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Cybernetic Transport Systems for the City of Tomorrow: resultaten van een internet-enquête onder potentiële gebruikers van dit innovatief vervoerconcept met volledig automatische voertuigen

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VOORWOORD

Cybernetic Transport Systems for the City of Tomorrow: resultaten van een internet-enquête onder potentiële gebruikers van dit innovatief vervoerconcept met volledig automatische voertuigen

Personenvervoer met automatische voertuigen over het bestaande asfalt, lijkt -op termijn- een serieuze optie[1]. Pilots met zogenaamde 'rubbergebonden' systemen in Capelle aan den IJssel (Rivium) en op Schiphol (P3) en demonstraties zoals op de Floriade 2002, bewijzen dat binnen Nederland hard aan de ontwikkeling ervan wordt gewerkt. Nederland loopt hiermee voorop in Europa. Samen met marktleiders FROG en Yamaha participeert TNO in Europees onderzoek op dit terrein.

Maar er komt nogal wat kijken bij de introductie van wat een *Cybernetic Transport System* (CTS) genoemd wordt. Zelfs als de techniek laat zien dat het allemaal kan, biedt dit nog geen garanties voor een succesvolle introductie. Ook de veiligheid moet goed geregeld zijn. Het systeem moet betrouwbaar zijn. Het moet betaalbaar zijn voor de eindgebruiker, de exploitant en de concessieverlener. Het systeem moet flexibel genoeg zijn om aan te kunnen blijven sluiten op de dynamiek in de vervoervraag. En, *last but not least*, het moet enkele beloften inlossen die het systeem zo aantrekkelijk maken:

- het neemt de negatieve milieu-effecten van autogebruik weg;
- het voorkomt extra druk op het gebruik van de openbare ruimte doordat er op de bestemming niet geparkeerd hoeft te worden;
- personeelskosten/exploitatiekosten worden substantieel lager;
- investeringskosten zijn laag (omdat geen aparte/gereserveerde infrastructuur behoeft te worden aangelegd), en
- vervoer-op-maat levert een kwaliteitsverbetering op ten opzichte van het reguliere openbaar vervoer.

In het Europese onderzoeksproject CyberMove wordt vanuit het vertrouwen dat een CTS levensvatbaar is, gewerkt aan de stap van inventie naar innovatie; met andere woorden: van de uitvinding van een automatisch voertuig voor personenvervoer naar de voorwaarden die aan een CTS moeten worden gesteld om tot marktintroductie over te kunnen gaan.

Binnen CyberMove heeft TNO Inro een Europese internet-enquête gehouden onder potentiële eindgebruikers om hun behoeften in kaart te brengen. Bijna 3000 reacties hebben het mogelijk gemaakt om een schets te maken van het door hen gewenste CTS. Het voorliggende rapport put uit de engelstalige *deliverable* en presenteert de uitkomsten van dit onderzoek.

Als auteurs willen wij graag onze collega's bedanken voor hun bijdrage aan en hun betrokkenheid bij het project, met name: Bart van Arem, Marianne Droppert-Zilver, Maaike Snelder en Mathieu Worm.

De auteurs.

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[1] Deze stelling is overigens in lijn met onderzoeksconclusies over automatisering in het openbaar vervoer [Schrijver, 2002] zonder dat hierbij wordt ingeperkt tot de rubbergebonden systemen.

KORTE SAMENVATTING

Cybernetic Transport Systems for the City of Tomorrow: resultaten van een internet-enquête onder potentiële gebruikers van dit innovatief vervoerconcept met volledig automatische voertuigen

TNO Inro heeft een interactieve vragenlijst ontwikkeld om onder potentiële gebruikers meer gedetailleerde informatie over de vervoerbehoeften met cybercars te verzamelen. Cybercars zijn schone, zuinige en stille voertuigen die *volautomatisch* over het bestaande asfalt rijden en derhalve geen parkeeroverlast hoeven op te leveren. De gegevens uit deze rapportage komen uit het Europese project CyberMove waarin TNO participeert.

Het vervoer in de richting van de binnenstad lijkt het meest gewenst. Uit de enquête blijkt dat het ultieme Cybernetic Transport System bestaat uit:

- een ABRI met actuele reisinformatie op de halte, en een toilet;
- voertuigen met een moderne uitstraling en met 5 à 10 zitplaatsen, niet-doorzichtig, en met deuren aan beide zijden, rijdend volgens een vaste dienstregeling; en
- een looptijd tot/van de vertrek-/aankomsthalte van maximaal 5 minuten.

Bijna 98% van de respondenten geeft aan dat zij van cybercars gebruik zullen maken. Zij zijn bereid om circa 2 Euro per rit te betalen.

ABSTRACT

Cybernetic Transport Systems for the City of Tomorrow: results of an Internet questionnaire amongst end users of this innovative transport concept with fully automated vehicles

TNO Inro has developed an internet questionnaire aimed at end users in order to gain more detailed information about transport needs for cybercars. Cybercars are clean, economic, quiet, *fully automated* vehicles that drive on existing infrastructure. The results have been taken from the European project Cybermove. TNO participates in this research project.
Transport in the direction of the city centre seems to be the most desirable. According to the results of the questionnaire the ideal Cybernetic Transport System consists of:

- a bus shelter with real-time travel information at the stop and a toilet;
- modern looking vehicles with 5 to 10 seats, non-transparent, with doors on both sides, performing scheduled services;
- a stop within 5 minutes walking time from/to origin/destination.

Almost 98% of the respondents indicated they will make use of the cybercars. They are willing to pay about 2 Euro per trip.

SAMENVATTING

Cybernetic Transport Systems for the City of Tomorrow: resultaten van een internet-enquête onder potentiële gebruikers van dit innovatief vervoerconcept met volledig automatische voertuigen

Achtergrond
Het stedelijk gebied heeft te maken met een toenemende problematiek door het autoverkeer, namelijk congestie, geluidshinder, parkeerdruk en emissies. Een bijdrage aan de oplossing voor deze problematiek levert de introductie van een cybercar. Cybercars zijn schone, zuinige en stille voertuigen die *volautomatisch* over het bestaande asfalt rijden en derhalve geen parkeeroverlast hoeven op te leveren. Vraagafhankelijk vervoer, zowel in tijd als in ruimte, kan worden geboden door met een vloot cybercars een *Cybernetic Transport System* (CTS) te vormen.

In deze rapportage wordt gekeken naar de wensen van eindgebruikers van een CTS. De gegevens uit deze rapportage komen uit het Europese project CyberMove waarin TNO vanuit TNO Wegtransportmiddelen en TNO Inro participeert.

