# Technological Support for Logistics Transportation Systems

Andrzej Bujak, Zdzisław Śliwa, and Alicja Gębczyńska

Wroclaw School of Banking, Faculty of Finance and Management,
ul. Fabryczna 29-31, 53-609 Wrocław, Poland
sliwazd@wp.pl

**Abstract.** The modern world is changing introducing robots, remotely controlled vehicles and other crewless means of transportation to reduce people's mistakes, as the main cause of incidents and crashes during traffic. New technologies are supporting operators and drivers, and according to some studies they can even replace them. Such programs as: AHS, UAH, IVBSS or MTVR are under development to improve traffic flow and its safety, to reduce traffic hazards and crashes. It is necessary to analyze such concepts and implement them boldly, including Polish logistics' companies, new programs, highways' system etc., as they will be applied in the future, so it is necessary to prepare logistics infrastructure ahead of time in order to capitalize on these improvements. The problem is quite urgent as transportation in the country must not be outdated to meet clients' expectations and to keep pace with competing foreign companies.

**Keywords:** logistics, telematics, transportation systems, logistics services Automated Highway System, logistics' technologies.

## 1 Introduction

The contemporary world is changing rapidly introducing robots, remote controlled vehicles and other crewless means of transportation aimed to reduce all the people's mistakes as the predominant cause of incidents and crashes. Moreover, traffic congestion is causing demands for new solutions to improve transportation reliability and the whole transportation system both for passengers and goods movement along highways and cities. For logistics, the transportation is a kind of bloodstream, which is connecting all the participants of the system, producers and final users, even continents and as such is the vital and fragile element. As a result, undisturbed traffic flow and safety are key enablers of an effective transportation infrastructure and system suitable for future needs. Safety issues are mainly the result of human errors, as "ninety percent of today's accidents are caused at least in part by drivers; about 70 percent are caused predominantly by human mistakes and 20 percent have some kind of component of human error that influenced a cause of an accident" [6]. To avoid them, new technologies are increasingly supporting transportation operators and drivers; according to some new research, they may even replace them. Such solutions are under quick technological development mainly in developed countries, as they are

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connected with high cost, technological capabilities and research and development infrastructure. The subject is not new in Poland and many institutions are following the development of such concepts including institutions of higher education, transportation companies and governmental agencies. Among them, the Wroclaw School of Banking is closely following such new trends, as according to new experiments, they will be introduced into logistics transportation systems [8]. Such concepts will be implemented in the transportation structure within 20-30 years as the problem is rather complicated, but the outcome could be profitable for logistics' providers, especially as long-term investment. Such concepts are under constant development in many countries with the USA in a leading role. Moreover, they have both civilian and military applications. Even now, some automated robots and vehicles have been effectively implemented encouraging civilian society and scientists to continue progress in this area. However, not all institutions are able to conduct such experiments as infrastructure and vehicles' systems necessary for tests are expensive, so big investments are needed for progress. As a result, smart highways and new type vehicles equipped in sophisticated sensors will be put into operation basically in developed countries with strong and rich transportation companies, ready to fund research and infrastructure. There are many future related concepts aimed to improve transportation systems. Among them the Automated Highway System (AHS) and Underground Automated Highway (UAH) have been developed and they are under serious research, as they could have promising effects on traffic management. Moreover, they are directly related to employment of enhanced trucks equipped in modern sensors to support the system and people and even crewless vehicles.

The aim of the paper is to present current projects connected with improvement of transportation as an essential part of modern logistics and to elaborate on the main directions of such research. First, the support for the drivers will be discussed, which will be followed by covering new concepts of constructing future highway systems. Next, the programs related to autonomous vehicles will be under study. Such research will be based on case studies, which can present new and broad system wide approaches demanding a comprehensive approach of scientists, national and regional level official organizations, working hand-in-hand with logistics transport companies. What is unifying these partners is the common understanding of the need to improve transportation as vital part of logistics along with their will to invest funds in the short term to realize profits later.

