Intelligent Transport System

Why should Building Physicists, Architects and Urban Designers Care?

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ABSTRACT

Urban traffic systems can be called intelligent if they react on changing circumstances with problem solving strategies. Unintelligent traffic systems create problems, enhance problems not only in transport, but also in economy and urban structures. They are damaging and destroying urban structures, social connections and economic stability. Pedestrians, cyclists and (to a certain amount) public transport are intelligent urban traffic systems. They are socially agreeable, environmental-friendly, flexible and - if they are not operated with high speeds - sustainable. Traffic itself is not the goal, traffic itself is a mean. Intelligent traffic systems are therefore dependent on intelligent urban structures. If urban structures are shaped in an unintelligent way as it happened in the 20th century by individual optimization of cars and human activities on every place, intelligent traffic systems are not possible any more. Precious urban space, was occupied not by the intelligent but by the powerful and ruthless car user. Caused by the fascination of effortless individual mobility, urban and transport planning created a word for cars and not for human needs. Traffic management removed obstacles for free car movement, but put barriers for all nonmotorized modes and public transport. The result was the unintelligent city, totally dependent on continuous inflow of fossil fuel. During this time period decisions and planning principles have not been built on sound-scientific background, but on unquestioned extrapolation of individual experiences, on observations of symptoms without any understanding of the deep inner mechanisms between man, city and traffic. Scientific findings from the last 30 years show the necessary basic paradigm change toward an intelligent traffic system embedded into an intelligent urban structure.

1   THE BURDEN OF FORCED MOBILITY

The city was the solution of the society to get rid from the burden of forced mobility. The city was the artificial body, where people could find the greatest possible variety of opportunities with the lowest amount of energy for physical mobility. The urban structures based on these principles are the wonderful and attractive medival cities in Europe but also in other parts of the globe.

Fig. 1 The City of human scale

These cities are characterized by high density, huge variety of activities, limited public space, but multifunctional use of it, mixture of activities in the same buildings and special patterns of places and streets connecting these places. Whether it is Vienna, London or the walled city of Delhi we find everywhere the same human scale and the same principles. These cities are the result of 10.000 years of urban development on a human scale, reaching its peak in the medieval age. The key attribute of the city is their inner beauty, the combination of places and narrow streets, the interwoven green parts and the beauty of the architecture of the building.

Six million years of adaptation, 10.000 years of urban development

To understand the behaviour of systems, it is necessary to distinguish between observation, behaviour and structures.
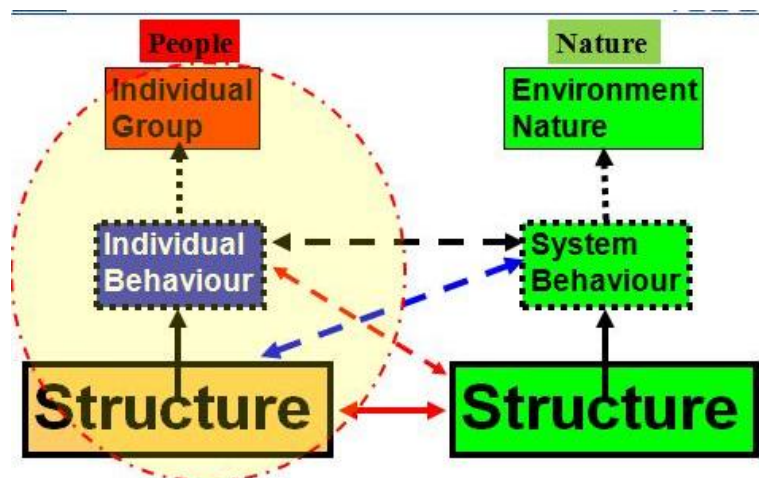

Fig. 2 Basic relationships between man an environment

What we see and collect as different data from observations is a reflection derived from behaviour and the behaviour is always determined by structures. Most time of human evolution our ancestors were dependent on the behaviour of the surrounding environment. They had to learn to adapt to the natural system by trial and error and finally they developed their neo codex to get a better understanding of the environment, the family members and finally other groups of people (a process which is still not finished as the actual tragedy in some countries show). With increasing technological development people were able to change the environment by technical means more and more. The final outcome of urban settlements were villages and cities.
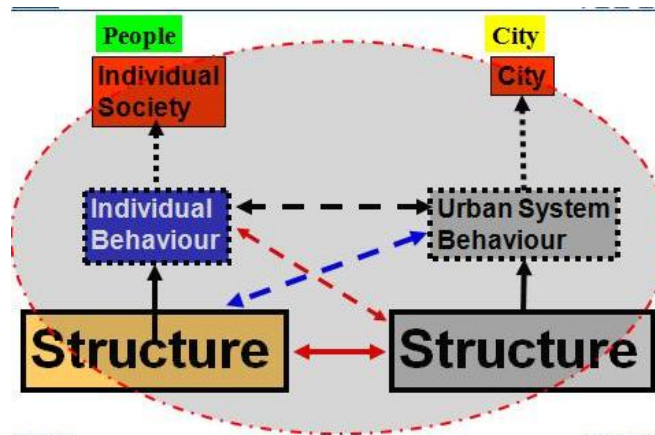

Fig. 3 The Process of Urbanization

The urban structures determined the urban system behaviour, which determined the human behaviour also in the transport system. This kind of urban structures we find in the famous remaining cities from this time, around the Mediterranean Sea, the walled city in Delhi with their wonderful market offering all the daily necessary goods and services for the urban population. The secret is that everything has to be arranged within the walking distance. The walking distance was determined by walking speed of people. People can only use about 8 % of their body energy for physical movement, 66 % of their body is water and the common walking speed is about 2-5 km/h. The maximum speed on a short distance is a little bit more than 36 km/h. Their sensual abilities are therefore only optimized for this range of speed. Speed and power were not the strength of mankind. The advantage of mankind was their high mental mobility. Mental mobility by designing urban structures compensated the need for physical mobility for the residents. This was the intelligent city.