CyberMove is een Europees onderzoeksproject in opdracht van het directoraat voor Energy and Transport en komt voort uit het 5FP EESD-onderzoeksprogramma 'City of Tomorrow and Cultural Heritage'. EESD staat voor: Energy, Environment and Sustainable Development. Het project heeft een looptijd van drie jaar en is gestart in december 2001. In 2004 zullen volgens planning pilots te zien zijn in diverse Europese steden. CyberMove is verbonden met het project CyberCars. Dit is een Europees 5FP project in het Information, Society and Technology programma. Dit project heeft de versnelde ontwikkeling van de techniek voor cybercars tot doel.

Onderzoeksresultaten
Om de wensen van de gebruikers van een CTS te kunnen beschouwen zijn in eerste instantie *focus groups* georganiseerd en gestructureerde interviews met exploitanten en concessieverleners gehouden. Hieruit bleek dat er een latente vraag bestaat voor dit soort systemen. Vervolgens heeft TNO Inro een interactieve vragenlijst ontwikkeld ten behoeve van de groep potentiële gebruiker om meer gedetailleerde informatie over deze behoefte te verzamelen. De vragenlijst is binnen Nederland getest en daarna in vijf talen op het internet geplaatst.

In de enquête wordt aan de respondent gevraagd om een ideaal CTS te ontwerpen. Voordeel van een internet-enquête is dat deze voor een grote groep toegankelijk is en dat de lengte van de enquête gereduceerd kan worden. Dit kan door de vragenlijst zo weer te geven dat alleen die vragen gesteld worden die voor de respondent van belang zijn. Natuurlijk heeft een internet-enquête ook nadelen. Zo kunnen alleen mensen met internettoegang de vragenlijst invullen en zullen ouderen en jongeren vaker uitgesloten worden van het onderzoek.

In totaal vulden 2.855 respondenten uit 24 landen de enquête volledig in. De enquête was beschikbaar van mei tot en met oktober 2002 in het Nederlands en van augustus tot met oktober 2002 ook in het Engels, Frans, Portugees en Italiaans.

De meeste respondenten reageerden in het begin terughoudend op de idee van een CTS, maar aan het einde van de vragenlijst leek bijna iedereen enthousiast over de toepassing ervan. Bijna 98% van de respondenten geeft aan dat zij van de cybercars gebruik zullen maken. Daarbij valt op dat het voornamelijk autogebruikers en OV-reizigers zijn die vaker aangeven 'regelmatig' of 'bijna altijd' gebruik te zullen maken van een CTS, terwijl mensen die nu lopen of fietsen aangeven dat ze er 'incidenteel' of 'regelmatig' gebruik van zullen maken.

Welke vervoerrelatie is kansrijk voor een CTS?
Eén van de eerste vragen in de internet-enquête is op welke locaties respondenten zich een CTS voor kunnen stellen. Voor het herkennen van de vervoervraag achter deze keuze was het van belang om te weten waar een CTS mogelijk is. Dit is bepaald met behulp van de Staalkaart Openbaar Vervoer [Egeter, 2000]. Hierin worden toepassingen geïdentificeerd door de diverse kenmerken van de vraagkant en van de aanbodkant met elkaar te combineren.

Voor de CTS zijn zes toepassingen geïdentificeerd die in de enquête als volgt zijn geïllustreerd:
1. Tussen een parkeerplaats en een bedrijventerrein.
2. Op een vakantiepark.
3. Van een parkeerplaats naar de bedrijven in het centrum van een stad.
4. Van het station naar de universiteit.
5. Tussen een parkeerplaats en een historisch stadscentrum.
6. Van het station op een luchthaven naar de vertrekterminal van een luchthaven.

Uit de enquête komt naar voren dat de meeste mensen zich een CTS *voor kunnen stellen* van het station op een luchthaven naar de vertrekterminal van een luchthaven. Wanneer hen echter gevraagd wordt voor welke locaties zij de enquête willen invullen (de locaties die het *nuttigst* zijn voor de eigen situatie) blijkt dat zij vooral kiezen voor de dagelijkse verplaatsingen: tussen een parkeerplaats en een historisch stadscentrum (27%) of de bedrijven in het centrum van een stad (26%).

Vormgeving van een CTS
De ideale cybercar heeft deuren aan beide zijden. Ongeveer 75% van de respondenten gaf aan deze variant de voorkeur boven een cybercar met alleen een deur aan de trottoirzijde. Bovendien dienen de voertuigen zo'n 5 à 10 zitplaatsen te bevatten, opvallend meer dan de twee tot vier zitplaatsen die momenteel door de meeste uitvinders en leveranciers worden aangeboden. Volgens 68% dient de cybercar een moderne uitstraling te hebben (wat overigens in dit onderzoek niet nader is geëxploiteerd). En tenslotte blijkt dat ruim 40% van de respondenten bereid is 2 Euro te betalen voor een rit met een CTS.

Opstappunt voor een rit met de cybercar vormt volgens 53% een halte met abri. Deze vorm krijgt de voorkeur boven een wachtlokaal (36%) of helemaal geen voorziening (11%). Overigens is het wachtlokaal bij oudere mensen wel favoriet.
Voor de aankleding van de halte gaat de voorkeur uit naar een aantal aanvullende voorzieningen. Zo zal er in elk geval een monitor met actuele reisinformatie en een plattegrond van de omgeving aanwezig moeten zijn. Bijna 70% van de respondenten gaf aan hier een voorkeur voor te hebben. Een internet-unit bij de halte wordt niet als relevant gezien, want slechts 13% noemt dit als één van de 3 belangrijkste voorzieningen bij een halte.

Ruim 75% van de respondenten is bereid om 5 minuten te lopen van / naar een halte. Wanneer de afstand tot de halte toeneemt naar 10 minuten is slechts 30% van de respondenten bereid deze looptijd te accepteren. Een ideaal CTS heeft dus een halte op maximaal 5 minuten looptijd van de herkomst / bestemming.

Een opmerkelijke constatering is dat het schoon zijn van een CTS belangrijker wordt gevonde dan bijvoorbeeld de veiligheid. Mogelijk geven respondenten hiermee uiting aan hun teleurstelling over verloedering van sommige openbaar vervoersystemen; mogelijk gaat men er als vanzelfsprekend vanuit dat een CTS veilig is.

Hoe nu verder?
Uit de resultaten van het onderzoek blijkt dat de potentiële vervoersvraag voor een CTS ligt in de verplaatsingen van en naar het historisch stadscentrum of de bedrijven en kantoren in de binnenstad. Door de potentiële gebruikers worden kwaliteitseisen gesteld ten aanzien van de vormgeving van het CTS (vervoer op maat) en functionele eisen ten aanzien van de dienstverlening (veilig en betrouwbaar). Ook bestaat er een potentiële bereidheid om hiervoor te betalen.

Op basis van deze resultaten behoeft slechts één aanbeveling te worden gegeven: meer praktijkproeven zijn wenselijk om de kennismaking met het CTS voort te zetten, de kwaliteitseisen nader te detaileren, de functionele eisen toepasbaar te maken en het potentiële gebruik proefondervindelijk te testen.