### 1.1 New Solutions to Support the Personnel

New concepts are putting an accent on supporting people to enable better performance during their daily duties. So, such advanced ideas will directly support system operators and drivers. At the same time these ideas will indirectly positively influence logistics companies by improving their effectiveness, safety and reducing costs. They are under constant research especially in developed countries as they are connected with huge costs, modern technologies, high level academic institution involvement and appropriate technical culture. One of the very important issues connected with technological support for logistics transportation is security, which is directly influencing the continuous flow of logistics supplies. There are many projects to improve the situation, which are conducted in almost every developed country, based on regional circumstances, capabilities and needs. Some of them are international in nature connecting educational institutions, national level organizations and also logistics companies to combine funds providers, scientists and final users of new technological solutions. Among many current projects, a very interesting example there is the cooperation of the Transportation Research Institute of the University of Michigan (UMTRI), U.S. Department of Transportation (US DoT) and their automotive and commercial vehicle industries' partners: Visteon Corp., Eaton Corp., Honda R&D Americas Inc., International Truck and Engine, TK Holdings, Battelle, Con-way Freight. Appropriate composition of participants is a guarantee of a very serious approach to the research as every organization is really concerned about the final outcome of the inquiries. The number of the participants also provides a comprehensive approach to solving the problem, which is critical as merging practical experiences and theory is supporting the process to improve transportation with reliable and long-term solutions. The total value of the agreement is about $ 32 million and is focused on "developing and testing a new, integrated crash warning system in a fleet of 16 passenger cars and 10 heavy-duty trucks" [5] in the frame of the Integrated Vehicle-Based Safety Systems (IVBSS) concept.

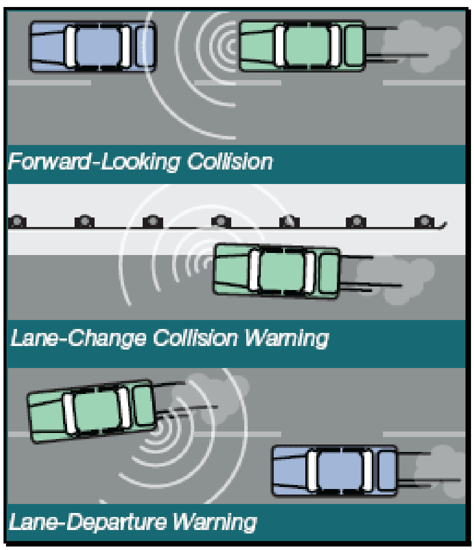


**Fig. 1.** The main road situation researched in IVBSS concept. Source: [17].

Regarding the conceptual phase of the project and research, the university is the essential contributor to the agreement, which is also important as it has all necessary capabilities to develop proper methodology and theoretical background of the project, and later is able to coordinate and to carry out all required laboratory and field tests. The concept is also a comfortable and reliable solution for the other contributors, as their involvement is rationalized based on real needs and complex approach needed to reach their expectations. The main focus of the program is to develop "integrated, advanced technologies that can help drivers avoid crashes" [5]. The research covers dangerous situations for drivers on highways especially when they are: leaving a highway, changing or departing lanes, a risk of collision with a car in front of them or if they are approaching a curve at excessive speed (see Fig.1 and Fig.2). These solutions, supported by inertial, video, radar sensors and GPS modules, will deal with some 67% of main situations leading to collisions, and those situations are rather an important factor causing difficulties for land logistics transport.