The miracle of effortless speed

Six millions of years the normal speed of the transport system on land was the speed of the pedestrian, but in the 19th century the situation changed dramatically. By using fossil fuel in steam engines and building railways the travel speed along railway lines exceeded more or less suddenly the human evolutionary experience.

Fig. 4 The fundamental change of the transport system since the 19th century

At the beginning of the 20th century the private car provided its use with the individual opportunity of a speed far away from human normality. This technical progress was so fascinating for planners, politicians and the society that they have never thought about the adverse effects of this fundamental change for the experience of space and time and the city.

The basis of traditional transport and urban planning: unproved assumptions.

Traditional transport and urban planners believe that there is a growth of mobility with increasing motorization, they believe on time saving by increasing speed and on freedom of modal choice for the individuals. These are the basic traditional myths which paved the way to the problems of today. They became blind for all kinds of mobility beside the car. They didn't recognize the needs for pedestrians, for cyclists and public transport. They were only trying to fulfil the needs for car users. Therefore they only counted car trips. This was their kind of "mobility" and they find really empirical evidence that with increasing wealth and increasing motorization the number of car trips was also increasing. They haven't understood why trips outside of homes occur. Every trip outside of home has its cause in the needs of the demands in the home. Therefore each trip outside of the home has the purpose to compensate the deficits of the origins and the destinations. Physical mobility is therefore always the expression of structural deficits. The number of purposes in the society is constant. Therefore the number of trips in the society is only related to the number of people since the average number of trips per person is constant (about three to four trips per day).
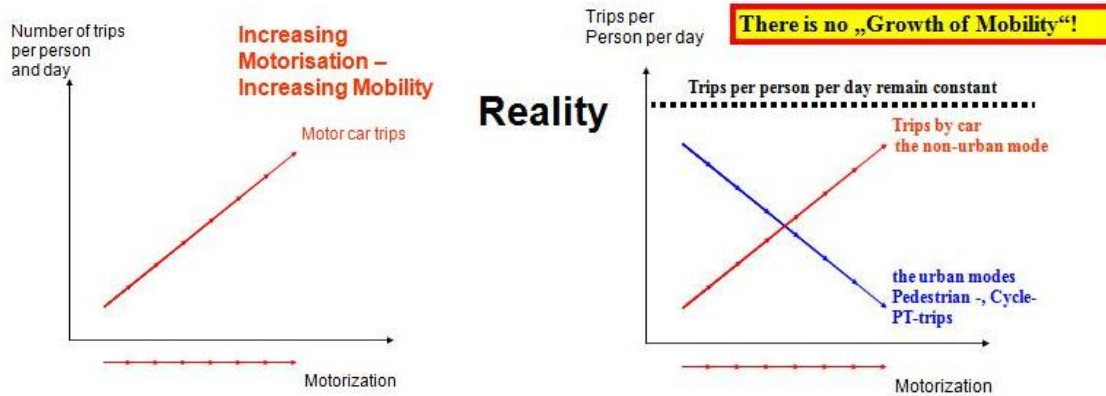
Figure 5: The Myth (left) and the Reality (right) of Mobility

If we look to the whole picture of human mobility we recognize that there is no growth of mobility but only a change of modes. Each car trip is compensating a pedestrian, cycling or public transport trip. Therefore the belief on growth of mobility was a mistake.

No travel time saving possible in the system

To save time by making transport systems faster has damaged our cities in the most dramatic way. It began with the widening of carriageways and ends with the damage and breaking down urban centres for urban motorways like in Shanghai.