EXECUTIVE SUMMARY

Cybernetic Transport Systems for the City of Tomorrow: results of an Internet questionnaire amongst end users of this innovative transport concept with fully automated vehicles

Background information
Cities face numerous problems as a result of car traffic, namely congestion, noise, parking problems and pollution. A possible solution to these problems might be the introduction of cybercars. A cybercar is a clean, economic and quiet vehicle that drives fully automated on existing infrastructure. When "shared", these vehicles cause no parking problems at the destination. On-demand passenger transport; both in time and in space, can be provided with a fleet of cybercars by forming a *Cybernetic Transport System* (CTS).

This report focuses on the user needs of a CTS. The results have been taken from the European project CyberMove. Both TNO Automotive and TNO Inro participate in this research project.

CyberMove is a European research project, commissioned by the directorate general of Energy and Transport, and part of the 5FP EESD-program 'City of Tomorrow and Cultural Heritage'. EESD stands for: Energy, Environment and Sustainable Development. The project runs for three years and started in December 2001. CyberMove aims to deploy CTS's. In 2004 pilots and demonstration projects can be expected in different European cities.
CyberMove is related to the project CyberCars, a European 5FP project in the Information Society and Technology (IST) program. This latter project aims to accelerate the development of new technologies for cybercars.

Research results
To determine the user needs of a CTS, a two-step process was used. First focus groups were organised, and, simultaneously, structured interviews were carried out. The interviewees were persons who could have a role in implementation of such systems, for example, decision makers, both public and private (businesses), as well as Public Transport operators, and concessionaires. One of the conclusions from these activities was that there is a latent need for such a system. Subsequently, TNO Inro developed an internet questionnaire aimed at end users in order to gain more detailed information. The questionnaire was first tested in the Netherlands and then put on the internet in five different languages.

In the questionnaire, respondents were asked to design his or her ideal CTS. The advantage of an internet questionnaire is that it can be filled out by many people and that the length of the questionnaire can be reduced by representing the inquiry in such a way that only the relevant questions will be presented to the respondent. Of course there are some disadvantages too. For example only people with internet access can fill in the questionnaire and young people as well as elderly people might be excluded from the research.

In total 2.855 respondents from 24 countries filled out the questionnaire. The questionnaire was on-line from May till October 2002 in Dutch, and from August till October 2002 in the languages: English, French, Portuguese and Italian.

In filling out the questionnaire, respondents reacted differently in the beginning in comparison to the end. In the beginning respondents reacted with reserve to the idea of a CTS. In contrast, at the end of the questionnaire, practically everyone seemed to be enthusiastic about the idea of using cybercars. Almost 98% of the respondents did indicate that they will make use of the CTS. Remarkable is that car users and PT users indicated that they will make use of the CTS 'regularly' or 'almost always'; walkers and cyclists indicated that they will make use of the CTS 'incidentally' or 'regularly'.

Which transport relation is the most promising for a CTS
One of the first questions in the internet questionnaire is on which sites respondents can imagine a CTS. To determine the transport demand behind the choice, it was crucial to understand how CTS fits in and compares to other transport services. This has been determined with the help of Classification of transport supply [Egeter, 2000]. This method provides a functional categorization of transport supply by combining diverse characteristics of supply and demand.

In the case of the CTS, six applications were identified, and subsequently illustrated in the questionnaire in the following way:
1. Between a central car park and a business park.
2. At a holiday park.
3. From a central car park to the central business district.
4. From the (train) station to the university.
5. Between a central car park and a historic city centre.
6. From the (train) station at an airport to the departure terminal of an airport.

From the results of the questionnaire it appears that most people can *imagine* a CTS from the (train) station at an airport to the departure terminal of an airport. When they were asked to indicate the location which are most *useable* in their own situation, it appears that they prefer to choose an application that could be used daily: between a central car park and a historic city centre (27%) or the central business district (26%).

Design of a CTS
The cybercar, preferable, has doors on both sides. About 75% of the respondents chose this option instead of a cybercar with only one door. And, according to the respondents, the vehicles should contain 5 to 10 seats, which is definitly more than the 2 to 4 seats that most commercial parties nowadays offer. Another striking result is that 68% prefer a vehicle with a modern design, although precisely what a modern vehicle is, is not covered in this survey. Furthermore, over 40% of the respondents are willing to pay 2 Euro's for a ride in the CTS.

From the results we learn that the respondents prefer a stop with a bus shelter. 53% of the respondents indicated that they prefer a bus shelter over a waiting room (36%) or a pole in the ground (11%). However it appears that elderly people prefer a waiting room. Moreover the stop has to be furnished with some additional facilities. For example almost 70% of the respondents indicated that they prefer a monitor with actual travel information and a map of the surrounding area. An internet unit at the stop is not seen as necessary since only 13% of the respondents think that an internet unit belongs to the first three most important facilities at a stop.

More than 75% of the respondents find a walk of 5 minutes to/from a stop acceptable. When the distance to the stop increases to 10 minutes, only 30% of the respondents are willing to accept this walking time. Therefore the ideal CTS have a stop within 5 minutes walking time of the origin/destination.

A most remarkable conclusion is that the cleanliness of the CTS is rated higher in importance than -for example- safety. Apparently, most people are annoyed by the current degeneration of some public transport systems. Or they just assume the CTS is safe – it goes without saying.

How to proceed?
Based on the results of this survey, transport in the direction of the (historical and business) city centre from a car park seems to be most desirable. Potential end users express quality demands on the design of a CTS (tailor made passenger transport) and functional demands on the service (safety and reliability). Furthermore there seems to be a willingness to pay.

On the basis of the results of the questionnaire only one recommendation is possible: more field trials are wanted to proceed the acquaintance with the CTS, to detail the quality demands and to make the functional demands applicable, and to test the potential use in reality.

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1 INLEIDING

Steden hebben te maken met toenemende problemen op het gebied van congestie, geluidhinder, parkeerdruk en verkeersemissies. Een oplossing voor deze problematiek kan een cybercar zijn. In deze rapportage wordt gekeken naar de wensen van de gebruikers van zogenaamde *Cybernetic Transport Systems* (CTS). Deze rapportage maakt gebruik van de gegevens die TNO Inro verzameld heeft in het kader van het Europese project CyberMove.

CyberMove is een onderzoeksproject in opdracht van het EU directoraat generaal voor *Energy and Transport*, in het kader van het programma 'City of Tomorrow and Cultural Heritage'. Het project is gestart in december 2001 en zal in 2004 resulteren in drie of meer pilots met cybercars in Europese steden. Het project is sterk gerelateerd aan het project CyberCars (in opdracht van het EU directoraat generaal Information Society and Technology). Dit project heeft het ontwikkelen van nieuwe technologieën voor cybercars tot doel. TNO Inro participeert in beide projecten.