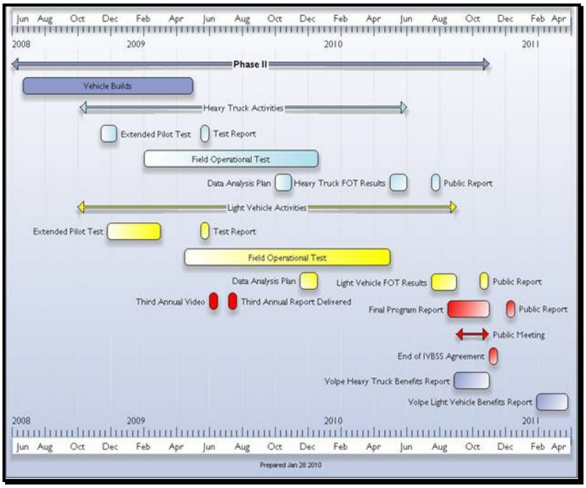


**Fig. 2.** IVBSS Program Roadmap. Source: [5].

In 2008 and 2009 the project was focused on creating and verifying prototype systems, which later were heavily tested to ensure their safety for field trials and meeting basic requirements of the concept. In 2009 field tests were performed. In the case of the heavy trucks (IVBSS-equipped International ProStar 8600-series trucks), operating as a part Conway Freight, Inc. car fleet, 20 volunteer drivers were using them for regular duties over the ten month period. The total driving time reached 16500 hours, covering some 650000 miles (over 1 million kilometers), enabling collection of full travel data for 140000 miles (224000 km), and the rest was performed with all the systems operational. Such tests had one more important feature as they had been performed in the real operating environment including: infrastructure, employed drivers and all-weather conditions. The results and conclusions were presented to the US DoT and business partners by UMTRI in November 2009 as "*Integrated Vehicle-Based Safety Systems (IVBSS) Heavy Truck Platform Field Operational Test. Data Analysis Plan*" [9]. The results are rather promising and at the end of the research the findings will be implemented in designing future integrated systems for vehicles to improve safety, efficiency and reliability of transport for the benefit of logistics providers. Such cooperation is a very good example of effective, focused, comprehensive and joint teamwork of a few varied organizations to support technologically transportation systems. In addition to profit potential this research is also providing other advantages to the companies involved over other transportation providers. For academic institutions it is a chance for their development by getting funds to do it. Not only is the

USA concerned regarding new solutions, also the European Union is heavily supporting transport and logistics improvements "*through research and development projects, thematic networks, concerted actions and integrated projects*"[16] as the importance is clearly understood to be competitive and effective in the future.

## 1.2 Current Driverless Concepts Development

As mentioned before, quality people are the most important resource for any system, but simultaneously they are also the main reason of incidents and malfunctions. As a result, some of new concepts, which are under research, are connected with eliminating people's mistakes by using driverless vehicles, which is also connected with preparing appropriate infrastructure to support them. They are promoted in the frame of the Intelligent Transportation Systems (ITS) and are under research conducted by many well-known academic institutions. For example the Defense Advanced Research Projects Agency (DARPA) organized Urban Challenge in November 2007 at the former George AFB in California as a continuation of the 2004 and 2005 Grand Challenges. The main purpose was to build an autonomous vehicle capable of driving in traffic, performing complex maneuvers such as merging, passing, parking and negotiating intersections. At the beginning 89 teams applied for the competition. Such initiatives are important step to speed up the implementation of new driverless vehicles into traffic and transportation systems, logistics and even for military logistics purposes. During the competition, constructors met three main technical challenges [1]:

- to install drive-by-wire technology in the vehicle and to modify the vehicle to fulfill DARPA safety requirements including equipment to provide electrical power for computers, actuators, and sensors,
- to provide sensing and information fusion algorithms as the autonomous vehicle should be able to sense both vehicle current status, such as: position, speed, direction, environment information, the existence and position of obstacles,
- to provide full control of vehicle based on the fused information, the autonomous-driving system to make the correct decision, apply the navigation algorithm, and properly control the vehicle through the driveby- wire capability. Visual road detection, map-based path finding, and real-time communication between computers were also important issues.

Such competition is evidence that ITS concepts are very important and real future solutions for different purposes and they are naturally enforcing the competition among participants. At the same time, the creativity is not hampered, allowing a search for new nonstandard ideas. Logistic requirements will be very important aspects of new capabilities provided by such innovative concepts. Ohio State University, in collaboration with Oshkosh Truck Corporation, had created Team TerraMax, which constructed an MTVR (Medium Tactical Vehicle Replacement) truck for Grand Challenge 04 being completely autonomous vehicle in order to support military requirements.

