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A set of tools for making urban transport more sustainable

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Abstract

There are six possible tools for making urban mobility more environmental friendly: more strict rules of the new urban transport policy, using advantages of connected vehicles, improving urban structure, showing better alternative for a car use, new financial sources for changing drivers behavior and the Business Model for cities wanting to have a green image. The new urban transport policy should concentrate on promotion of environmental friendly vehicles, equal access to public transport modes, better telecommunication services and better goods transport management. The Autonomic Road Transport Support Systems can change the street view: fights congestion by ramp-metering and better traffic distribution on the road network; autonomous cars densely packed when moving; no traffic signals, traffic signs, signposts and road painting; narrower carriageway means more space for bicycle routes, sidewalks, greenery and coffee gardens. Multifunctional and Intensive Land Use should be promoted to reduce travel needs or to make travel distances smaller (acceptable for walking or cycling). MILU will help also with urban sprawl – higher density means people are not car dependent. My Smart Eco-travel Planner and its database can be used for implementing sustainable urban transport policy in more efficient way. The main financial source for promotion of eco-friendly travel modes could be a transport policy rule: fuel prices can never go down – probably more effective measure than all Climate Summit 2015 results. Only during last 3 years changes in fuel price could result in Poland in gathering ca. 10bn € on the eco-fund for financing e.g. the new metro lines. Business Model (showing the cities their potential gains in result of above measures implementation) will help the cities authorities to vote for the new way of mobility management. Financial Div. of the City Transport Dpt. will calculate gains of the lower car use: lower costs of road construction and maintenance, new work places, shorter travel times, better environment, better inhabitants health and the Green City image – minus costs of the new system implementation. Measures mentioned above shape the new paradigm of urban transport management.

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1. Introduction

The biggest challenge of sustainable transport policy in urban areas is to decrease car use in densely populated areas where the highest traffic flows are observed. Although the idea of sustainability is well known since 80., it will be useful for this paper to explain how it is understood here. Implementation of sustainable development for a smart city is to support economic growth with minimal harm for environment and high living standards. In case of sustainable transport it means less energy and land consuming investments – sustainable use of environment looks for profit not at present but in a long-term perspective.

In most of the European countries is full understanding that today's investments in the physical environment, in particular in infrastructure and mobility, are the main driver for urban economic and environmental vitality of tomorrow. Achieving a smart green and integrated transport system is a key to sustaining and developing economic and social vitality of urban Europe. Within this context the challenge is to deliver the next generation of infrastructure governance, design, management and operation. This enables optimal accessibility, liveability, health, safety and security across the scales from the local daily urban system to the wide EU-regions that cluster metropolitan areas (MIEN, 2014).

The core idea of Smart Cities is to better connect human capital, social capital and ICT infrastructures in order to generate greater and more sustainable economic development and a better quality of life for citizens. The concept of Smart Cities calls for intelligent approaches to local economy, mobility and environment by focusing on people's needs and interests. In the long-term, every city should provide improved and smarter public services that are more citizen-centered, economically viable and environmentally sustainable. There is a need for flexible partnership between public and private sectors as well as diverse industries such as telecommunication, energy providers, manufacturers and suppliers to ensure improvements in mobility, energy consumption, governance and social cohesion in European cities (PublicPolicyEx, 2014). At present the modal split of transport in Europe is dominated by passenger cars accounting for 73.4% of passenger traffic compared to just 1.4% for tram and metro combined. According to the World Health Organization, some 40 million people in the 115 largest cities in the EU are exposed to air exceeding WHO air quality guideline values for at least one pollutant (MyWay, 2015).

The author's scheme below (Fig. 1.) illustrates the path of city management which makes sustainable urban growth possible.