Cybercars zijn schone en stille voertuigen die volautomatisch rijden. Zij bieden vraagafhankelijk vervoer; zowel in tijd als in ruimte. Dit type transport kan een oplossing zijn voor de steeds verder oplopende stedelijke problematiek, zoals congestie, geluidshinder, parkeerdruk en verkeersemissies.

Figuur 1.1: Voorbeeld van een cybercar.

Op onderdelen is de techniek voor *cyber transportation* reeds beschikbaar. Computersturing, obstakeldetectie, voertuig-voertuig communicatie, automatisch parkeren/halteren, tele-navigatie en diverse wijzen van plaatsbepaling zijn technieken die reeds afzonderlijk toegepast worden. Wanneer deze technieken in één voertuig worden gecombineerd, wordt er gesproken over een cybercar. Een vloot van cybercars op een netwerk van wegen, met een 'vraagafhankelijk' karakter en een vervoeraanbod van 'deur-tot-deur' wordt een CTS genoemd. De innovatieve voertuigen worden gecontroleerd en gemanaged door een centrale computer en vinden hun eerste toepassingen bij vervoervragen in de bebouwde omgeving (bijvoorbeeld de Parkshuttle in Capelle aan de IJssel en de Parking Hopper op Schiphol).

In het beginstadium zijn cybercars bedoeld voor de korte afstand (max. 5 kilometer), met een relatief lage snelheid (de eerste generatie van de Parkshuttle in Capelle aan de IJssel had bijvoorbeeld een maximum snelheid van 40 km/h) en zullen ze rijden in de bebouwde omgeving, of worden toegepast op 'eigen terrein'. Op langere termijn zullen cybercars met hogere snelheid kunnen rijden en zich veilig mengen met het overige verkeer.

De eerste mijlpaal van het project CyberMove was het kiezen van geschikte testsites [CyberMove, 2002]. Hiervoor is aan de partners van het project gevraagd om steden aan te geven die eventueel geschikt zijn als testlocatie. Dit resulteerde in 18 aanvragen (16 uit Europa, 1 uit Israël en 1 uit Australië) waar vervolgens door middel van selectiecriteria twee werkelijke demolocaties uit naar voren zijn gekomen. Het betreft hier de locaties 'Rivium II' in Capelle aan de IJssel en 'Ouchy' in Lausanne. Daarnaast is er gekozen voor het bestuderen van een aantal theoretische locaties. Het betreft hier Kopenhagen, 'Crissier' (verbinding met het station) en 'EPFL' (universiteit) in Lausanne, Antibes en Nancy in Frankrijk en Werfenweng (een wintersportplaats) in Oostenrijk [DITS, 2002][2].

Deze rapportage is gebaseerd op een andere mijlpaal binnen het project; het analyseren van de wensen van de gebruikers van CTS. De data voor deze analyse is verkregen middels een internet-enquête[3]. Door het invullen van deze enquête kan een potentiële toekomstige gebruiker op een interactieve manier bij het ontwerpproces betrokken worden. Daarnaast is deze methode van informatieverzameling sneller, minder kostbaar en bereikt bovendien een grotere doelgroep dan een 'klassieke' enquête. Omdat het invullen van de enquête zo'n 15 minuten duurt, zijn degene die de enquête invullen voornamelijk mensen die interesse hebben in het onderwerp. Dit is een nadeel van deze internet-enquête. Bovendien worden in zijn algemeenheid oudere mensen vaak niet betrokken bij een onderzoek middels een internet-enquête. Deze mensen hebben in vele gevallen geen internetaansluiting waardoor ze niet de mogelijkheid hebben om dit soort enquêtes in te vullen.

De volgende hoofdstukken van deze rapportage zijn opgesteld in het Engels. De meeste tekst is rechtstreeks overgenomen uit de rapportage die geschreven is in het kader van het Europese project CyberMove [TNO, 2002]. De originele rapportage is onder andere op te vragen via de website van het project: http://www.cybermove.org.

Het volgende hoofdstuk gaat uitgebreid in op de doelstelling van het project CyberMove en de reden van het CyberMove project om een onderzoek naar de gebruikerswensen in te stellen. In hoofdstuk 3 wordt ingegaan op de achtergronden bij dit onderzoek en wordt bovendien ingegaan op de reden tot en de problemen met het uitvoeren van een internet-enquête. In hoofdstuk 4 wordt o.a. dieper ingegaan op de opbouw van de en-

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[2] In januari 2003 is om divergerende redenen Biaritz (Fr) alsnog aan deze lijst toegevoegd.

[3] TNO Inro heeft goede ervaringen met het uitvoeren van internet-enquêtes. In het verleden heeft zij bij het uitvoeren van een onderzoek naar een innovatief fietsconcept, MITKA genaamd, deze methode voor het eerst toegepast [Broeke e.a., 2000]. Ook bij een onderzoek naar een fietssnelweg is een Internet-enquête toegepast [Wilmink e.a., 2000].

quête en wordt een verantwoording gegeven van de gekozen steekproefgrootte. Hoofdstuk 5 behandelt de specifieke problematiek van de 'virtuele site'. Hoofdstuk 6 geeft de einduitslag van de enquête weer en hoofdstuk 7 is gewijd aan de analyse van de database. De rapportage wordt in hoofdstuk 8 afgesloten met conclusies en aanbevelingen.

2 PROJECT STATEMENT

Cybercars are road vehicles with fully automated driving capabilities. A fleet of such vehicles forms a Cybernetic Transport System (CTS), for passengers or goods, on a network of roads with on-demand and door-to-door capabilities. The fleet of cars is under control of a central management system in order to meet particular demands in a particular environment.

2.1 Objective of the CyberMove project

The main objective of CyberMove is to accelerate the development and implementation of CTS for movement of people and goods. These systems aim at improving the mobility, while reducing negative effects of the private car use in cities, by complementing mass transit systems and hence offering a real alternative with better convenience and efficiency than the private car in the cities.

CyberMove focuses on bringing together all European actors of this field, in order to test and exchange best practices, share some of the development work and make faster progress in the experiments. Several cities throughout Europe will collaborate with the partners in the project, studying the potential to run such systems, providing their specific constraints and accepting to do some preliminary tests of technologies and demonstrations. Co-operative work with selected cities will lead to conceptual design of systems for specific sites, optimised with regard to mobility, energy, environment, safety and will lead to the evaluation of these designs.

CyberMove is funded through the EESD-Programme (Energy, Environment and Sustainable Development) and started in December 2001. CyberMove has a 'twin sister' project with the same objective, called CyberCars, which is funded through the IST-Programme (Information Society Technology) and started in August 2001. Both projects are funded for three years.