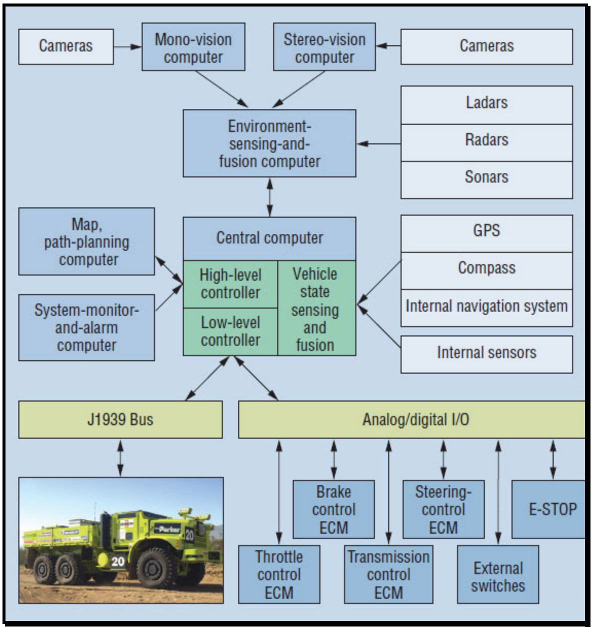


**Fig. 3.** TerraMax's hardware (example). Source: [1].

TerraMax hardware included "*the drive-by-wire electronic actuators, local network, computers, vehicle ego state sensors, and several different types of environment sensors*"[1] (see figure 3), including six computer systems for navigation and control. All the connections "*were virtual links and the connections between computers were linked through a local network, and the connections between computers and sensors via hardware interfaces*" and "*directly connected analog and digital signals*"[1].

Experiments revealed the necessity to upgrade and stabilize the network and inter-process communication especially in more complicated and demanding environments, like built-up areas and crowded roads [1]. So, new sensing technologies including scanning radars are under research along with tests to place sophisticated systems on smaller platforms. These means have the potential to create driverless capabilities for a wider range of logistics services by reducing hazards and crashes, although they are connected with new risks, uncertainty and the uncertain performance in changing circumstances.

### 1.3 New Infrastructure Solutions

To fully operate such systems it is necessary to improve transportation infrastructure especially highways, which should contain many characteristics to simplify new challenges caused by automation, including uninterrupted traffic flow, new type cross-roads, controlled access for vehicle, and so on. The present status of highways will be significantly useful to implement new transportation solutions, for instance the problem of crossroad collisions can be reduced by "*activating the onboard warning systems and automatic braking systems with electronic signal lights in addition to the* *normal traffic signal. If the intersection detects a potential for a collision it can notify equipped vehicles*" [12]. Moreover, one of challenges during smart vehicle deployment on automated highways will be "*integration of cyclists and motorcyclists to the Automated Vehicle Control (AVC)*" [10] systems. In Parallel, the effects of both pedestrian and animal traffic will need thorough research.

Another challenge will be connected with overall acceptance of new systems which are driverless, privacy issues related to Automatic Vehicle Identification (AVI) along with Automatic Vehicle Location (AVL) concepts, and others. The issues are heavily connected with the unpredictability of traffic situations and the best way to cope with them; as a result a successful AVC system must address many vital issues, like false alarms and system failures. If they will be overcome such challenges acceptance will come rather soon, but accidents and failures can ruin public confidence in very short time. So, the challenges are quite substantial and the systems must be checked very thoroughly before entering daily traffic. Additionally, there are some countries with very poor infrastructure and very bad driving habits, so new concept implementation will be, in some cases, restricted to only smart roads, and the cost-benefit ratio will be rather unacceptable. The concepts mentioned before have worldwide significance as every country has similar problems and only close cooperation will enable joint solutions. As a result, many international conferences have been held share experiences. According to Chuck Thorpe, who runs the Navlab group in the Robotics Institute of Carnegie Mellon University, "*we need cars that are much more intelligent than the cars that we have today. This is not because we want to take people out of the cars, but because we want to help people get to where they need to get too much more safely and much more efficiently than we can today. People have done a good job driving. But there's so much traffic congestion, and there are so many accidents still left that the only way to get better surface transportation is to have automated cars, automated trucks, and automated buses with all of the sensors that can help people do the driving*" [6].

### 1.4 Automated Highway System (AHS) Concept

New transport opportunities are closely related to appropriate infrastructure to fully exploit such the emerging capabilities. As mentioned above, another rather future oriented option is the introduction of the driverless trucks, which will reduce employment costs, improve reliability and limit the number of mistakes. However, next to new equipment, sensors, command and control centers, they will also need improved infrastructure. When concerning the complexity of such the concepts it is a rather long-term vision connected with serious research and considerable funds. One of the probable future concepts is the Automated Highway System (AHS), also called Smart Road, and it is a futuristic concept of a highly developed intelligent transportation system technology. AHS can be defined „*new relationship between vehicles and infrastructure. It refers to set of designated lanes on a limited roadway where special equipped vehicles are operated under completely automatic control*" [2]. It is one of the major international concepts in the frame of the ITS designed "*to provide the basis for, and transition to, the next major performance upgrade of the vehicle/highway system through the use of automated vehicle control technology*"[12].