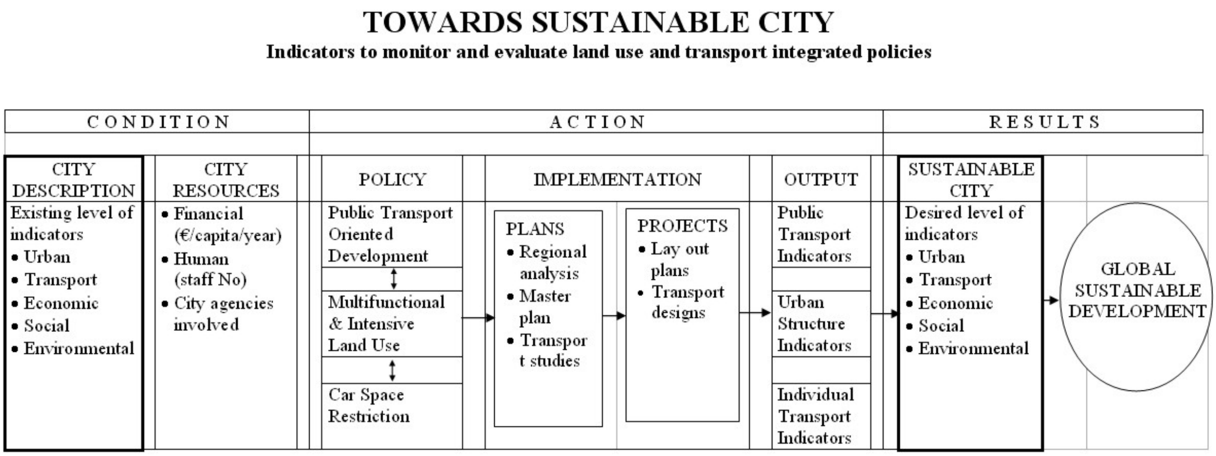

Fig. 1. Indicators to monitor and evaluate land use and transport integrated policies.

Urban transport policy have to answer three main European challenges:

- Climate warming – by decreasing greenhouse gases emission
- Personal safety & security – by improving road safety and preventing taking control (hacking) over an automatic car or Traffic Management Center
- Aging population – by increasing elderly people mobility.

2. The new urban transport policy

As mobility is one of important living standards and big achievement of our civilization, we have to be sure that any restrictions for car use will not decrease an indispensable mobility. Keeping only indispensable mobility in mind means that policy measures should try to reduce the need for a car use by other solutions: better communication, attractive public transport, modern land use, and last not lease clever and sound transportation policy.

A smart use of a better communication can substitute a lot of travels. Internet and other telecommunication services can substitute: personal meetings (you can call, fax or send e-mail), everyday work trips by tele-work (working at home), business trips (visiting bank, city administration, etc.) and looking for goods in shops.

Attractive public transport means: quick travel by preferences in traffic (separated right-of-way for trams, bus lanes, priority at junctions, etc.); cheap (subsidized) tickets; short, convenient and safe walking distance to mass transit stops; short waiting time at public transport stops (smaller vehicles where needed) or reliable time tables and well organized interchanges; call-and-ride services mostly for handicapped.

Land-use planning in urban areas should follow such rules as: work close home (because of big achievements in making industry clean there is no need to separate workplaces according to the Athen's Charter) and shops close home (hypermarkets generate high volumes of car traffic). In general: multifunctional and intensive land use (MILU) should be promoted. Main trip generators (high-rise office buildings, shopping malls, sport arenas, etc.) should be located close to the main public transport corridors and multimodal terminals. Urban sprawl should be stopped (low density generate additional car traffic) using financial and administrative measures.

Coordination of spatial & transport planning policy (Malasek J., 2012) means: balance in the CBD of three capacities: internal road network = external access roads = internal parking lots; parking zones (standards for maximum parking spaces per 1000 sq. m. of offices in CBD and minimum in the outskirts with law density); P+R system close to the public transport terminals outside downtown area; bicycle routes network development and well facilitated pedestrian areas.