Figure: 6 The "City Center" of Schanghai today

It is obvious that we can prove that the increase of speed reduces the travel time of a same trip between the origin and destination if they are fixed. This is the basis of traditional calculation of benefits for investments for faster transport systems. These benefits are based on the calculation of time savings.
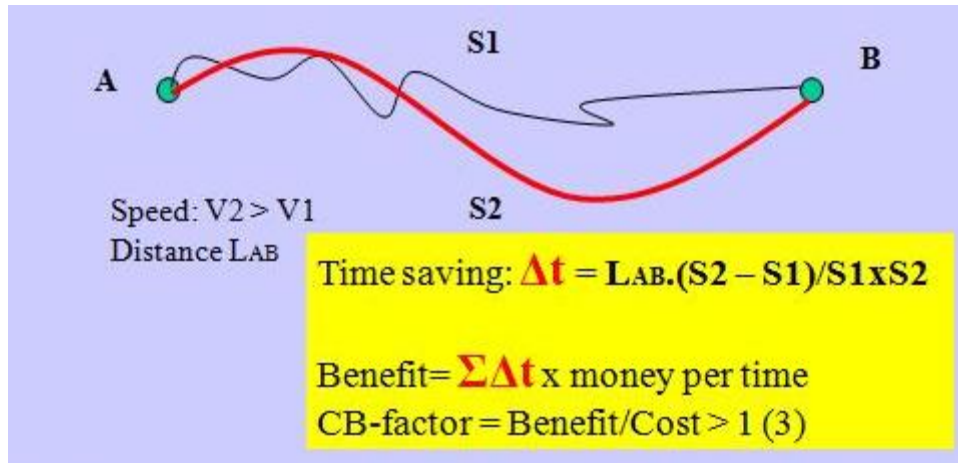
Figure 7: How "Travel Time Saving" is calculated in traditionale transport ant urban planning

If time savings would be real the faster transport system user must save time compared to the slow pedestrian or cyclist.

Empirical evidence on the local level shows worldwide that car drivers with a speed five or ten times faster than pedestrians have the same travel time distribution like the slow pedestrians.
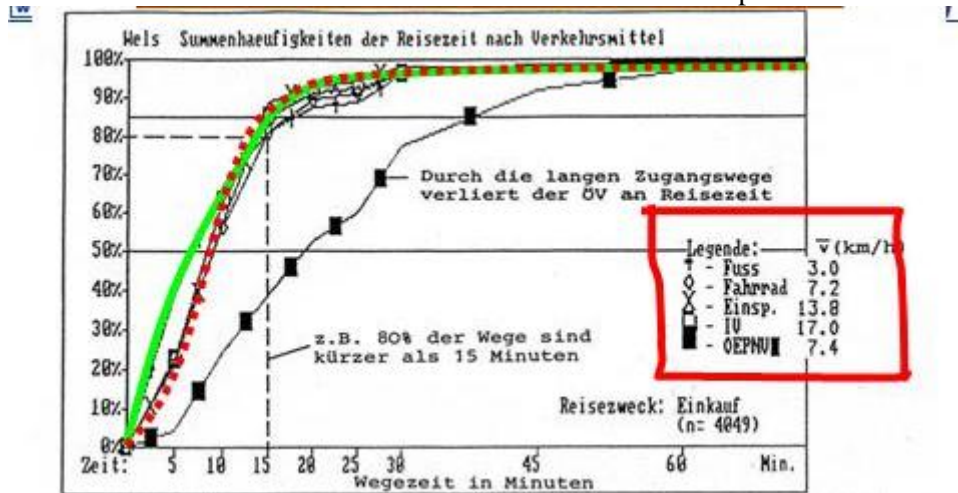

Figure 8: There is no difference in travel time distribution between slow and fast individual modes

They obviously cannot save time in the system. The travel time budget is a constant globally. It has been proved by analysing surveys in societies without cars and in high motorized societies like we have them in the northern hemisphere. If we would be able to save travel time non-motorized societies must have a much bigger travel time budget than the fast society. But this is not the case. Travel time is the constant in the system, independent whether the society is motorized or not. And this has tremendous effects on the understanding of urban planning, urban structures, the local economy and the environment. Since we cannot change travel time the system is always adapting its structures in accordance to the speed of the traffic system.
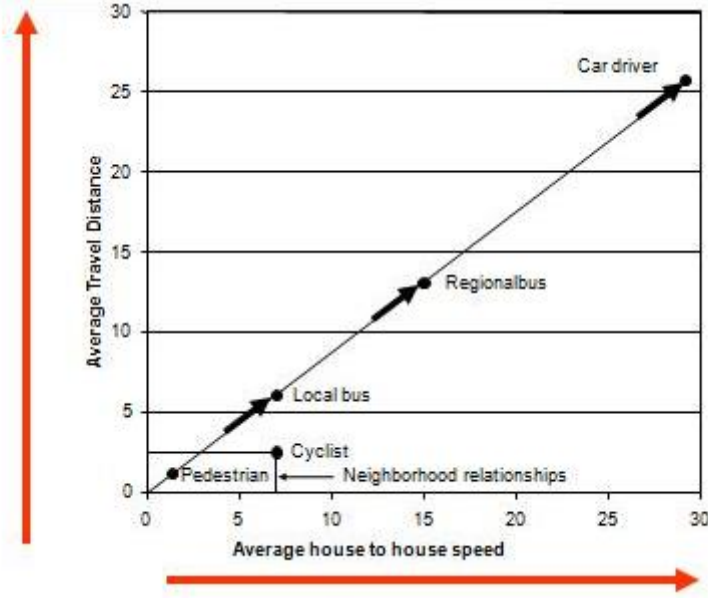
Figure 9: The reality of system behavor: Speed change urban sstructures.

It was the pedestrian who forced planners to develop an intelligent traffic system and it is the car who let them escape from this burden by damaging the cities, the human scale, the environment and the local economy. If traffic speed is increased the system changes its origins and destinations. Two effects are easily visible:

1) urban sprawl in an uncontrolled manner happening everywhere on the globe when societies are motorized and
2) the concentration of economic activities on few points damaging the sensitive local optimal adopted shops and workshops and destroying local business and working opportunities.