Partners in the CyberMove project are:
- Inria (France);
- Dipartimento Idraulica Trasporti e Strade, University of Roma, "La Sapienza" (Italy);
- TNO (Netherlands);
- TRG, Transportation Research Group University of Southampton (UK);
- GEA, Groupe d'Etudes en Aménagement (Switzerland);
- Frog Navigation Systems (Netherlands);
- Yamaha Motor Europe NV (Netherlands);
- Fiat Research CRF (Italy);
- Robosoft (France);
- CN Serpentine S.A. (Switzerland)
- Technion (Israël);
- University of Bristol (UK);
- ISR, Instituto de Sistemas e Robotica, University of Coïmbra (Portugal);
- RUF (Danmark), and
- Griffith University (Australia).

2.2 User Needs Analysis

One of the aims of CyberMove is determining user needs in relation to CTS applications. To assess the user needs, two types of analysis have been done. At first TNO Inro has held some focus groups and structured interviews. The results are reported in the work of TRG [2002]. The various activities carried out showed a discrepancy between responses on a theoretical subject and on opinions on systems people have personal experience with. Therefore the universally mentioned concern about a CTS in a shared environment has to be seen in context with the fact that a system like that does not exist yet, with the Schiphol and Rivium systems being the closest operating systems to it, and therefore no group participant or interviewee having personal experience with it. This main issue can therefore change substantially with growing experience and exploitation of the technology.

The second part of the user needs analysis is the use of an interactive questionnaire. It aims at the challenge of people's imagination to conceptualise virtual sites and state their preferences based on this vision. The results of this last analysis are reported in this document. It contains the explanation of the work that is carried out, the motivation for choosing the interactive questionnaire, and the frame for expectations on the results. Sequentially the results of the questionnaire are being summed up, analysed and explained. And finally conclusions have been drawn upon the results.

3 BACKGROUND AND OBJECTIVES OF THE SURVEY

User needs have been examined via focus groups and structured interviews. The results are reported in TRG [2002]. The participants in the focus groups were exclusively the potential end-users of a CTS. The structured interviews covered the needs of three other very important groups comprising the decision makers: potential CTS operators, public authorities at various governmental levels and (large) businesses that could implement a CTS on their own terrain.

However, more quantitative research is needed to deepen the conclusions that have been drawn from this part.

3.1 Focus groups and structured interviews

TRG [2002] investigated user requirements and perceptions of CTS. An analysis framework was developed to establish which user groups and sub-groups are involved in the process of implementing, decision-making, planning, operating, using and being effected by a CTS. Based on this framework a resulting matrix of site and application characteristics was developed. The aim of the analysis was to cover the user requirements of all user groups, according to the analysis framework. The analysis was carried out on various levels, involving different activities.

According to the analysis framework, developed as a preliminary step for planning further activities, the user needs analysis will, on the highest level, investigate requirements for end-user, who could be potential system users, or non-users, who are effected by the system, decision-maker and operators, both in case of a public application and decision-maker / operator combined for the special case of a private application. According to different user group and/or site characteristics, different activities were carried out in order to obtain responses on the concept of a CTS from all user groups involved.

The activities carried out for the user needs analysis included a literature review on CTS related transport systems, moderated formal group discussions (focus group technique) and structured interviews with interviewees representing various user groups and subgroups. The literature review covered the system operating characteristics and the user requirements for various systems related to the CTS technology. These related systems included automated transport systems, demand-responsive transport systems and carsharing/ -pooling schemes. The review was carried out on related examples, as there are no user needs analyses for CTS yet.

The focus groups were carried out to obtain responses from end-users with general needs on present urban transport issues, user requirements and perceptions of the CTS technology for different technology levels, including the short-term (e.g. 2005, relating to the CyberMove city test sites) and the long-term scenario (e.g. 2030, relating to the long-term definition of CyberCars) and whether they can potentially be a solution to problems in urban transport. Structured interviews were carried out to cover all other user groups involved and their views on the use of a CTS in urban environments.

The literature review on CTS related systems unveiled gaps in the literature on user requirements. Most references only contained lists with envisaged user requirements, instead of results of market research with actual users involved, reinforcing the decision to carry out group discussions (focus groups) and interviews for the analysis of user requirements and perceptions for a CTS.

The focus groups activities revealed a common inability of group participants to envisage the use of the CTS technology in a shared environment with other traffic, including manually driven vehicles, bicycles or pedestrians, despite a general trust in the technology involved. Potential applications of the CTS technology imagined by group participants were therefore mainly in contained environments.

The structured interviews again showed concern about the use of a CTS in an environment mixed with other traffic. But a high potential for CTS technologies to solve some of the present transport problems was acknowledged, however concern about operational, political and institutional issues in view of the actual implementation of CTS technology, especially in urban environments was expressed.

The variety of activities carried out in context of the user needs analysis for CTS revealed a conflict between the perception of a theoretical subject presented and an actual existing system, which can be used and experienced. This has to be considered in context with the concern about a CTS in a shared environment. The results of this analysis may change with growing experience and exploitation of the CTS technology.

3.2 The need for more quantitative research

The focus groups and structured interviews provided a good overview of how various user groups looked at a CTS, what is important to them and whether those systems are at all credible for future implementation. What we know is what user groups say is important, and that there are differences between the groups. From a transport analysis point of view, however, this information just begins to scratch the surface. There is much more that we would like to know. The biggest gap in the User Needs Analysis knowledge is at this moment in the area of the end-users (consumer perspective). Building on what was learned in the focus groups we aim to gain more detailed quantitative and qualitative information. Specifically, the following topics are of interest:

- *Who are the potential users of a CTS?* Do users form a homogeneous or heterogeneous group? Are they one-time users or regular users? Locals or tourists? How much are they willing to pay? What specific requirements do these groups have? What is the composition of the household? Does it make a difference whether the users are Dutch or Swiss?
- *When and why do they want to use the CTS?* Do they use the system in peak or off-peak periods? For what purpose do they use the CTS: commuting, shopping, leisure activities? Is the CTS use part of a chain of mobility, combined and integrated with other transport modes, or is it a stand-alone, door-to-door service?
- *Where do users want to use the systems?* Do users envision the systems in urban areas, at transferia, or in low-density living areas?
- *What physical and operational attributes do the vehicles, stops and the infrastructure have?* Which are “absolute musts”, which are “nice to haves”? Should the system be

on-call or have a fixed (frequent) schedule? How many people can ride in the vehicle?

Answers to these questions will provide more information to ultimately answer the question about the perceived latent potential demand that exists for these systems. It will also provide insight into what existing alternative modes meet the transport requirements of the end users. Will cybercars generate new trips? Or will there simply be a change of modes for existing trips? Ultimately, the final question that we want to answer is: Does a CTS have the possibility of being a commercially viable system?

3.3 Why to make use of an interactive questionnaire?

To get the type of desired information about individual users, their needs, choices and preferences, in-depth interviewing or surveys are needed. In the context of CTS, there are special requirements placed on the surveys. This is due to the fact that the survey would be based on a stated preference approach, about something that does not yet exist and is difficult to imagine. This last point is critical: the survey medium must enable the interviewees to visualize what it is they are being questioned about. In essence, it must transport them in space and time. An interactive internet-based questionnaire offered a promising way; open to everyone with internet access. TNO developed and tested such a questionnaire, before it was made public on the internet and then translated it for use in a total of five languages.

