



Brainport's Advanced Transport System



gemeente Eindhoven



Samenwerkingsverband
Regio Eindhoven





Ambition and motivation



Eindhoven, the fifth largest city of The Netherlands, is a real hot spot for technology. As center of the Brainport region, it is called the research capital of The Netherlands. Our ambition is to excel as an international top technology region. Already we are competing in Europe's top five of innovative regions.

In the mid nineties of the last century we found ourselves in a totally different situation. The region went through an economic dip due to massive lay offs in big companies like Philips and DAF. We then realized it was necessary to find a way to prevent this from happening again. So knowledge and forces were joined together in the Triple Helix, a strong cooperation that is based on the combined strengths and responsibilities of business, public authorities and knowledge institutes.

Today our economy is booming again. One of the consequences of this success is the growing supply of traffic and the increasing pollution of Eindhoven's air quality. With that in mind, Phileas was developed. A result of joined development between Triple Helix partners, Autobusfabriek BOVA B.V. (now VDL-group), N.V. Brabantse Ontwikkelings Maatschappij (Ltd BOM), Duvedec International B.V., Netherlands Car B.V. Product Design & Engineering (now APTS), Simac Systems B.V., Neways Electronics B.V, united in the Foundation Hoogwaardig Openbaar Vervoer (HOV). They worked closely together with stakeholders from the municipalities of Eindhoven and Veldhoven, Samenwerkingsverband Regio Eindhoven (SRE-regional cooperation), Hermes Group (public transport group in the region) and the Ministries of VROM (Housing and Spatial

Planning), EZ (Economic Affairs) and V&W (Transport, Public Works and Water Management). The EU contributed to the preparation of documents and studies through the Stimulus program. A program, which intended to restructure and reinforce the socio-economic base of our region.

The urgency to tackle the problems of congestion and air quality created Phileas. Our advanced public transport system, a viable product, which solves problems and adds to opening up new business opportunities. And this is only one result of linking problems to the strengths of the regional automotive, electronic and design oriented industry and knowledge institutes.

Inventing and producing high quality technological products is one thing, finding markets and opening them up is another. But you always need the skill of making and maintaining contacts. The better you are at this, the bigger your success; not only in business but also in your personal life.

As alderman of Eindhoven, representing one of the launching customers in the region, I am proud to present to you Phileas, a result of motivated and innovative joined cooperation.

*H.J.A. van Merrienboer M Sc
Alderman of the city of Eindhoven*



gemeente Eindhoven



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1 Main urban transport problems, history and objectives of urban transport policy

Eindhoven – the fifth largest city of The Netherlands – is the Dutch number one innovation area. Brainport Eindhoven scores already well above the Lisbon Agenda benchmarks where it concerns R&D and innovative criteria. It competes in Europe in the top five of innovative regions. This economic motor creates economic growth. There is a growing pull attracting innovative knowledge intensive enterprises, resulting in growing congestion problems in the region and the city. Influx of small sized businesses, their employees and the accompanying logistics generate more and more mobility within the city and its surrounding region. Besides this growing transport, Eindhoven is also situated on two important international truck routes from the Randstad Holland (Amsterdam and Rotterdam and their respective air- and seaports) to the East and the South of Europe. The accessibility of the (center) city and its direct surrounding region is threatened by this growing supply of traffic. The once transparent

and accessible infrastructure of Eindhoven became seriously threatened. The growing traffic also burdened Eindhoven's air quality of the (center) city and its direct surrounding region.

