating the environment through restorative strategies (repairing the damage that has already occurred), complementing the natural resources as opposed to simply maintaining them. In effect, roads can guarantee ecosystems' health, reduce pollution and allow water runoff, simply by introducing landscape elements like Bioswales[28] along the roadways (Fig. 14).

Surely, history shows us that when infrastructures lose their original function and become obsolete, they can remain in place - like the still partially intact Roman aqueducts that appear as second natures[29]

25. Support services for cyclists include rider-sensors to control traffic lights, mirrors at corners to alert motorists, balancing rails at intersections, universal tools at selected pump stations, bike and tourist information points, bike and ride stations with storage lockers for tools and raingear, 'do-it-yourself' space for repairs and showers.

26. For example, while fossil fuels are invisible within the folds of the earth, the elements needed to produce and transport electrical energy are highly visible. Moreover, while fossil fuels are processed, measured and transported in terms of their volume (mass), electrical energy demands surface area.

27. For example the perception ad experience of the car driver is influenced by the trajectory of the highway and the framing of a windshield (JAKOB, 2009,pp. 119). Similarly, the train and the rail, which impose their point of view on the observer, influence the landscape perception of a passenger travelling by train (Cfr. JAKOB, 2009,pp. 112).

28. Landscape elements designed to remove silt and pollution from surface runoff water. They consist of a drainage course with gently sloped sides, filled with vegetation, compost and/or riprap. The soil in these swales is engineered and layered to promote infiltration; using native planting improves the diversity of the site.

29. In "Viaggio in Italia" Goethe defines ancient ruins as "Second Natures that operate on a civil level".

in the Italian landscape – and potentially acquire a new function. If the highway as an infrastructural system as we know it were to become obsolete one day, it would still be possible to reuse its surface to produce renewable energy. However, even if car ownership was never to decline, and the motorway's future is to remain tied to the presence of cars, this 'necessary evil' could at least be used more efficiently, imagining new and complementary uses for existing infrastructures. As recent examples of approaches toward a more efficient way of using infrastructure, we could mention the project to build Solar Roads in France (2015), or solar-panel bike paths in The Netherlands (2014) (which are both integrating PV modules on the infrastructure's surface[30]) and the production of Smog-Eating Pavement (pavement that absorbs nitrogen oxides[31]) (Fig. 15). Or, more radical proposals like the "HEADS UP HIGHWAY! Cultivating Energy 2050" [MODUS- Sandy Attia, Matteo Scagnol architects, 2013. Project exhibited at the "ENERGY, Oil and Post-Oil Architecture and Grids" exhibition - MAXXI, Rome, 2013]. The basic idea of the project was covering "the Italian network of autostradas with a renewable energy system: a gigantic roof of photovoltaic panels, that could meet half of the country's household energy needs"; "making energy production visible" (Ibelings, 2013,pp. 114). To mitigate the highway's negative impact on the surrounding context, 6.650km of Italian highway are reactivated to become a continuous 160 million square meter surface superimposed on the existing highway system, that produces and distributes energy – solar energy, wind energy (wind turbines are activated by natural wind and by the wind produced by the moving vehicles) and water collection towers. An electrical park with the potential to level the "uneven social and economic division of the country", where energy farms are built in the poor South, while the rich North is consuming most of the energy. In fact, more energy would be produced in areas with more highways and where energy consumption levels are higher (Ibelings, 2013,pp. 115) (Fig. 16).

Fig. 14 Top: L.A. Zoo's new bioswale median set to capture parking lot runoff. © Ciara Gonzalez (source: https://lacreekfreak.wordpress.com/2011/05/21/l-a-zoo%E2%80%99s-new-watershed-friendly-parking-lot/#more-6827. Bottom: West Silk Road [GEO-Green Earth Operations]. Project located in the City of Hanzhong, Shaanxi. A system of vertical bioswale filters will provide storm water treatment and protect the Xing Yuan Lake. Source: http://www.greenearthops.com/new/category/news/)

Pneumatic Networks 2.0

The strategy to make efficient use of otherwise unused space along, above and below infrastructures, is something

30. http://www.solarroadways.com
31. http://inhabitat.com/dutch-scientists-invent-smog-eating-pavement-to-help-clean-the-air/

Fig. 15 Solar Roadways®, PV integrated roads. (source: http://www.solarroadways.com)