TNO's experience with internet-questionnaires in the past was quite positive. The MITKA questionnaire, about a future type of hybrid bicycle-vehicle, was positively viewed by the respondents [Broeke et al, 2000]. Furthermore, based on the stated preferences of the respondents, conclusions on how to design and promote the "MITKA" could be drawn.

Using the MITKA experience, the CyberMove interactive questionnaire was designed to extract stated preferences, information about the respondents, and reactions to the sites at which a CTS could operate. All this was carried out in such a way that the survey was personalized so that only relevant questions and responses, based on previous answers, were shown. That meant that several benefits could be realized:

- Choices about vehicle configurations, stop amenities, and locations were combined into images to assist the user in imagining their choices for the CTS;
- Respondents could pick and choose facilities throughout the questionnaire, then modify choices by "going back" if they changed their mind;
- The length of the questionnaire could be shortened by personalizing the survey (by avoiding irrelevant questions for individuals);
- Easy access to the survey was provided via internet. Any internet connection allowed the user to fill in the questionnaire, eliminating physical barriers, and
- Upon completion of each questionnaire, the results were stored immediately in the electronic database.

In spite of the many benefits, there are also drawbacks to the internet-based approach. Access via internet introduces bias. Only internet users can fill in the questionnaire. That means that persons without internet access were far less likely to be represented in the database. Efforts to neutralize the drawbacks included publicizing the survey via other media, such as the newspaper.

4 CREATION OF VIRTUAL SITES

One specific issue we dealt with was the matter of the 'virtual sites'. Virtual sites are sites the respondents of a questionnaire can imagine. Besides these sites have to be applicable for CTS.

4.1 Site characteristics

The CyberMove project has defined a typology to make a selection of sites that are suitable for a pilot. These sites are indicated in the report 'site selection' [DITS, 2002]. This typology divides the different transport systems into functional characteristics. The typology is strongly reasoned from a transport area, which you can see in table 4.1. Figure 4.1 indicates which areas and accompanying transport relations are meant by the terms 'city-wide', 'city centre' and 'periphery'. The arrows within the centre indicate the movements which can be summarized in the term 'city centre', the arrows from the centre to the periphery indicate the 'city-wide' movements and the arrows within the periphery indicate the 'periphery' movements.

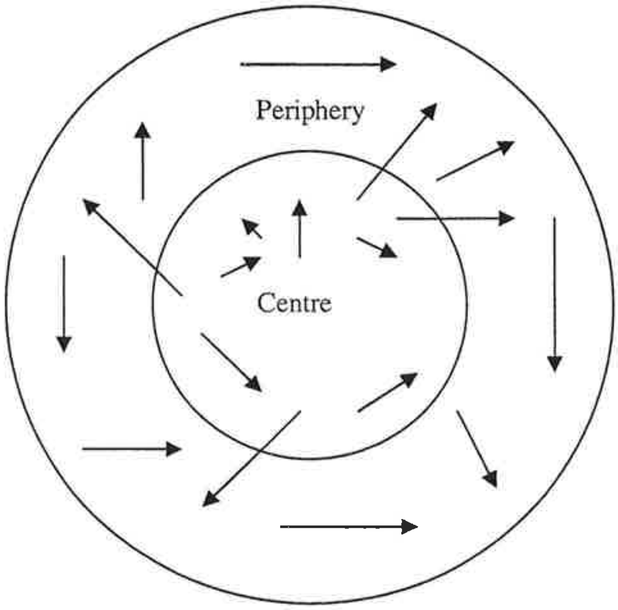


Figure 4.1: 'City-wide', 'city centre' and 'periphery' movements.

The problem with this typology, particularly the movements from class B in table 4.1, is that naming a site does not describe a transport system. At the concerning location different transport relations are possible. At the airport it is for example possible to travel by cybercar between a central car park and the entrance of the departure terminal of the airport (one to one relation) or between the check-in desks and the different gates (many to many relationships)[4].

[4] The meaning of 'one to one' and 'many to many' relationships is described in section 3.4.4.

Table 4.1: Site characteristics.

Class A:	**Public applications**
A.1	City-wide
A.2	City centre
	A.2.1 For general users
	A.2.2 For special users: tourists, conference centre, etc.
A.3	Periphery
	A.3.1 For general users
	A.3.2 For special users: business-park, shopping centre, etc.
Class B:	**Private applications**
B.1	Airport
B.2	Theme-park
B.3	Large business park
B.4	Tourist resort
B.5	University campus

It appears that this typology is not useful for the execution of the internet questionnaire. In a questionnaire one has to indicate clear which transport relation you mean, such that the respondent knows what is meant by this. To say more about the transport relations in a transport area, it is important to look at first to the transport markets (and the accompanying transport relations) where a CTS is likely. To determine these transport markets we have used a method which is already used in the 'classification of transport supply' [Egeter et al, 2000] which is designed by TNO Inro. This 'classification of transport supply' offers a functional categorisation of the complete range of passenger transport available, which can serve as a base for the design and evaluation of multimodal passenger transport. This classification is based on functional characteristics that are directly relevant for the traveller. A distinction is made between a number of organisation forms, such as own transport versus transport services, individual versus collective transport and scale level. However there is not a distinction between transport markets.

4.2 The use of a classification with supply and demand characteristics

To create a good view of the applications where a cybercar can be likely, for drawing up this 'classification' (where the likely applications of a CTS are indicated), a distinction is made between supply and demand characteristics.
The demand characteristics can be divided into the following five categories:

1 *Spreading in time:* Indicates whether or not people arrive together on a certain node. For example there is no matter of spreading in time when a train arrives at a (train) station and the travellers have to be transported further by means of a cybercar.
2 *Spreading in space:* Indicates whether it is possible to travel to different nodes / destinations with the same mode of transport. When there is spreading in space this does not necessarily mean that there is a connection without intermediate stops. It is possible that the cybercar will stop at other stops as well before arriving at the destination stop of the traveller. This is also visualised in figure 4.2.