History of local transport policy

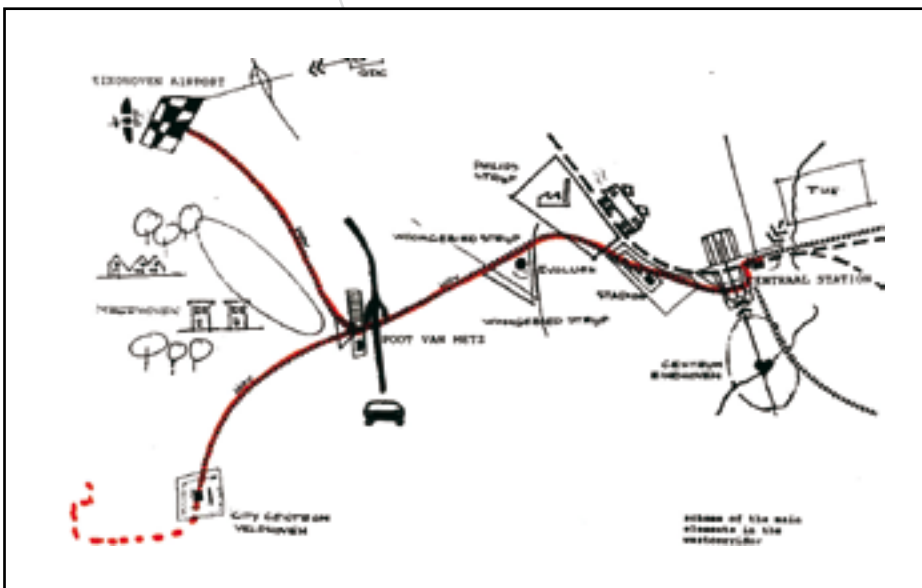
The once well accessible center of the city started from the early nineties to be in a similar situation as a heart suffering from clogged up arteries. Serious congestion and pollution lead to economic and health problems. To prevent a heart attack and asthmatic spasms something needed to be done.

The first transport measures were to plan and implement the realization of free bus lanes. Notwithstanding the fact that this measure as such created faster movement of buses to and through the city (center), the use of public bus transport kept decreasing.

The implementation of a new urban area in the West Corridor (Meerhoven neighborhood) of at least 6000 homes, the upgrading of the local airport and attraction of business on the new to develop industrial estate Flight Forum (West), together with the loss of public transport in favor of even more private car kilometers, air pollution and health problems, combined with the strong interest from the industry to innovate public transport created the fertile ground for the Phileas Advanced Public Transport Network concept. The ambition was to make it one of Europe's leading innovative concepts, using a free infrastructure, with a vehicle easy to board and accessible for a large group of residents and commuters.

In 1999 the terms of reference and financial side of the project were agreed between the main stakeholders. A milestone for innovation of public transport¹.

Phileas first line from central station to city center Veldhoven and to Eindhoven airport