Finally the high speed changes the political system toward the benefits and dictatorship of international corporations dominating democratic social structures and the cities. Before car traffic came in use, companies had to compete to get the opportunity to settle in the cities. Today the fast transport system has switched the situation in the opposite direction. Cities are competing for international corporations, which have only one goal: exploit everything for the own growth.

Urban sprawl and concentration is therefore dominating in modern urban planning, it is the expression of the ignorance of planners about a healthy human scale city and the future development of mankind. In their blindness this kind of planners see only the effects and recognize the appearance of so-called megacities without knowing what is the cause of these increasing disparities between countryside and cities.
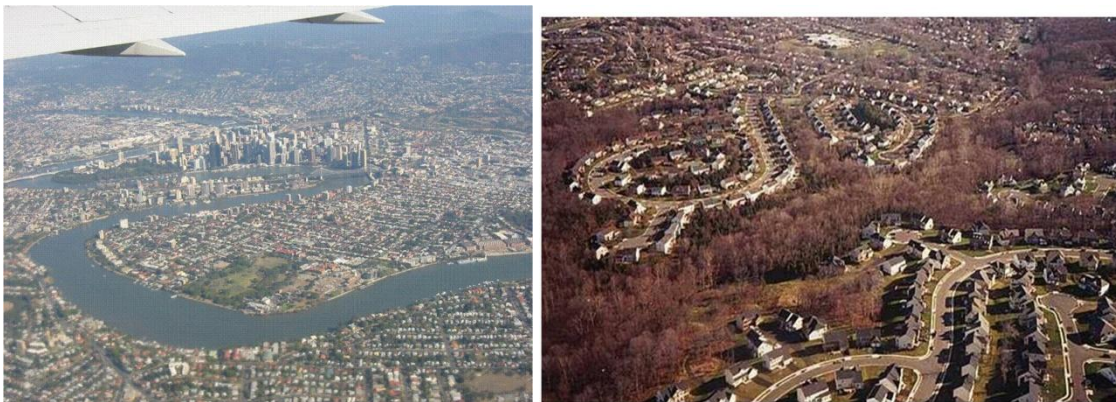

Figure10: The city of high speed, the city built for and around cars.

Nothing is more boring than urban sprawl settlements characterized by mono- functional structures. There are no shops, no working opportunities, no leisure opportunities, no cultural activities around. If somebody has no car he has to walk for long distances across a traffic system which is not adapted for humans but for cars.
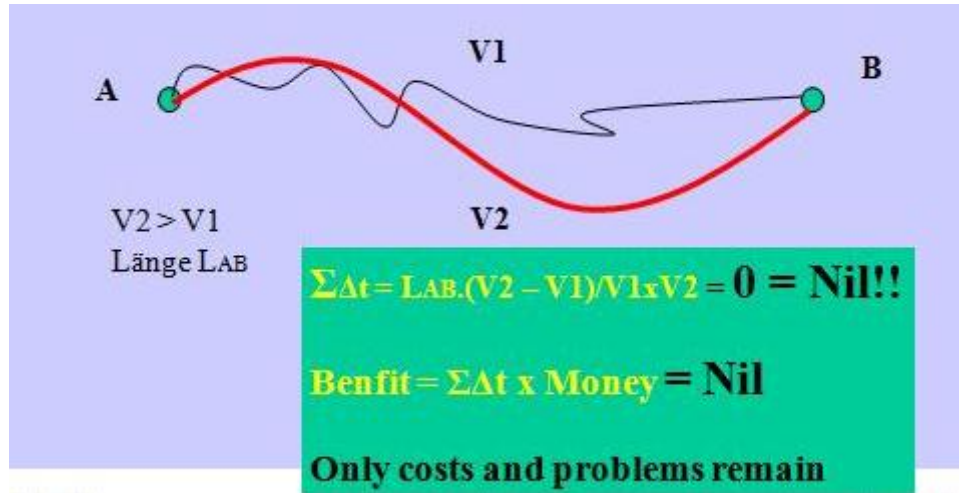

Figure 11: The reality of the System: No travel time saving by increasing speed.

Calculations based on travel time savings are therefore wrong. They are sheer nonsense. Transport systems cannot save time by increasing speed. They can also not loose time by decreasing speed, for example by congestion. Congestion is not the problem as it is called popular, congestion is the expression of the extreme high attractivity of car use. If congestion would be a problem, nobody would be there.
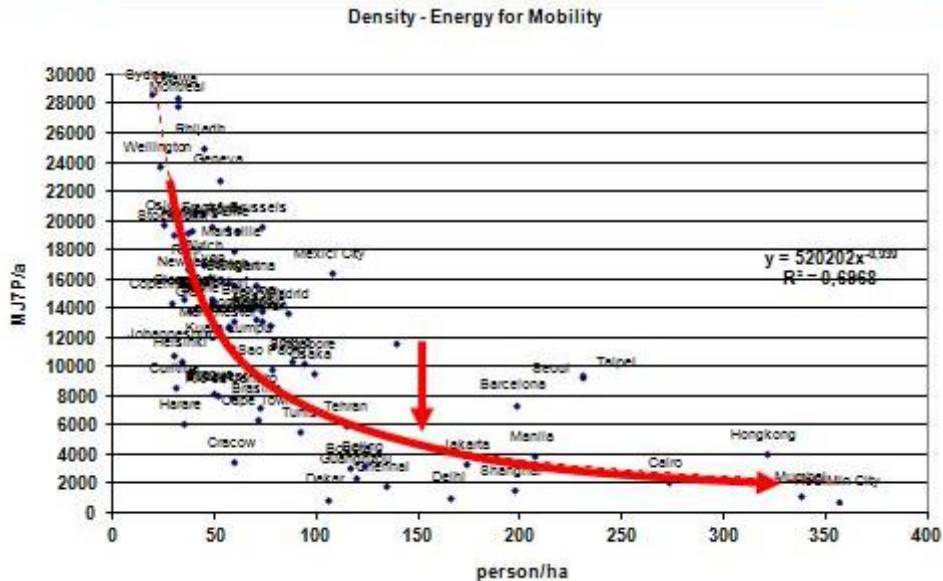