Measures mentioned above do not include enforcement like parking and road pricing (congestion charging), limited access to specified areas, etc. Enforcement can help policy implementation and usually is quite effective, but the more elegant solution is to attract people to other transport modes than to forbid car use administratively. In the cities, regions or even the countries facing really big transportation problems, soft measures mentioned above should be supported by the more painful administrative decisions. 10 measures or commandments, we called it the Decalogue for Sustainable Urban Transport Strategy, could be here very helpful:

I. **Promotion of public transport modes**: better accessibility and higher attractiveness of public transport modes can be done by: development of high quality public transport networks; preferences for public transport vehicles in traffic; more convenient interchanges; safe and environmental friendly public transport vehicles; good national passenger information system.

II. **Car restrictions within the cities**: can be done by high charging of using more cars in a household and limiting their number to 1 in case of households in parking charging zones.

III. **Fuel price can never go down**: lowering fuel price makes people who choose public transport because of economic reasons going back to the car use. Profit gained when the market fuel price goes down should feed the city or national eco-fund for public transport development (Malasek J. et al., 2012).

IV. **Ecological transport tax**: each car ride is automatically taxed and the tax amount depends on the city district, journey length, emissions, the noise level and on the day time (the highest during pick-hours).

V. **Promotion of more environmental friendly vehicles**: buying the more expensive hybrid or electric car should be awarded with a couple of gains, connected with its purchase (lower VAT and registration fees) and use (entering limited access zones, lower parking fees, etc.).

VI. **Equal access to PT modes**: can be done by arranging better conditions of functioning in the city environment for the handicapped and those who can't use private vehicles, and are fully dependent on public transport.
VII. **Co-financing of transport investments**: all real estate owners should participate (by paying the higher tax) in financing all local investments which increase accessibility of their houses, flats and plots.
VIII. **Sustainable spatial planning policy**: revitalization of urban areas with multifunctional and intensive land use, which makes that transportation needs are lower and more journeys can be covered by walking and cycling.
IX. **Better telecommunication services**: access for everyone to high quality telecommunication and Internet networks, which can in many cases substitute travels and, what's probably the most important, makes tele-working possible.
X. **Better goods transport management**: deliveries within the city should be served in smaller (instead of HGV) and more environmental friendly (using alternative fuels) vehicles or, if only possible, by train.

Obviously, final decision on implementation of all measures mentioned above should be done during public participation process attended by all main groups of the city stakeholders.

What else could be done? Some methods are known for decreasing car ownership in cities by the more effective car use, however, carpooling and a car-sharing in their well known version looks to be a little out of fashion. To be cool, car-sharing system should use at least eco-friendly electric cars like in Amsterdam (Step-by-Step, 2015 - analysed in "Step-by-Step EU project, the author participated in). With all its controversies the Uber system is what nowadays changes the urban transport pattern worldwide.

Uber (Uber Technologies Inc.), an American international transportation network company headquartered in San Francisco was founded in 2009. It develops, markets and operates and operates the Uber mobile app, which allows consumers with smartphones to submit a trip request which is then routed to Uber drivers who use their own cars. In 2013 USA Today named Uber its tech company of the year. In 2014 Uber started also experiments with carpooling features. Drivers in Warsaw began using the Uber app on August 2014. The services are available in 58 countries and over 300 cities worldwide, and Uber is estimated to be worth $50bn (Bracky K., 2015).

Uber's pricing is similar to that of metered taxis (however usually even twice cheaper, and you can ask to share pricing among passengers), although all hiring and payment is handled exclusively through Uber and not with the driver personally. In some cities, if the Uber car is travelling at a speed greater than 18 km/h the price is calculated on a distance basis, otherwise, the price is calculated on a time basis. At the end of a ride the complete fare is automatically billed to the customer's credit card. You can watch the car on the map on your phone as it makes its way to you. Users of the app may rate drivers and drivers may rate users.