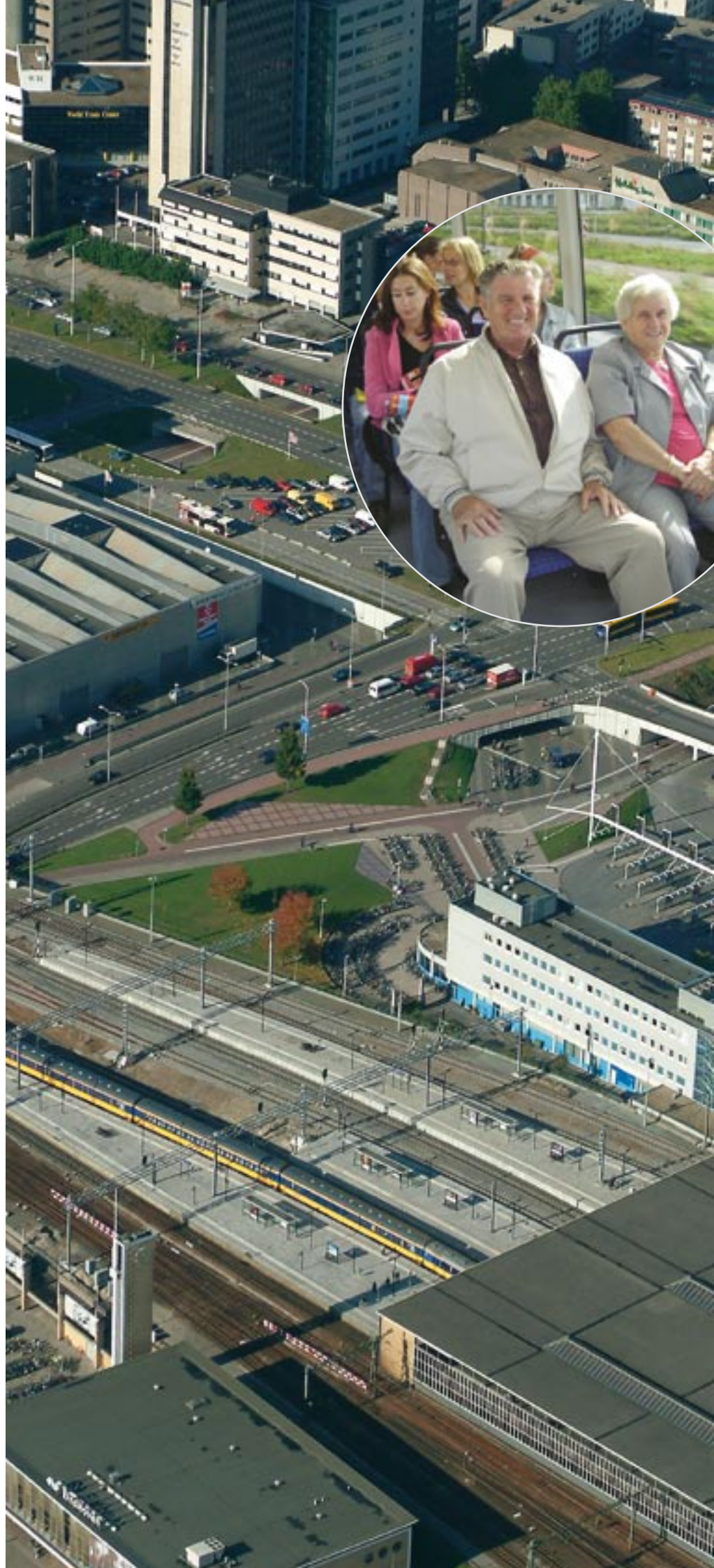


As the list of stakeholders clearly shows, the development of the Phileas can be shown as a hands-on-experience of joined development between what in Brainport Eindhoven is known as the Triple Helix. A strong cooperation based on the strengths and responsibilities from business, public authorities and knowledge institutes. The urgency to tackle the problems of congestion, air quality and health in the region and city, by linking them to the strength of the regional automotive, electronic and design industry and knowledge institutes, has created a viable product, which solves problems and adds to opening up new business opportunities.

Objectives of local transport policy

1 To stimulate the public transport within the city (center) and the direct surrounding region with a transport concept that could be further established in the first decades of the 21st century by:

- A Improvement of the bad air quality and the fear of further air quality reduction because of growing mobility, specifically in Eindhoven's city center.
 - B Reduction of the overall national trend of growing 2nd car ownership in the households living in the direct area of service of the new Phileas APT network system.
 - C Inverting the trend that the city center (shops, train station, etc.) becomes less accessible for residents and commuters from the new to develop residential and industrial areas in the West Corridor of the city of Eindhoven and vice versa.
 - D Inverting the trend of quality cuts in the local public bus services due to decreasing profitability because of diminishing numbers of passengers.
- 2 To stimulate the public transportation service (first objective) by taking supportive policy measures:
- A Making the use of private cars less favorable through increasing the usage costs, which can be locally influenced.
 - B Making the transport to and from the APT network easier and faster.
 - C Stimulation and developing mobility management plans for industrial estates.
 - D Stimulation of the quality of the public transportation system.





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2 Innovative Urban transport Measures

Innovative Measure 1:

A cleaner and faster high quality public transport system, more competitive with the private car.

This implicated terms of reference on²:

- A Environmental cleanliness.
- B Speed and capacity.
- C Costs.
- D High quality of the vehicle system.

Objectives

A Environmental cleanliness:

- 1 Reduction of the exhaust to Euro 3 norm for buses.
- 2 Hybrid or electric propulsion giving the ability to run on electric traction for a stretch of minimal 3 kilometers.
- 3 Electronic guidance increasing fuel economy, enabling more accurate and quicker stops, thus a higher average speed and decreasing the use of road space.

B Speed and capacity:

- 1 Average speed on total route of 25 - 30 km/hr.
- 2 Maximum speed within municipal boundaries on free infrastructure of at least 70 km/hr and outside these boundaries of at least 80 km/hr.
- 3 A transfer time factor (travel time per public transport divided by travel time per private car between two points) below 1,5.
- 4 1000 passengers capacity maximum on busiest time of the day, on the busiest spot in the busiest direction.
- 5 Large passenger capacity leading to a maximum of travel schedule intervals of 10 minutes.

C Costs:

- 1 Costs per kilometer of the free infrastructure of the Advanced Public Transport Network System should be between a conventional bus on a free lane and a fast tram.
- 2 Reduction of 25% of fuel use compared to normal bus.
- 3 Income - cost ratio should be at least 50%, based on the Dutch public transport budget reimbursement system.