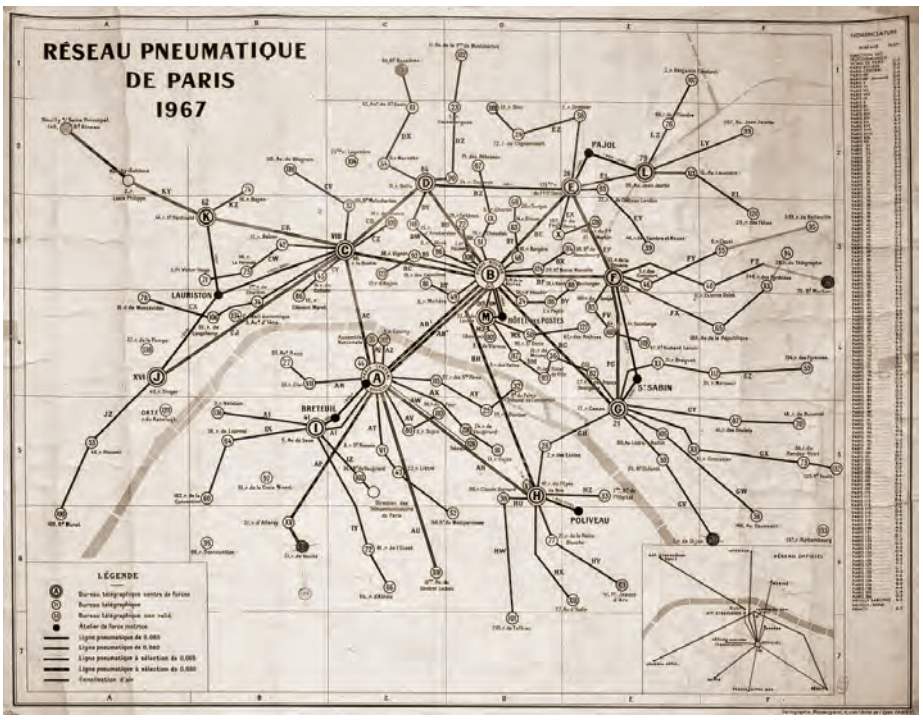


Fig. 17 Top: Historical Map: Pneumatic Mail Tube Network, Paris, 1967.
Bottom: Sewers with the tubes from the Poste Pneumatique in Paris. Image caption from the Ignite/LA: Molly Wright Steenson - A Series of Tubes, EP 7.

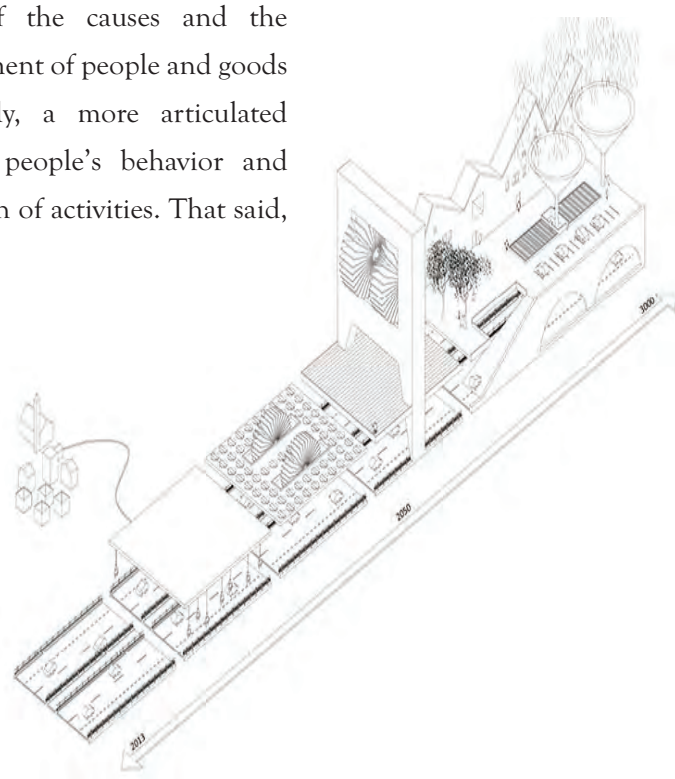
that could be learned from the Pneumatic Networks in the major cities of the 19th century. Back in the 1800s in France they had the ingenious idea of using an existing infrastructure to boost the movement of information (which back then was mostly done by mail), avoiding the traffic on the busy streets of the city. Since the city had an existing underground system that covered the entire city - the sewers - they wrapped the entire network with pneumatic tubes (or capsule pipelines) which could shoot mail through air-pressurized ducts at a speed of 10 m për second. The pneumatic mail, also known as Pneumatic Tube Transport (or PTT), was invented by a Scottish engineer in the 1800s. Major cities like London and New York had very efficient networks of pneumatic post. However, in Paris, with 467 kilometers in total length, Parisian Pneumatique [1934] became the world's largest network, and it remained in use until 1984, when it was abandoned in favor of computers and fax machines. Pneumatic post stations usually connected post offices, stock exchanges, banks and ministries (Fig. 17). Typical current applications of the pneumatic network on a smaller scale are in banks, hospitals and supermarkets. Many large retailers use pneumatic tubes to transport checks or other documents from cashiers to the accounting office. An evolution of the pneumatic mail was the original idea of the Pneumatic meals

Fig. 16 Top and Bottom: HEADS UP HIGHWAY! Cultivating Energy 2050" [MODUS- Sandy Attia, Matteo Scagnol architects, 2013]. Project exhibited at the "ENERGY, Oil and Post-Oil Architecture and Grids" exhibition - MAXXI, Rome, 2013. (source: "Energy. Oil and Post-Oil Architecture and Grids", Electa (2013).)