Uber faces competition from lower-cost real-time ridesharing startups such as Lyft, Sidecar, Ola Cabs and Haxi, but the biggest problem looks to be legality. The legality of Uber has been challenged by governments and taxi companies, who allege that its use of drivers who are not licensed to drive taxicabs in unsafe and illegal, e.g. in April 2014 Uber was banned by the government in Berlin. Leaving competition fights aside, it looks Uber at present try to collect data on city traffic and taxi demand, to use it for creation a software for fully automated (without a driver) taxi services.

Car ownership index in Polish big cities (like in most of European cities) is unreasonably high – in Warsaw, where public transport is really good, it is ca. 600. The main reason is a too low purchase barrier. A young driver can buy his first car for 500 € or even less. Each year people buy ca. 1 million cheap, secondhand imported cars (3 times more than new cars), mostly over 10 years old, unsafe and not environmental friendly. Also new cars are less expensive – when in 1999 a popular new car costed 22 average salaries, now it is 12. A good solution for decreasing traffic jams and emissions, as well as for improving road safety (extremely poor in Poland) could be, I'll suggest, a new environmental tax, e.g. 1000 € for registering a car older than 10 years.

A big problem which should be solved are also company cars for private use. In Poland 9% of all cars are cars owned by companies, however, in Warsaw a share of company cars in traffic flow during pick hours is estimated on 40%. Company cars as a staff allowance are more and more popular. When in 2000 their share in new registered cars was 4.6% in 2014 it reached 61.3%. Car sellers lobby made that since April 2014 a company buying a car can deduct 50% VAT of its price and since July 2015 company car users can deduct 50% of VAT for petrol – what makes it even more attractive. What's more, company cars are bigger than average private car and more often premium class – means use more fuel. Now in case of a car price 50 000 € a company can deduct over 6000 €, when in 2013 less than 5000 €. Something very special is a high number (4500) of governmental agencies cars, which cost the tax payers 22 million € a year (Fundacja Republika, 2015).

Electric and zero-emission cars (as well as all two-wheelers) should be strongly promoted in the city traffic. The Dearman Technology Centre (UK), the first dedicated liquid air engine facility of its kind, works on zero-emission, high-efficiency auxiliary power unit for use on buses and heavy-duty vehicles, with planned commercial on-road trials later this year (Rawley A., 2015).

3. Autonomic Road Transport Support Systems

Nowadays ICT is leading changes in many aspects of city life, including radical new approaches to urban transportation. ICT has emerged as a transformative force, shaping the form and role of cities around the world. Smart cities turn to ICT and data-driven approaches that increase their efficiency and boost their sustainability. As mobile technologies allow greater levels of interconnection, data from vehicle-based sensors can be aggregated with that from fixed infrastructures, such as traffic lights and cameras.

One of the most important changes in transportation is the automotive industry’s push toward autonomous driving. Many major automotive manufacturers have autonomous vehicles on their agenda, beginning to shift their business models from selling cars to providing mobility services. An autonomous and interconnected transportation ecosystem can greatly reduce all of the current transport related burdens and create many environmental, societal and economic benefits. In Europe alone, traffic congestion cost 130 billion € per year, and road transport makes up 20% of the continent’s total CO2 emissions.

A current societal problem is the frequent failure of road transportation networks, resulting from traffic incidents, system overloading and lack of optimized support systems. The aim of COST action TU1102 “Autonomic Road Transport Support Systems” (COST, 2015) was to align groups across Europe from computer science, engineering and transport studies into a world leading research community that will develop new ways of designing Road Transportation Support (RTS) systems based on the ideas of autonomic systems – to deliver savings in the cost of system configuration, maintenance and infrastructure, while potentially improving network efficiency and reducing the chances of human error. For the road safety improvement, results of UDRIVE (UDRIVE, 2015) EU research project, the author participates in, will be also very helpful.

Automated vehicles have crossed the United States in self-driving mode and have undertaken long distance motorway and arterial trips in Europe and Japan. From a technical point of view, current technology for highly automated driving in controlled environments is quite mature. These vehicles use the sensors (radar, lidar, GPS and camera vision systems) combined with high accuracy maps allowing on-board systems to identify appropriate navigation paths, as well as obstacles and relevant signage. Some manufacturers have announced the arrival of highly automated and possibly fully automated vehicles by as early as 2017 (OECD/ITF, 2015).