D High quality of the vehicle system:

- 1 A quick and easy access for all passengers, more specifically senior citizens, passengers who are handicapped, in wheelchairs and with trolleys for children.
- 2 An appealing design, which adds to the public experience.
- 3 A payment system requiring no interference of the vehicle operator, contributing to shorter stops and higher average speed.
- 4 A vehicle system with a large flexibility from the infrastructure.
- 5 A network system that can be extended to the rest of the Eindhoven region.

Initiator(s)

Stichting (foundation) Platform Hoogwaardig Openbaar Vervoer (HOV).

The foundation is a cooperative of:

- Autobusfabriek BOVA B.V. (now VDL-group).
- N.V. Brabantse Ontwikkelings Maatschappij (limited BOM).
- Duvedec International B.V.
- Netherlands Car B.V. Product Design & Engineering (now APTS).
- Simac Systems B.V.
- Neways Electronics B.V.

They intended to work with the following stakeholders:

- Stichting Platform HOV;
- Municipalities of Eindhoven and Veldhoven;
- Samenwerkingsverband Regio Eindhoven (SRE-regional cooperation);
- Public transport group in the region (now Hermes Group);
- Ministries of VROM (Housing and Spatial Planning), EZ (Economic Affairs) and V&W (Transport, Public Works and Water Management).

The EU contributed to the preparation of documents and studies through the Stimulus program. A program which intended to restructure and reinforce the socio-economic base of the region.

Target groups

- Inhabitants of Eindhoven and Veldhoven.
- Employees working in Eindhoven.
- Incoming travelers through Eindhoven International airport and by train (tourists and businessmen).

Description

The techniques of the hybrid combustion engine have been specially tuned for LPG³. It provides direct drive to a liquid cooled 3-phase synchronous permanent magnet, which feeds the interchange circuit via a rectifier. The generator is directed by the power demand of the traction installation, where attempt is made to keep the inter stage circuit voltage as constant as possible. This LPG generator charges a nickel metal hydride battery and stops when batteries are fully loaded. On top of that the electro-motors – which drive the wheels except the two in the front – use the released energy during braking to feed to the batteries.

² See note 1

³ Global technical description of Phileas, the solution for High Quality Public Transport; APTS B.V.; 2001



However since the start of Phileas until today the technical evolution has increased in speed. Due to the fact that the Eindhoven Phileas was the first in its sort, a real pilot project in the full sense of the word, several new technical developments have surpassed the Eindhoven Phileas versions.

Currently diesel engines with a Euro 5 norm are on the market and Euro 6 Diesel engines are being developed. The newest diesel engines save 30% of fuel and have a better environmental performance, as compared to the normal bus.

The Phileas which has been sold to the French city of Douai has a more advanced propulsion system than the Eindhoven version and would qualify for the current EU emission norms.

This version also tackled the safety back up for the failure of power steering during a situation when driving emission free.

If future technology allows further improvements like the use of the gas turbine or fuel cell, the combustion engine and/or the complete generator will be replaced by an alternative energy source.

(Expected) Results

Environmental cleanliness, the results

The current techniques of the hybrid engine and battery system meet the Euro 3 norm easily. Emissions CO: 0.6 g/kWh – NOx: < 0,4 g/kWh – CH: < 0,02 g/kWh – particles: < 0,01 g/kWh. The battery management system enable the Phileas to run 4 kilometers without any exhaust. This contributes to the improvement of the air quality, which is so essential in the air polluted city centers.

The electronic guidance system uses magnetic markers, placed apart for reference every 4 meters in the road surface. This infrastructure is rather flexible compared with tracks of a tram for instance. When a route needs temporarily deviation, it's possible to install magnets and adjust the software in one day.

The guidance system proves to be very accurate and enables Phileas to drive in a straight line, stop automatically at a guaranteed distance from the station platform (curb) and provide a constant information between the vehicle and the control room of the transit organization and vice versa. This is essential for accurate passenger information on station platforms, in the Phileas and the control room. In combination with the all wheel traction (except front wheels) and all wheel steering, the Phileas needs less space than a tram or multi segmented bus. Lanes can be smaller and curves less wide, thus saving on construction costs.

Speed and capacity, the results

The transfer time factor has been decreased from 1,93 between Eindhoven airport and Eindhoven central train station in 2003 to 1,19 in 2005. Total trip length first took 31 minutes. Phileas uses 19 minutes and is also more dependable in time of departure and arrival. During rush hour this figure will be even better. All this is realized by driving within the speed limit of 50 km/h.