The concept of "*fully automated intelligent vehicle-highway system*" is interpreted as a system that [12]:

- evolves from today's roads (beginning in selected corridors),
- provides fully automated "hands-off" operation at better levels of performance than today's roadways in terms of safety, efficiency, and operator comfort,
- allows appropriately equipped vehicles to operate in both urban and rural areas on highways that are both instrumented, and not instrumented.

The main aim of the concept is to implement driverless cars on developed roads to reduce traffic congestion by decreasing distances between cars, and at the same time allocating more cars on the roads. This is because "platooning" enables vehicles to "*operate much closer together than is possible under manual driving conditions, each lane can carry at least twice as much traffic as it can today*" [14]. Additionally, wind-tunnel tests conducted by the University of Southern California have proved that the drag force in a "platoon" or convoy can be cut in half in the case of vehicles operating at a separation of about half a vehicle length. At the same time they have proved rather significant decrease of fuel consumption (20 to 25%) with accompanying emissions reductions. However, the main idea of the study is the creation of special highways, or at least short parts of existing ones, ready to support such the purposely designed vehicles. Having many sensors onboard, such vehicles could drive automatically and safely along "smart" roads, equipped with power steering and automatic speed controls operated by onboard computer. AHS system sensors will be design to "*read passive road markings, and use radar and inter-car communications*" to organize cars in traffic themselves without the intervention of drivers. As a result, it will be possible to organize cars into convoys of eight to twenty-five cars driving without human support just about one meter apart. Parallel, air resistance will be minimized and the distance between platoons will follow typical conventional braking distance, so in the case of trouble only one convoy would be affected.

The AHS project has been started by researchers from The Ohio State University and the first automated vehicle was built in 1962, as probably the first land vehicle equipped with a computer to control steering, braking and speed. Very interesting progress was also achieved in the frame of the highway programs called the California Partners for Advanced Transit and Highways (PATH), established in 1986 by agreement between University of California's Institute of Transportation Studies and the California Department of Transportation. The mission of the program was to *"apply advanced technology to improve highway capacity and safety, and to reduce traffic congestion, air pollution, and energy consumption"*. The program focuses on areas that offer potentially quick improvements regarding the transportation systems as "the growth of population and travel demands is so rapid, that the effects of incremental solutions are likely to be absorbed by this growth by the time that they are implemented". To meet such goals, the research involved "*forty professors and about eighty graduate students at both UC Berkeley and other universities throughout*" the California. A prototype automated highway system (PATH project) was tested in San Diego, California in 1991 along Interstate 15 with technical success. In the frame of PATH concept scientists has created a block diagram of the five-layer AHS normal mode of operation control architecture, which is a result of their long-term effort. The layers are entitled as: network, link, coordination, regulation, and physical [4]. The most important concepts in the frame of link, coordination, regulation, and physical layers detailed models and corresponding control systems have been specified and tested. "*The physical layer comprises all the on-board vehicle controllers of the physical components of a vehicle*" including "*the engine and transmission, brake and steering control systems" and "lateral and longitudinal vehicle guidance and range sensors*"[4]. Their role is "to decouple the longitudinal and lateral vehicle guidance control and to approximately linearize the physical layer dynamics".

"*The regulation layer is responsible for the longitudinal and lateral guidance of the vehicle and the execution of the maneuvers ordered by the coordination layer*". It is designed to carry two longitudinal control tasks [4]:

- the first is related to vehicle-follower in a platoon and is focused on maintaining a prescribed constant spacing from the preceding vehicle;
- the second is related to a platoon leader and is focused on safely and efficiently executing a maneuver commanded by the coordination layer.