Figure 12: Urban density and energy for mobility

Cities with fast transport systems need exponential increasing demand of fossil fuel. If the urban density goes down under 150 people per hectare urban sprawl is beginning to destroy the urban structures. These structures can only be kept together by the continuous inflow of external energy. This can be fossil fuel, LPG or electricity, it makes no difference since energy destroys the compact, rich and beautiful urban structures.

Intelligence or ignorance can be easily tested by using the basic relationship between Flow, Density and Speed.


Figure 13: Basic relationship between flow, density and speed

This is also the formula to calculate the amount of energy in the transport system. Since energy was no available the people were forced to develop intelligent urban structures with high density and low speed before cheap fossil fuel came in use. This is the characteristic of an intelligent city. But as soon as energy for mobility became cheap and abundant, urban planners and transport planners have lost the ability for the sustainable city by decreasing the density, separating the functions of the city and introducing high speed in transport systems. This is the formula for the endless production of urban problems.
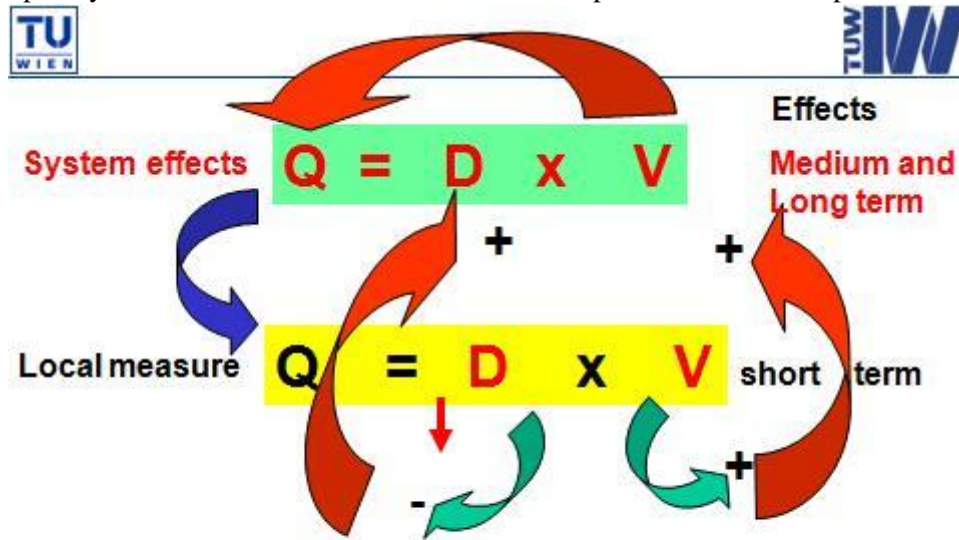
Figure 14: How Transport Planners produce transport problems continuously

The contribution of transport planners is the continuous growth of congestion by building more lanes and more roads, when congestion occurs. They reduce the density by providing more capacity, the speed goes up locally but also in the system and the system is becoming more attractive for car users, which enhance the number of car kilometres in the system and finally we have congestion on a higher level. Traditional educated transport planners are totally ignorant about system behaviour. They are counting trips between origins and destinations for example between two cities and if this number of trips is increasing they build new traffic opportunities. But if they would know what they are doing, they would recognize that they are destroying the urban structures in both cities, because the number of trips in a system is constant and each trip counted outside is the indication that the cities have lost destinations inside. Increasing traffic means decreasing destinations nearby. It is the clear indication that urban structures are degragated.

Effect on urban development

With the upcoming of cars cities were not planned and built for the needs of people anymore. Cities were planned and built for the needs of cars and around the cars. The visible structures are private parking places in front of the houses, the garages in front of the blocks and in front of all economic activities, shopping centres for example. The effect of these stupid and unintelligent urban structures are congested roads everywhere on one, two or three levels. Instead of analysing and understanding system behaviour, transport planners and technicians try to find a solution by implementing so-called intelligent transport systems. This "intelligent" transport system tries to enhance the speed, makes car use even more attractive and is therefore the so-called electronic tool to maximize transport and urban problems instead of solving them. ITS is therefore a misleading term, it should be called NITS - non intelligent transport systems, which is really their effect if they are implemented.