It appears that for trips to school and work the Phileas is much more frequently used when compared to regular bus lines in the city of Eindhoven. The very dependable time schedule between departure and arrival and the quickness in rush hour makes the Phileas highly competitive with the available alternative the private car and bicycle.

The stability of travel time will further increase after the last infrastructural improvements on the line will have been finished end 2006.

The gain in speed is caused by the free infrastructure with some fly-overs and at every crossing, due to absolute priority and the reduction of stops. The normal bus lane has stops every 300 meters. Phileas stops every 550 meters. Furthermore the quick changing of passengers due to the low floor at the same height of the platform and the decisions not to sell tickets by the bus driver, plus the

installment of stop buttons (instead of halting at every stop even if no passengers board or exit) have contributed to a high operation speed.

Costs, the results⁴

Costs per kilometer of infrastructure for Phileas can be compared to the costs for a regular bus on a free lane. This is much cheaper than a fast tram on a free lane.

The fuel economy for a conventional bus running on LPG is 1,05 liter/km. The Phileas needs only 0,84 liter/km. A reduction of 25% as was required.

The integral maintenance costs for Phileas are 0.40 eurocent. These consist of depreciation of the vehicle, costs for tires and other technical aspects. The costs which need to be made to prepare the bus for service are comparable to normal buses.

The costs per kilometer for Phileas were in 2005 € 1,12/km. For a 18-meter regular bus they were 50% lower, € 0,56/km.

On the cost – income ratio the performance is still under strain, mainly due to the cost side. Exploitation costs need to be reduced substantially to reach the objective of at least 50% income – cost ratio.

High Quality of the vehicle system, the results

The station platforms are different from normal vehicle systems. The level of Phileas and the platform are equal. Thanks to the wide access doors and the level entrance, wheelchair and rollator users and people with pushcarts have no problems boarding. The electronic guidance system takes care that Phileas docks exactly alongside the curb.

The user travels in great comfort thanks to the excellent shock absorption and air-conditioning facilities of Phileas and there is extra space for luggage, pushcarts and wheelchairs.

On board the Phileas passengers will be given information on the route, the upcoming stops and the expected time of arrival at the final destination.

Phileas breaths a futuristic design, on the outside as well as the inside of the vehicle. Even when Phileas is guided electronically, there is always a driver on board as a general safety precaution and to ensure that it follows its route safely. To further promote the general safety of travelers, Phileas is fitted with cameras.

A digital payment system was developed in the region specifically for Phileas. Due to the implementation of the national OV-chip card (public transport chip card) in 2008, the decision was taken not to introduce the regional version. Currently the national Public Transport cards can be used on the Phileas. Today every Phileas has been fitted with a card-stamping machine. Traveling by Phileas costs the same as regular bus travel.

Innovative Measure 2:

To stimulate the public transportation service (first objective) by taking supportive policy measures

Objectives

- A Making Phileas more competitive compared with the private car.
- B Minimal transfer friction between modes of transport.
- C Creation of a dynamic and attractive transport mode in design and service.

Initiators

The initiators are the same as mentioned for measure 1.

Target Group(s)

See measure 1.

Description (Expected) results

Several supportive policy measures have been taken. The parking costs for cars in the center of Eindhoven have been raised substantially; 35% compared to 2005. In 2006 € 2,15 per hour needs to be paid for parking, making the Phileas an even more

competitive choice. Phileas is now not only highly dependable, it also brings you to the city center in the same time and cheaper than by private car.

Stimulating measures were also taken to minimize transfer friction between other modes of transport and Phileas.

Eindhoven and Veldhoven are busy constructing a new cycling connection in order to make urban areas more accessible. At the Landforum, Meerrijk, Flightforum, Grasrijk and Zandrijk stops in Meerhoven there will be covered (but unguarded) bicycle sheds. In the city and at the central railway station the number of bicycle parking places have been increased from 4000 to more than 8000. An experiment with an automatic bicycle lending system has started at one of the industrial estates (the Hurk) along the route. Transport management arrangements have been actively marketed to enterprises on two industrial estates along Phileas' route.