**Table 1.** The five layers and their main functions. Source: [4].

| Layer | Function | Model |
|---|---|---|
| Network | Control entering traffic and route traffic flow within AHS network | Capacitated graph |
| Link | Compute and broadcast activity plans (i.e. the routes, maneuvers to be executed, speed, platoon, size) for each vehicle type in each section | Fluid flow model with distributed control |
| Coordination | Communicate and coordinate with peer and select one maneuver to be executed | Finite state machine |
| Regulation | Execute maneuvers such as join, spit, line change | Feedback laws based on linear models |
| Physical | Decouple lateral and longitudinal control | High order nonlinear differential equations |

The coordination layer selects "*the activity that the vehicle should attempt or continue to execute, in order to realize its currently assigned activity plan. It communicates and coordinates its actions with its peers -the coordination layers of neighboring vehicles - and supervises and commands the regulation layer to execute or abort maneuvers*" [4]. The link layer controller "*receives commands from the network layer in the form of demands on the inlet traffic flows at the AHS entrances, and outlet flow constraints at the AHS exits, as well as desired inlet-to-outlet traffic flow split ratios, in case a vehicle can take more than one route to observe that there are far fewer such commands than the number of cars in each section reach the same destination*" [4], while traveling in that highway link. The network layer is responsible for controlling entering traffic and route traffic flow within the network of highway links that constitute the AHS, in order to optimize the capacity and average vehicle travel time of the AHS and minimize transient congestion in any of its highway links. The overall effort in the frame of PATH is clearly presenting that the progress in the field of technological support for transportation systems is quite significant. When we put together DARPA's Grand Challenges and PATH it is visible that when connected with AHS type concepts they are not futuristic ones only. This approach creates the reality of current research and the nearest future practical usage.

However, after the first promising results, investments have been moved more toward autonomous intelligent vehicles rather than building specialized infrastructure. The concept is still under progress as possible results are rather promising and for developed countries and also developing like China and India, as it is good solution for traffic congestion which is causing more and more problems. New system can help by using automated vehicles on "smart" highways for example during night or out of rush hours. In Poland there are not developed concepts to use AHS type vehicles and infrastructure, although there are many institutions capable to conduct such studies. Especially, infrastructure must be improved as soon as possible as it cannot support futuristic solutions and in the field the country will not be able to follow modern transportation trends. The concept is also presenting that the shift from infrastructure focus into independent vehicles was caused when sponsors realized high costs of not only research, but as well further implementation of new type of highways.

### 1.5 Underground Automated Highways (UAH)

UAH is still rather futuristic concept but it is now are under development to improve traffic flow and its safety. It was first proposed in 1963 and at present it has many followers. The study "Urban Underground Highways and Parking Facilities" provided "examples of what highway needs might be if all the users of mass transit systems were transferred to passenger cars in Los Angeles, Chicago, and Manhattan" [3]. Moreover, it provides the foundation for future studies and technical development of the underground-highway concepts. The concept of AHS has been predicted to run through decades, but at present there is similar discussion regarding implementation of UAH system concepts. Futurists and transportation experts agree "that when it comes to letting machines drive you through underground tunnels; it's probably more a question of when, rather than if" [7]. They predict that in 50 - 100 years such UAH systems will become reality perhaps in the United States or Europe, although it would be huge undertaking.

To achieve such a goal and to implement it into practice it will be necessary to experience significant advancements in the three fields [13]:

- A working AHS net as it is obligatory to welcome a similar system and technology aboveground first. This step will enable testing new smart highways and appropriate vehicles plus AHS connected with UAH will create a complete transportation system. Moreover, once all users gradually become accustomed to the technology with aboveground solutions they will be ready to go under the ground level rather easily.
- Zero-emission vehicles must be developed as an underground highway would involve a great deal of traffic whizzing through subterranean passages and it will be challenging to ventilate them without having to pump out clouds of vehicle exhaust. As a result, vehicles that produce zero emissions (fuel cells, batteries, solar power, hydrogen power or other energy-efficient methods) will be necessary.

- Improved tunnel-boring technology, as it will be necessary to dig a significant number of large tunnels. Taking into consideration the Channel Tunnel, which is 50 kilometers long and runs 60 meters underneath the English Channel; it took four years to complete it. New more effective tunnel-boring solutions are needed. Some countries have continued to develop tunneling projects, leading to a decrease in tunneling costs and an increase in efficiency ($1.50 per cubic foot, rate of six meters per hour).