The core problem: the organization of parking

Parking at origins and destinations produce car drivers and destroy intelligent transport traffic systems. Each parking space destroys 10 square meters of shopping areas in the city as it has been proved in Japan. And the Americans who have never known what is a real city are producing agglomerations with separated activities in an endless desert of parking lots. The car at home compensates everything which should be in the neighbourhood, shops, recreation, social contacts, culture and even friends.

Figure15: Parking at origin and destination (left) is the cause of transport and urban problems (right)

How the car comes into the core of our brain

Acceptance of walking is decreasing with increasing distance exponentially. The mathematical function was observed by analysing the behaviour of bees and discovering the so-called "language of bees" by Karl von Frisch.
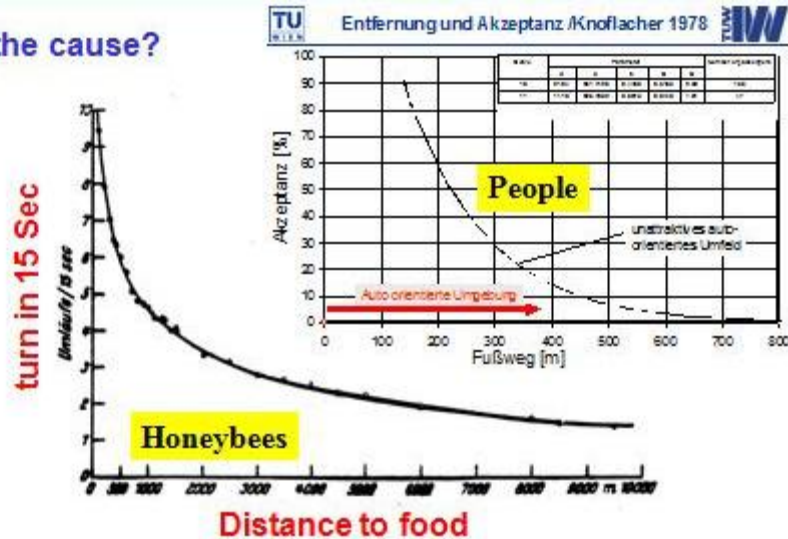
Figure 16: Fundamental law of distance and acceptance

This was the key to understand real human behaviour in the artificial environment. In both cases the key indicator was body energy consumption. People as well as bees (like other living beings) try to save their own body energy, which is a life supporting behaviour. And the car is doing an excellent job in this respect. Car drivers need only half of the body energy per second compared to a slow walking pedestrian. And they can drive a speed far out of reach of the pedestrian speed. This is happening in the brain, where on the deepest level of our brain energy registration and calculation is happening. The car slips into this oldest evolutionary level of our brain and switches everything toward the needs of the car. People are changing their values, they are building structures for cars and they give up their culture of humanity for example not making harm to others.
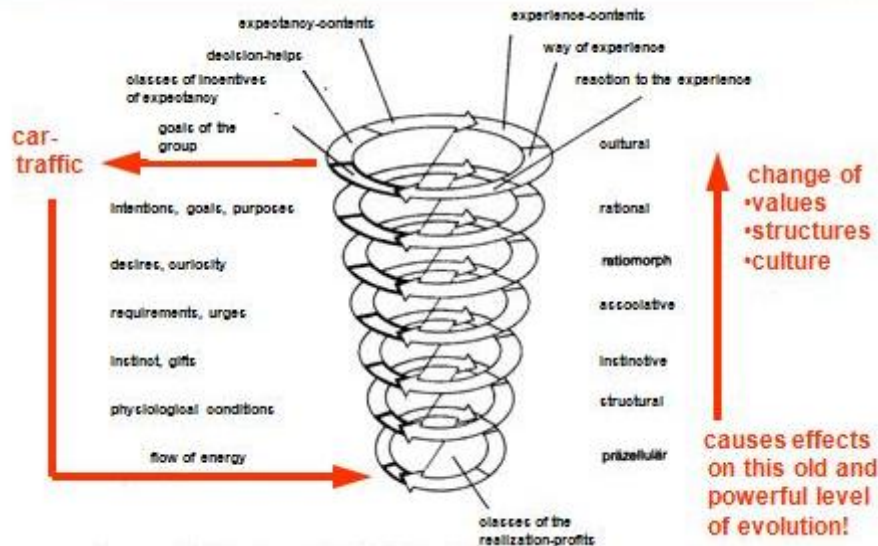

Figure 17: How the car goes into our brain

The car sit in the brain of planners and decision makers of the 20th century and controls the urban development and transport system, because the administration provides each house or apartment with a parking place and they provide car lanes to each building and finally somebody not doing this has to pay a