To create a supportive dynamic image the vehicle system supports real time passengers information on mobile phones, via internet and at bus stops. The station platforms offers weather shelter comfort and has been made attractive and recognizable by a uniform layout of the entire route. Thus the bus track is lined by 'green' shoulders with typical trees, and high-quality materials are used - for example on the bus stops - to give public transport a prominent role, helping to structure the urban area. These effects are enhanced by the attractive design of the Phileas.

Other stimulating measures are just part of the HOV concept. As there are free infrastructure and priority at crossroads with stoplights, route infrastructure only for the Phileas, with some exceptions for taxi's, other public transport and emergency vehicles.





3 Cooperation with public and private partners and sectors

Partners and their contributions

Cyclists ngo (Fietsersbond)	Testing of the bicycle services
Organisations of Handicapped	Testing the accessibility of Phileas and the station platforms
User panels	Testing of elements of the Phileas APTS concept
Ministry of Housing and Spatial Planning	Donation for the improvement of air quality and the decrease of emissions
Ministry of Economic Affairs	Contribution to create a marketable product
Ministry of Transport, Public Works and Water Management	Contribution to stimulate use of public transport and reduce usage of the private car
City of Eindhoven	Design and construction of the infrastructure





4 Public Consultation/ Communication Strategy

Information concerning the project was communicated in an informal way through consultation with organizations of handicapped persons, consumer organizations like ngo's for cyclists (ENFB) and pedestrians (Voetgangersbond), neighborhood groups and by participation in conferences, special events, fairs and neighborhood days.

A communication package was prepared to inform (potential) users about the advantages

of Phileas. This consisted of newsletters, folders, advertisements, bus schedules and bus station platform information. Also a website for general information www.phileas.nl and one for real time passenger information www.optijdvoordebus.nl can be addressed.

A special project brochure from the first idea until production and implementation was made. Promotion teams were active to introduce the concept of Phileas to (potential) users. Free publicity and communication on two video

walls in the center of Eindhoven have been used as well. Last but not least a DVD is available for whoever is interested and Phileas has been promoted during international conferences.

The developer APTS has recently renewed their website www.aps-phileas.com



5 Additional Remarks/ Information

The Phileas that is now running in Eindhoven is not the most modern version available on the current market. This is due to technical developments, which do not come to a standstill after terms of reference have been formulated and prototypes are being tested. During the initial start of the pilot of Phileas in Eindhoven the LPG combustion combined with nickel metal hydride seemed a logical combination. Given the state of developments of diesel engines this is now considered a rather surpassed solution. But after some time, investments have been made, lines of development have been chosen, political statements posted and connections are made with separate development projects of another scale and dimension. Many times these are outside the control of the pilot project at hand. The terms of reference – in the beginning the guideline which should lead to the desired results – become in some areas a burden without enough flexibility. Political positions are at stake, other development processes stall for reasons beyond the control of Phileas. This happened for instance with the development of a chip card to be used on Phileas. It appeared to be too costly and therefore it was decided to fall back on the Dutch National Chip card for all public transportation. Due to its set backs in development and date of implementation these difficulties also had their effects for Phileas. The chip card was counted on as the perfect means to relieve the bus driver from selling and checking tickets and thus shortening the time of stops. The current unavailability of the chip card is a reason why Phileas is less quick and punctual than expected. More open and flexible terms of reference would help to adapt to these sort of developments. A combination of several new

developments – without central steering – leads to higher risks of partly failure.

The marketing of a new and innovative concept for a public service needs to be done with great care. A public image created cannot be changed overnight. In the case of Phileas the image was advertised that it would be able to run without a driver. This could be the case, but of course not at the current state of technology, in a city where cyclists, children, cars, pedestrians can cross the bus lane freely. Today this would only be possible on a fully free and (for other traffic) non accessible bus lane. The capability of the transport system was mixed up with the actual plan to implement the system in Eindhoven region. This has caused a group of Eindhoven region's inhabitants to be rather hostile to support Phileas, because they find it dangerous and threatening.

If it appears that according to the terms of reference implementation should start, but at the same moment problems of the essential elements in the system still exist, second thought should be given to prolong the period of testing. The test program needs to run as long as necessary to evaluate and monitor the objectives. It also needs to cover a period long enough to test if solutions for problems which arise work well enough to meet the targets. Going to 'the market' under time pressure is risky. Because it's well known that a positive experience is told to someone else only once, but a negative one at least ten times. That makes a damaged image hard to correct. However if we look back on these setbacks in some years let us hope we have learned from them.

Colofon



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