So, promoting the environmental friendly travel modes we should not forget car drivers needs and have to understand that in the near future the autonomic systems for personalised mobility services will serve also autonomous cars. Autonomous, self-driving vehicles will affect transport planning decisions such as road and parking supply, as well as public transport demand. Autonomous vehicles within a decade or two will probably enable a doubling of highway capacity, but may be restricted only to special, non-general-purpose traffic lanes. In 2040s autonomous vehicles are likely to represent approximately 50% of new vehicle sales, 30% of the total vehicle fleet and 40% of total vehicle travel (Litman T., 2014). Even now basic cars have 30 or more computers (some luxury cars more than hundred – electronics represent 15-20% of their cost) and we have to make a good use of it for improving the city environment (Williams B., 2014).

At present major carmakers are working on their models of smart and connected car while the US Department of Transport (USDOT) wants to make them mandatory by 2017, all convinced of the benefits and potentially big impact they will have on safety, mobility and the environment – test results show a range of fuel reduction between 4.5 and 25.1% in cars and 2.4 -15.3% for trucks (Castermans J., 2014). Another USDOT program Real-Time Information Synthesis (AERIS) shows that the application itself can provide average fuel savings of 5-10% per vehicle, what makes annual savings of 170 USD for cars and 280 USD for SUVs, based on vehicles driving 8 000 miles per year on arterial roads (AERIS, 2014). Big energy savings can be done also by using the smart street lighting. Solid –state lighting solutions offer significant energy savings over HPS by both eliminating light spill and delivering more effective and uniform lighting with lower overall lumen output. In Edmonton (Canada) streetlights account for 21% of the city power consumption and now they try to reduce this by 40 to 50% (Bullough J. D., 2014).

Autonomous driving promises many benefits: improved safety, reduced congestion and lower stress for car occupants. The move towards autonomous driving involves different technological configurations. Some rely on greater connectivity between cars and between cars and infrastructure. Others rely more on vehicle-embarked sensor platforms and require little infrastructure investment. Both models require precise digital representations of their environment, including high definition maps. Self-driving cars may be deployed in fleet-wide systems that would fundamentally reshape individual travel and have an impact on industries such as public transport and taxis. The problem is, vehicles with automated driving systems that are introduced in the next few years will not be perfect and will still be present on roads for years after they have become outdated. To avoid it the author will suggest: buying a new car one should receive a license on exchanging an updated smart module free, during next 5 or 10 years.

Some test areas where automated systems are in place under controlled conditions are in La Rochelle (France) and in Wimbledon (London), and some are going to be announced and developed in the next 2 or 3 years. People in cities will shift from using private transport to using self-driving public taxis, as fleets of shared, low-speed electric cars are introduced over the next decade. That fleets of on-demand driverless vehicles (Fig. 2.) will pick people up from their homes and connect them with public transport networks. In Kivisto (Finland) in August 2015 four electric driverless Citymobil2 buses (each carries 10 passengers, most of whom have to stand) operated autonomously on a one kilometer route for pedestrians and cyclists,which was closed to other traffic (ERTICO, 2015).

Fig. 2. CityMobil2 project has already trialed self-driving vehicles in La Rochelle (France) and is now doing so in Lausanne (Switzerland).

Self-driving cars operate at speeds of up to 30 km/hour, they run on electricity from renewable sources, and they can talk to the road infrastructure as well as to each other. The vision is that wide-scale adoption would not only make transport in cities cleaner and safer, but also free of traffic jams, as the flow of traffic could be controlled centrally, a bit like air traffic control. Now the big challenge is to set up a transport cloud, whereby vehicles and infrastructure can share information about events and conditions so that vehicles are able to anticipate any increased level of risk and organize themselves accordingly. The digitally available information about the road infrastructure will be as important as the signs posted along the roads in the future.