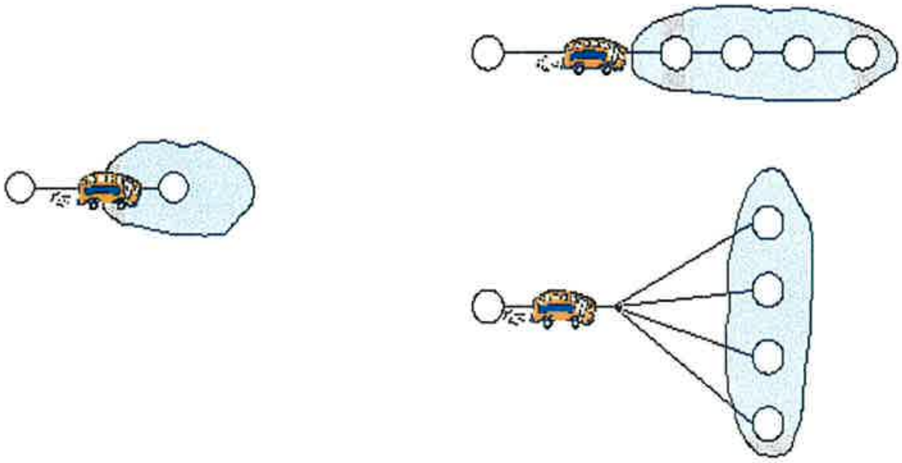


Figure 4.2: Differences between no spreading versus spreading in space.

3 *Activity density:* The activity density indicates how many people want to travel to a certain spot. So the activity density is high in the city centre, because a lot of people want to travel to it (for example for shopping or working reasons).
4 *Car use:* This term indicates whether people travel by car or with another transport vehicle to a certain area.
5 *Parking problems:* The term 'parking problems' indicates whether the one who travels by car have to look for a parking lot a long time. This can be caused for example by a lack of car parks and/or high parking rates.

Supply characteristics [Egeter, e.a., 2000] that have to be distinguished are:
1 *Individual transport:* Which means that the transport vehicle is reserved for one person or one group (an in advance compounded group of travellers with equal origin and destination) during the trip?
2 *Collective transport:* In this case many travellers make use of the same vehicle, combining different origins and destinations.

So there is not a direct relationship between the number of people in a transport vehicle and the 'rate of collectivity'. A rented bus by a company is considered as individual transport, a regional bus without passengers as collective transport.

To determine the likely markets of cybercars, a table (see table 4.2) is drawn up on the basis of above mentioned supply and demand characteristics. Likely applications of a CTS are for example niches in the transport market or a transport system with spreading in time. Furthermore a cybercar application is likely when there are parking problems in the transport area. However a cybercar is not likely in areas with a low activity density, because to few people will make use of the transport system.

Moreover a CTS is not likely in transport areas with no matter of spreading in space and spreading in time. In this case too many people will travel at the same moment to the same place. A CTS is not able to deal with this busyness. This is caused among other things by the relatively low speed of a cybercar. When there is a matter of spreading in space, but no spreading in time, a CTS can be likely. Because travellers travel to different places, the number of travellers at the concerning connection is limited and the transport system is able to carry on this travellers.

In table 4.2 the likely applications of a CTS are represented in grey.

Table 4.2: Transport typology CTS: demand and supply characteristics.

Demand characteristics					Supply characteristics	
Spreading in space	Spreading in time	Activity den-sity	Car use	Parking prob-lems	Individual	Collective
Yes	Yes	High	Yes	Yes	1	
				No		
			No	No	2	
		Low	Yes	Yes		
				No		
			No	No		
	No	High	Yes	Yes		3
				No		
			No	No		4
		Low	Yes	Yes		
				No		
			No	No		
No	Yes	High	Yes	Yes	5	
				No		
			No	No		6
		Low	Yes	Yes		
				No		
			No	No		
	No	High	Yes	Yes		
				No		
			No	No		
		Low	Yes	Yes		
				No		
			No	No		

In general it is said that in the near future (15 to 20 years) a cybercar is especially likely for distances of one to five kilometres. If the distance is below this level, travellers will walk because the time of waiting and travelling by cybercar is longer than the walking time. For distances of more than 5 kilometres the travellers will make use of the car or the current Public Transport. Because of the low speed of a cybercar (in relation to the car and the current Public Transport) it cannot compete on distances larger than 5 kilometres as to travel time with these transport systems.

The shaded cells with numbers in table 4.2 correspond with the examples of transport relations which are described in the next section.

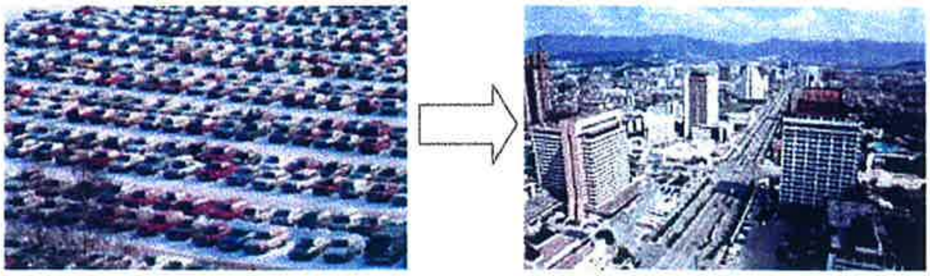
4.3 The use of example sites in the internet questionnaire

Some of the questions about the CTS refer to the transport areas the respondent concerns a cybercar applicable. The transport areas which are indicated in the questionnaire are derived from the likely applications of a cybercar that are indicated in the previous subsection.

The numbering below corresponds with the numbering in table 4.2.

Below an explanation is given on the different transport relations, so it is clear for the respondent what is meant by the concerning movement. Besides it appears that when a CTS will be successful, there has to be a problem in the concerning transport area.

1 Between a central car park and a business park

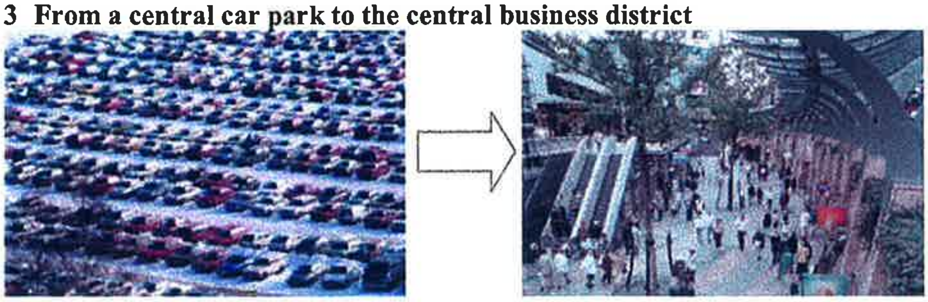


The visitor of a business park runs the risk that almost all the parking places are occupied during working time. That is why the seeking time to a parking place is high. To avoid wasting time looking to a parking place, a cybercar is introduced from the parking place at the edge of the business park to the companies at the business park. Because visitors arrive spreaded out over the day, it is possible to offer individual transport.