high financial compensation for parking places not built. This creates the various effects of cars and shows that the responsible people in the urban and transport system are blind for the reality.
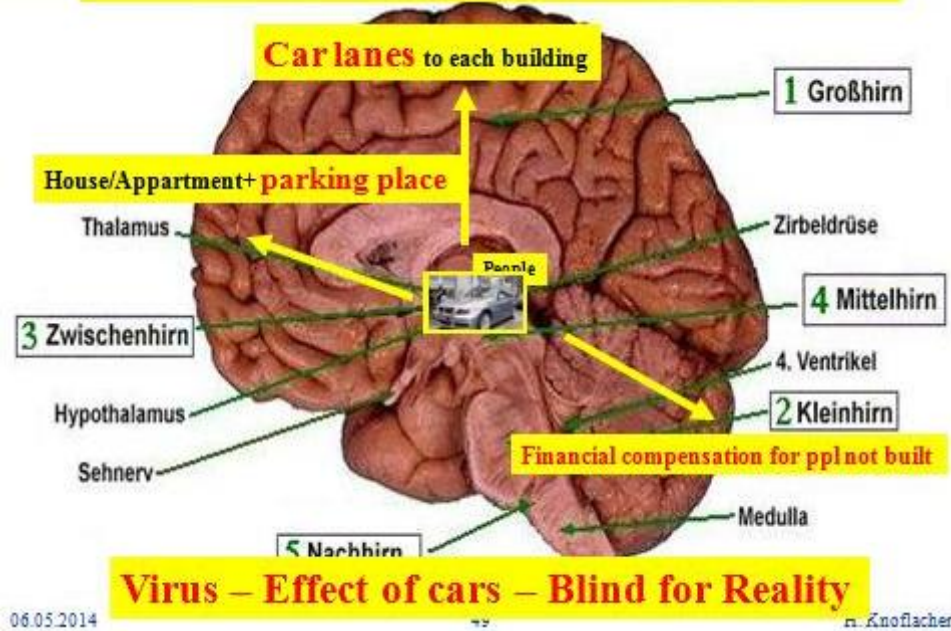

Figure 18: The car in the brain control human behavior

The legal base in Europe at least is the so-called "Reichsgaragenordnung" from Hitler from 1939. §2 which is still a part of the building codes in most of the European countries forces everybody to provide enough parking places for each apartment, workshop, shop, etc. This creates the unintelligent urban structure, as an expression of built ignorance with the following attributes:

- at the origins and destinations parked cars everywhere,
- carriageways to each location and no pedestrian facilities,
- no facilities for cycling and no public transport stops.
- The dominating information system is for the benefits of cars and nothing else.

This non intelligent urban structure creates the transport system in which pedestrians cannot move freely to cross the streets everywhere, in which public transport stops are not easily accessible and they are separated by wide lanes and barriers for the intelligent transport modes everywhere. The effect of the unification of man and car is the total loss of control over the worldview outside. If the car is in the brain, we don't see the environment like a human. We accept everything which is of benefits for the car but we don't recognize the tremendous disbenefits for all other transport users. To make this fundamental change in our brain visible I invented a so-called walking tool, which has the same size like a middle class car to demonstrate how crazy the behaviour of experts, politicians and the society is concerning the so-called car traffic problems.
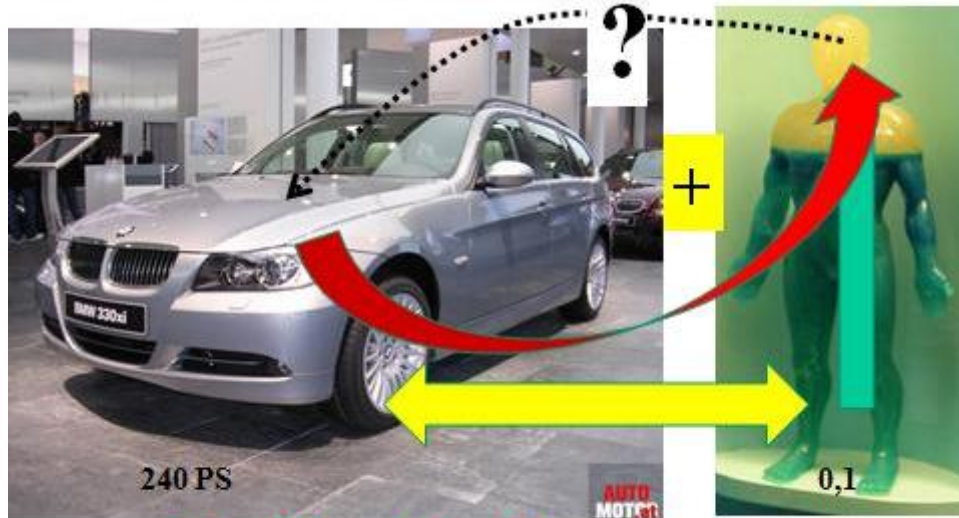
Figure 19: Unification of man and car create a new species: the cardriver

The effect of cars on the city

The urban physics of ignorance is characterized by structures in which parking is provided everywhere on every place without taking care on public transport stops, the needs of pedestrians, children, elderly people and handicaped. Parking organization is therefore the leverage point in the transport and urban planning system.

Figure 19: These structures come from the brain of urban and transport planners

The dominating parking regulations are destroying the environment, the quality of life, the market for public transport, the safe environment, the local shops and finally the cities.

Figure 20: Parking at home damage the urban structure and destroy the public space

They are the expression of solid ignorance and planning stupidity. This behaviour has demolished the share of public transport in Germany, which was 65 % in the 50s to 17 % today. This parking regulation is damaging the city from inward as it can be proved in every European city where we see the dying shops in the urban centres and the appearance of shopping centres outside of the cities pulling the lifeblood of the city, the money out of the urban body.