So, the traffic rules in the 1949 Geneva Convention, and later the 1968 Vienna Convention, will need to be changed. The problem is that usefulness of the crash data we've been gathering for many years is limited in many ways because new technologies are behaving very differently, and it will be difficult to decide who's at fault in case of automated car traffic accident: carmaker, software or a driver.

At current levels of technology the term self-driving car can refer to a range of quite different vehicles:

A. Slow-moving robotic pods are the closest to becoming a reality, and versions of these vehicles are already being tested under controlled conditions in European cities. They are relatively low-risk as they move at speeds up to 30 km/hour
B. The next stage of automated cars is likely to be hybrid vehicles, where drivers will be able to hand over control once the car has reached automation compliant roads, such as sections of motorway that are equipped with the infrastructure needed to enable cars to monitor traffic conditions

C. The final stage would be cars that can come and pick passengers up at home, and take them to their destination without any input. At current levels of technology, these are still relatively far in the future.

And what about next achievements? Will we need in a further future any transport system except pathways and maybe bicycle routes for recreation? Will teleportation (the ability to arrive without traveling) make a dramatic change in the city landscape – no roads, no railways and airports, no cars, trucks and trains? Maybe this science fiction will come true before the end of this century.

The basement for teleportation theory was formed in 1993 by Charles Bennett of IBM's T.J. Watson Research Center in his paper "Teleporting an Unknown quantum State via Dual Classic and Einstein-Podolsky-Rosen Channels" where he demonstrated how to link two particles together a certain way and keep them linked even at great distances. Teleportation technology progressed rapidly since 1993 and it is now tested in the labs. In 2013 a team led by physics Alex Kuzmich (Georgia Institute of Technology) demonstrated a practical form of information teleportation by entangling a computers atoms and photons (particles of light) on demand (Powell C. S., 2014). In 2014 Prof Hanson's team (Delft University) showed for the first time that it is possible to teleport information encoded into sub-atomic particles between two points 3 meters apart with 100% reliability. The demonstration was an important first step towards developing an internet-like network between ultra-fast quantum computers whose processing power dwarfs that of today's supercomputers. There are some 10^29 matter particles comprising a human person, each of which has position and momentum degrees of freedom in addition to spin. One have also to teleport the photons, gluons and other energy particles comprising a person. Quantum computers will exchange information via a quantum phone – a device capable of sending and received quantum messages (Prigg M., 2014).

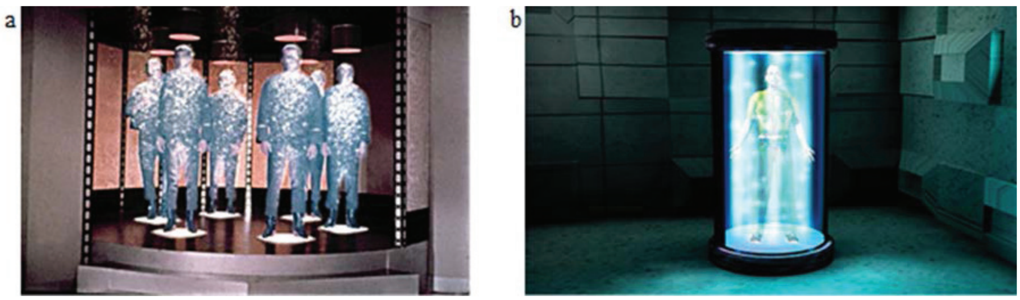

Fig. 3 (a) Teleport in a Star Trek style (Foto: Paramount/Everett Collection) (b) Personal tele-pod (Foto: East News/Science Photo Library).

In the first stage teleports (Fig. 3a.) could work like a Park and Ride system today – some in a suburban public transport hubs and some in the city center. Later on everybody will have a personal teleportation facilities (Fig. 3b.) at home… OK – let's leave it for our grandchildren, who will be brave enough to be teleported.