[Berlin, 1935] where instead of mail, thermos bottles containing part of some house wife's meal, were shooting at a mile-a-minute speed through pneumatic tubes far beneath the streets of Berlin. Or, the Foodtubes project [2010], conceived by a consortium of academics, project planners, and engineers, that intended to mimic the networked infrastructure of the Internet for pneumatic-tube-aided food delivery. (Fig. 18). Interestingly enough, until it closed in early 2011, a McDonald's in Edina (Minnesota) claimed to be the "world's only pneumatic air drive-thru," sending food from their strip-mall location to a drive-through in the middle of a parking lot. More recently, a restaurant in New Zealand, "C1", installed pneumatic tubes (or 'food delivery' pipes) to deliver dishes to diners. Finally, a very interesting application of the vacuum systems could be in waste transportation networks, as the waste would be transported, directly and rapidly, to cleaning plants.

Preventing instead of curing

To conclude this brief reflection on mobility and infrastructures, we can highlight the main difference between strategies brought forward by utopian projects and planning practices of the nineteenth and twentieth century, and the new tendencies of the current century. The first were concentrated on the infrastructures themselves and on the differentiation between users and modes of transport (WHO & HOW), while the new strategies put forward in the contemporary discourse on transport and cities, are addressing the aspects related to people and accessibility first (WHY & WHERE). Therefore, we could say that the first were trying to cure the disease with a 'drug', while the latter are trying to eliminate the causes of the 'disease' itself. Current tendencies are attempting to 'prevent' the negative consequences caused by the need to move, adopting a more holistic approach that acknowledges the complexity of issues related to transportation needs of people and goods. Such issues require a deeper understanding of the causes and the patterns of movement of people and goods and, consequently, a more articulated investigation on people's behavior and spatial distribution of activities. That said,



Pneumatic Tubes Shoot Hot Meals To Homes

Complete meal is delivered via pneumatic tubes fifteen minutes after order has been placed by phone, to Berlin homes near new food center. Right: Housewife holds one of thermos jugs used in delivering meals.

In Berlin's gigantic central kitchen food is cooked in huge kettles like those in above photo, then placed in thermos jugs, set into corrugated paper containers, and forced through pneumatic tube by compressed air to kitchens in vicinity. Coffee, soups, and other drinks are drawn from huge tanks through faucets; entrees, meat dishes, salads, and desserts are packed into thermos jugs by hand or by automatic machinery. Menu is 300-page book.

Loaded thermos jugs are slipped into these pneumatic tubes at food kitchen, for delivery to homes. Separate pipe runs from kitchen to each home getting service. Compressed air pushes containers at high speed through the smooth tubes.

WHIZZING at mile-a-minute speed through pneumatic tubes far beneath the streets of Berlin, Germany, are thermos bottles each containing part of some housewife's meal. A phone call is enough to bring, in less than fifteen minutes, a complete meal ready to serve, containing exactly the desired quantity and kind of food for each course.

Housewives select their meals from a 300-page menu book distributed to tenants in every apartment house and home within a radius of ten blocks of the gigantic central kitchen. Orders may be placed by phone for delivery at any specified time.

In the kitchen food is prepared in huge galvanized troughs and pots. Long rows of thermos bottles are stacked in readiness to receive dishes ready for delivery. The bottles are wrapped in corrugated containers in preparation for their trip through the vast network of underground tubes.

Newer homes in Berlin will have no kitchens—simply a few pneumatic tube outlets beside the kitchen cabinet or sink. With the elimination of all stoves and ovens in the home, the fame of German women for tasty cooking may soon pass into obscurity.

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Fig. 18 Top: Pneumatic Tubes that shoot hot Meals to homes, 1935. Bottom: "Foodtubes project". A proposed Foodtubes station in London.

in terms of contemporary strategies aimed at eliminating the impact of transpiration on the environment and on people's health, it is crucial to acknowledge that technology alone will not be sufficient to achieve a sustainable transport system in the future. Sustainable transport also requires changes in behavior, which can be encouraged through various land use, regulatory, pricing, education and awareness mechanisms.

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