Measures for intelligent solutions

1) We must remove the car from our brain.
2) The precondition for an intelligent transport system is the intelligent urban system.
3) We must rewrite our housing and parking standards. Apartments, shops and other human activities have to be totally separated from parking places physically, economically and regulatory.
4) Cars have to be parked outside of cities.

The intelligent urban transport system consists of pedestrians, cyclists and public transport and a few amount of car traffic for handicapped people, for delivery and public purposes. This structure is characterized by low energy demand for mobility (less than 5 % of today), plenty of space for free mobility of people for pedestrians, cyclists and public transport.
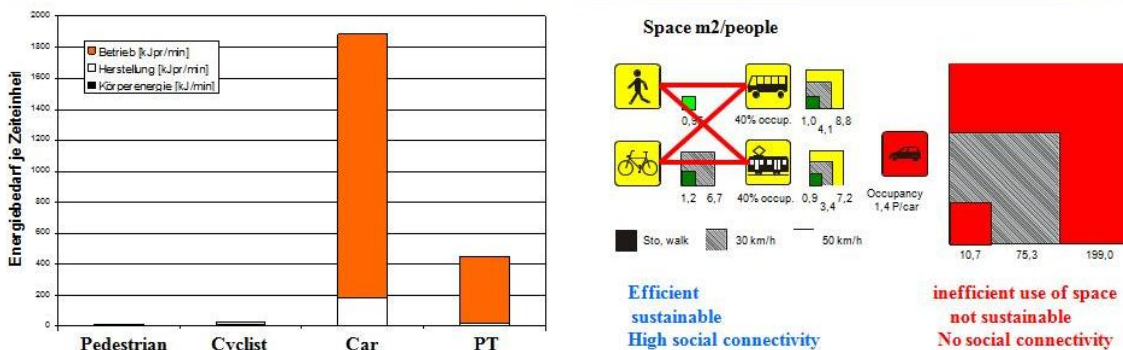

Figure 21: Indicators of intelligent transport modes, pedstrians, cyclists and public transport and the unintelligent car traffic

The key for the solution is a new organization of parking. Public transport stops must be more easily accessible than parking places.
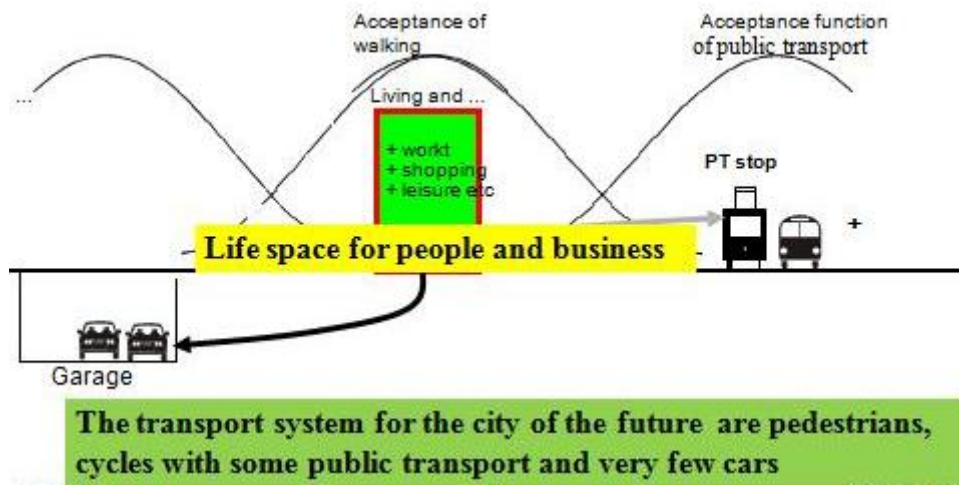

Figure 22: Cars have to be parked further away than the public transport stop

This means parking has to be removed from the surface and from the urban structures to few garages far away or the better solution: remove cars from cities at all, leave the car at the entrance to the city in garages accessible by bicycles and public transport. The effect of physical outer and inner structures on human behaviour can be proved by empirical data. If the distance to parking places is increased, the share of car use is decreasing exponentially – as expected.

The calculation of the expected human behaviour shows that compared to the existing situation by changing structures in the manner as described we can reduce the share of car traffic to 3-15 % of the today volume. This is happening already in cities where these principles are applied. The motorization in the city of Vienna is decreasing continuously since 2002.

Figure 23: How modal spit can be changed in the cities (Vienna)

The share of car trips in Vienna has decreased from 1993 with 40 % to 28 % today and is planned to decrease farther to 23 % by 2020.

Paradigm shift is necessary
The paradigm shift is now happening. We have to replace the old paradigms as described above with the new ones.

1) There is now growth of mobility in the transport system. The number of trips is a constant and is only changing with the number of people.
2) No time saving in the transport system is possible. Travel time is constant, therefore we cannot calculate benefits based on an indicator which doesn't exist. The travel speed is now losing its importance. It is not anymore the guiding indicator, it is a dependent indicator dependent on the environment, the topography and the local situation.
3) We have to take into account the real behaviour of people. Structures determine behaviour and therefore planners and decision makers are responsible for the people's behaviour and not the people themselves. We don't have to blame the people, we have to blame the responsible people providing the society with structures which create the wrong behaviour of people.

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