4. Business model for the Smart Eco-travel Planner

Smart Eco-travel Planner (SEP) and its database could be used for implementing sustainable urban transport policy in more efficient way. The real novelty of our travel planner proposal is: it will work on strictly personalized Internet portal, will cover environmental aspects (pollution counting), the participants will be awarded and the business model for cities implementing SEP makes it more economically viable. SEP will provide reliable advising for optimal travel planning, according to: actual traffic conditions, road accidents, road works, public transport problems in operation and air pollution observed - taking into account also personal circumstances. The results of TrafficCheck.at (the project funded by the Austrian ministry responsible for traffic, innovation and technology) will be followed here. With their smartphones, TrafficCheck contributors can track their positions on OpenStreetMap while underway and select the signal-controlled intersections they wish to rate. They enter their transport mode to provide information on whether the rating comes from the perspective of a car driver, cyclist, pedestrian or public transport passenger. The crowdsourcing contributors will then report problems or enter the score, rating from 1 star for an intersection regarded as bad to 4 stars for one regarded as satisfactory. The score is based on factors such as waiting time ,visibility, conflicts between road users and system layout (Koesling S., 2014).

Personal needs, habits and limitations should be uploaded by each system participant to the Personalized Internet Portal (PIP) which will cover the following data: home and workplace locations; working hours; other obligatory trips (taking children to school, sport activities, church, etc.); public transport season ticket (if any); using own bicycle or a city bike; accepted cycling and walking distance (depending on weather conditions); car type (for calculation emissions – or e-car); location of favorable P+R; membership of a carpool team or a car-sharing system; accepted travel time limit and accepted travel cost.

If something unusual happens (have to take a car because of a heavy luggage, etc.) PIP should be informed before. Before each travel (obligatory during pick-hours from home and work) suggestions on the most suitable travel mode, with detail route description (in case of public transport – what time at what bus stop, where change for metro; also best route for cycling and walking) is available on ones PIP or a smart phone or navigation system. Those choosing car will get for their on-board navigation an optimal route, according to actual traffic constraints and air pollution in particular area. Using e-car or car instrumented for eco-driving, and following suggested guidance will be awarded.

In each city several stakeholders should be involved in SEP implementation for fulfilling the following tasks:

- Individuals: to inform PIP on travel needs and try to follow social behavior principles
- Big companies (workplace providers): to promote tele-working, decrease capacity of parking lots, participate in public transport season tickets cost, provide cycling infrastructure (a shower, etc.)
- Public Transport Authority: to improve quality of operations, adjust capacity to demand and inform Traffic Management Center on-line on public transport vehicles location
- Traffic Control Center: Avoiding traffic jams (alternative routes), informing on-line on traffic constraints, parking capacity and sectoral traffic speed
- Environmental Dpt.: to inform on-line on air pollution in particular areas
- SEP operator within Traffic Management Center: to gather and proceed data, advice individuals, coordinate public transport and road traffic
- Media: to promote idea of sustainable transport using celebrities and individuals with their success stories
- City Hall: to implement sustainable transport policy measures (including MILU) and calculate gains of changing drivers behavior.

The Business Model idea for SEP implementation looks like that. Financial Div. of the City Transport Dpt. calculates gains of the lower car use taking into account: lower costs of road construction and maintenance, new work places, shorter travel times, better city environment, better inhabitants health and a Green City image - minus costs of SEP implementation. I believe there will be some profit which should be used for: further improving of environmental friendly travel modes (public transport, P+R, cycling, etc.); tax relief for participating companies and, what's crucial, for the incentives for individuals (everyone gathers points for each eco-friendly choice): free public transport season tickets, access to the „rare goods": best kindergarten, star concert free ticket, etc.