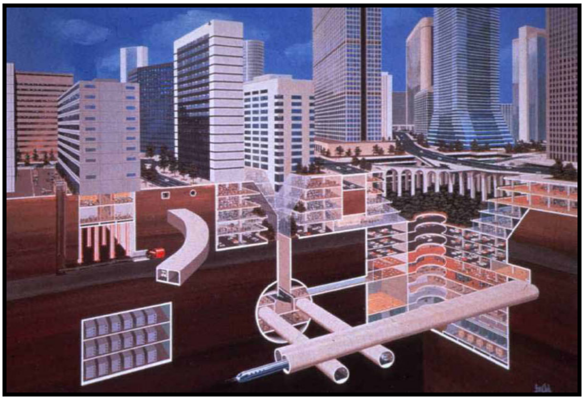

**Fig. 4.** Extended use of underground space. Source: [15].

However, the concept is very complex, as UAH will create additional challenges including the need to create improved earthquake protection systems. Past examples have shown that underground projects are reasonably strong and somewhat resistant so these protection measures might be put in place at reasonable cost. For example, the tragic 1995 earthquake in Japan proved that underground constructions survived it with rather minimal damages inside the Kobe city [15]. Moreover during construction, a great quantity of dirt and rock will be produced and there will a need to relocate it. Finally, at least at the beginning, people will be rather cautious before starting to use new highways, so the public must be informed ahead. According to experts if enabling technologies, mentioned above, will continue to improve, it is possible to "*forecast that construction on the first underground corridors for AH networks will begin circa 2030 in our largest and wealthiest cities, as that is about the time we are likely to have cheap and plentiful tunnel boring machines (TBM's), a limited surface-level AH network in HOV lanes in a few cities, and a significant percentage (≥ 40%) of hybrid, ultra low, or zero emission vehicles in deployment*"[11]. This is because UAH are important factor involving many benefits e.g. support for "*urban space utilization, efficient and sustainable transportation, and automating a significant fraction of the urban commute for city inhabitants*" [11].

It is necessary to emphasize that low expense and well-organized mass transit in the overcrowded cities must reverse what has been a worsening situation regarding urban transportation and to start new dimension planning, as it provides the most reasonably priced and highest density transportation option. There are also opinions, that "*the most rapidly growing complementary long term transportation system in the* *leading high density cities*" at the end of the current century will be a "*gigantic network of UAH*" [11]. Again, this is for the reason that the construction of UAH will considerably increase the safety, speed, aesthetics, and capacity of goods and human transport in cities. When combined with underground parking structures at source and destination, "*such systems promise to increase metropolitan traffic capacity and throughput by at least another order of magnitude in their presently conceivable deployment, eventually halving or thirding today's average urban commute times, and reducing surface transportation architecture, noise pollution, and visual blight through the selective takeback of some of our most valuable surface architecture currently dedicated to surface transportation*" [11].

## 2 Conclusions

This paper explores some concepts have been discussed regarding ideas which will be able to replace drivers and to improve the safety of logistics processes in the field of transportation. New type highways and trucks equipped with sensors to support drivers along with new automatic vehicles represent the main direction of these efforts. AHS and UAH concepts are very especially promising and are being developed. In the near future, they will probably change logistics' transportation services. Smart highways connected with driverless cars will enable better flexibility to plan and conduct shipment of goods especially during periods of less demand on road networks. Adaptation of these systems would be beneficial for all the logistics providers. Furthermore, in the case of technological support for the logistics, there is a need to take a multidimensional approach as all the elements must meet some standards to make new, long-distance transport solutions really operational. This will require that all components of the system must be developed in a continuous way. So, it is necessary to analyze these components and incorporate them with modern logistics including Polish logistics, technologies, highways etc. Such solutions will be implemented in the future, so it is necessary to prepare logistics infrastructure in the country for their needs in advance. At present the research should be focused on support for the drivers and investment in new, better vehicles, as there are strong research centers and academic institutions to provide such the support. The reason is that funds are not big enough to deal fully with new highways concepts. At the same time, it is rather necessary to merge science approach and practical improvement of highways to include even now some passive road sensors to use them in the future. The problem is quite urgent as new capabilities will be available, so modern transportation in the country must up to date to meet clients' expectations and to keep competitive with foreign companies. However, the case studies presented above, although promising, are still under development and some of them are still rather in early stages and the progress is slow. The current financial crisis will definitely influence that continuity by cutting research and implementation funds. But, new growing economic powers like India, China, will support USA and EU in their efforts, as they also are looking for new solutions and they have surplus of funds for investment in the futuristic concepts, looking for better capabilities, to improve the competitiveness of their companies and to develop new practical technologies.

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