Rules of competition for individuals (SEP users) are a part of the city Business Model:

- Each travel mode decision is calculated in PIP – comparing with using average (for the city) car emissions during pick-hour.
- Social cost (covers: emission, noise, other travelers time losses, risk of traffic accidents) of each travel is measured in Euro and changed on points.
- Using a car with higher emissions one receives minus points, when travel by e-car, a new car, on alternative fuels, etc. is awarded with plus points. Higher number of plus points you'll receive choosing public transport modes, cycling or walking.
- Those with the highest points number are periodically awarded and presented by media.

The III commandment of my Decalogue ("Fuel price can never go down"), published in Polish (Malasek J., 2011; Malasek J. et al., 2012) and in English (Malasek J. et al), is a powerful tool for supporting eco-friendly investments in urban transport. During last 3 years fuel price in Poland dropped by 26.7% i.e. by 1.58 PLN/l – ca. 0.8 PLN/l on average during last 36 month. As Polish drivers buy per year ca. 19m m3 of fuels they paid during this period ca.45bn PLN less. Assuming that the fuel price will not decrease and these gains are kept on eco-found account, construction in Polish cities of 500 km of rail rapid transit + 2000 modern trams or 900 km of urban expressways, as by-passes for decreasing the through traffic.

Quite comprehensive SEP system (as presented above for the year 2030) will cost more, but its efficiency in changing: drivers behavior, decreasing pollution and improving traffic conditions will be higher. Each city have to decide what quality of TMC, PIP and SEP to choose – according to its budget surplus and expected gains. Cost/Benefit analysis should be here applied.

5. Conclusions

A set of the new tools (in this paper described) for making urban transport more sustainable covers:

- A path for the city management which makes sustainable urban growth possible.
- The Decalogue for Sustainable Urban Transport Strategy.
- Promotion of the car-sharing and Uber-like systems for the more effective car use.
- New environmental tax on registering a car older than 10 years.
- Decreasing the number of company cars for private use.
- Smart Eco-travel Planner with personalized Internet portal for pollution counting and participants awarding.
- "Fuel price can never go down" rule as a money source for the transport environmental friendly investments.
- A license on exchanging an updated smart module free, for making automatic cars more attractive for buyers and better adjusted to the changing Smart City environment.
- Teleportation as the emission-free travel mode in future.

At present the way for urban sustainability is quite clear, however, a lot have to be done. The changes which look to be indispensable form the new paradigm for urban transport management:

1. New EU research projects on urban IT are concentrated mainly on the Smart City issues.
2. Providing by the city a good mobility for inhabitants will be one of the high-tech services aimed in making urban transport system more sustainable.
3. Preconditions for integrated urban transport system (characterized by higher efficiency, safety and environmental sensitivity) are intelligent road, intelligent vehicle and a smart traffic management center.
4. Connected/intelligent car is equipped with a set of facilities and sensors for absorbing information arriving from intelligent road, other vehicles in vicinity and from traffic management center.
5. Further development of transport systems is connected with tested at present automated cars and research on autonomic traffic management systems.
6. ARTS (Autonomic Road Transport Support Systems as a new generation of ITS with artificial intelligence), able to be self-healing, self-maintaining, self-adapting and self-optimizing, will allow the full automation of traffic management process, fighting congestion by the ramp-metering and better traffic distribution on the road network.
7. An autonomic traffic management system and automatic cars will change the street view: no need for traffic signals, traffic signs and the sign posts. Traffic automation will make vehicle platooning (vehicles densely packed while moving: bumper to bumper and side by side) possible, for better utility of a road space. Road painting will vanish.
8. Narrower carriageway will form better traffic conditions for public transport (additional space for tram tracks or a busway), cyclists and pedestrians (high speed people movers) – also more space for greenery, coffee gardens, etc. Streets will be more livable.
9. Automation of traffic management and smart vehicles will radically improve the road safety – Vision Zero (no fatal traffic accidents) will come true.

10. The city terrorism observed at present calls for special concern on transport system protection against hacking of Traffic Management Centers and automatic vehicles – taking remote control over train/metro or a car full of explosives is now possible.

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