2 At a holiday park

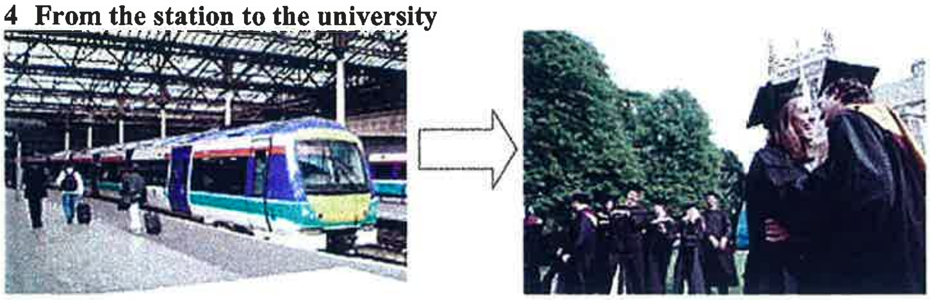
Different holiday parks are car-free to increase the safety at the park. However because especially at large holiday parks the distances between the holiday homes and the various recreational activities are rather long (between 1 and 5 kilometres), the vacationers can make use of cybercars. These bring the vacationers from any place to any destination. Because obstacle detection is not developed so far that cybercars can be used in mixed traffic, the cybercars will drive at special lanes and there will be pedestrian crossings. Because the transport demanders will make use of the CTS spread out over the day, it is possible to offer individual transport.

3 From a central car park to the central business district



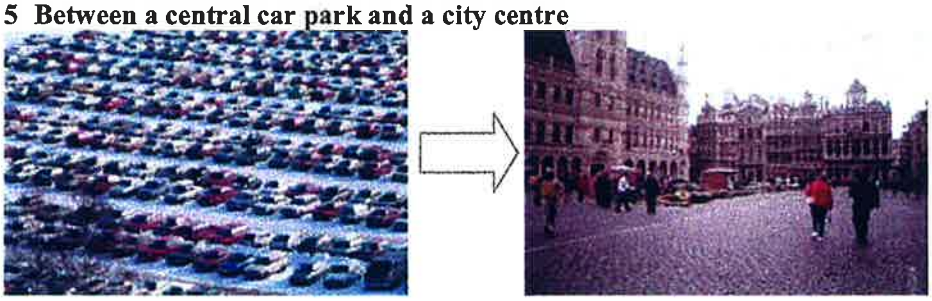
Many city centres are car-free or the number of parking places in the city centre is reduced. That is why the employees cannot park their car in the vicinity of their office. As an alternative they can make use of a CTS. The cybercars bring the employees from the parking place at the edge of the city centre to their own office. Because all the employees start working at approximately the same time, collective transport has been offered.

4 From the station to the university



Employees of the university and students have often to do with an enormous busyness in Public Transport in the morning. This has been caused by the fact that they start working or following classes at the same time. In stead of regular Public Transport (like busses and trams) the suppliers of these transport services can decide to deploy a CTS. The cybercars bring the employees and students to their own faculty. Because students and employees will make use of the CTS at the same moment, collective transport has been offered.

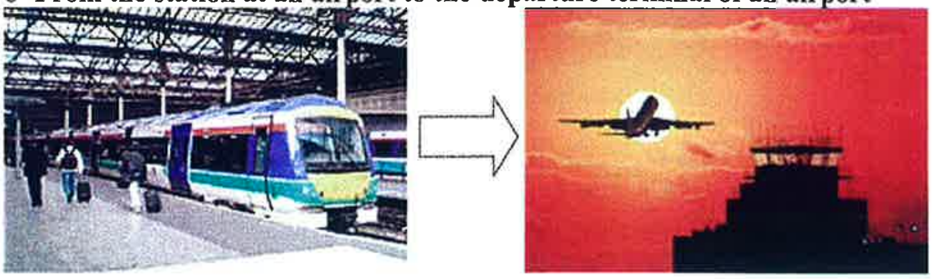
5 Between a central car park and a city centre



City centres are in many cases car-free. As an alternative, visitors of city centres can make use of a CTS. This transport system brings the visitors from a parking place at the edge of the city centre to a central place in the city centre. Because visitors arrive spreaded out over the day at the central car park, it is possible to offer individual transport.

The difference between the transport from a central car park to the central business district (see example 3) and the above described movement is that in this movement there is a matter of transport between two stops. However it is possible to travel by cybercar to different places (read 'offices') in the city centre in example 3. Moreover it is in this case possible to offer individual transport. The visitors arrive spreaded out over the day at the central car park in this example.

6 From the station at an airport to the departure terminal of an airport



Travellers who travel by train to an airport have often to walk or travel by bus to go to the departure terminal. To make this trip easier, a cybercar can be useful. Because the travellers arrive massively at the (train) station at the airport, but spread out over the day, collective transport is offered.

4.4 Overview of transport relations

The above described examples almost look the same in some cases. An example of this is the already indicated explanation of the differences between the movement 'between a central car park and the central business district' and the movement 'between a central car park and a city centre'. The different trips of the traveller can be summarized shortly in the following terms:
- One to one: from one node can be travelled to one other node.
- One to many / many to one: from one node can be travelled to several nodes (and reversely).
- Many to many: from every node can be travelled to every other node.

In table 4.3 an overview is given about the relationship between the different transport relations and the rate of collectivity and the examples that have been used in the interactive questionnaire. The numbers correspond with the given numbering of the examples in section 4.3.

Table 4.3: Overview transport relations / rate of collectivity and examples internet questionnaire.

	One to one	One to many / many to one	Many to many
Individual	5	1	2
Collective	6	3 + 4	Not relevant

The cell 'many to many – collective' is empty because a transport system with spreading in time and collective transport is not likely for a cybercar application. This has been caused by the chance that two or more travellers with unequal destination will make use of the transport system is very small. Therefore it is not profitable to offer collective transport.

4.5 Expectations for the selected field trials and feasibility studies

On the basis of the test site descriptions in the European project CyberMove [DITS, 2002] an estimation of the rate of spatial spread, temporal spread and activity density is shown in table 4.4.

Table 4.4: Transport demand characteristics.

Site	*Spatial spread*	*Temporal spread*	*Activity density*	*Promising combination[5]?*
Rivium (NL)	High	low	high	yes, if collective vehicles
Ouchy (CH)	Low	high	low (guess)	No
Antibes (F)	High	high	high	yes, if individual vehicles
Crissier (CH)	High	medium	high	yes, individual or collective depends on temporal spread rate
Copenhagen (DK)	High	high	high	yes, if individual vehicles
EPFL (CH)	High	low	high	yes, if collective vehicles
Nancy (F)	High	high	high	yes, if individual vehicles
Werfenweng (A)	High	high	low (guess)	No

This is, of course, a subjective interpretation of the real world. But it is on the other hand interesting to link the results of the internet survey to the layout of the CyberMove test sites, to indicate potentials for success. In the most right column the assumed transport demand characteristics are compared with the promising cells in table 4.2. It is shown that most sites seem to have the right combination of characteristics, under the condition that the service is exploited with collective vehicles, or individual. In the cases of Ouchy and Werfenweng it is doubtful whether the transport demand is high enough: the activity density is assumed too low.

[5] According to table 4.2

5 THE INTERACTIVE QUESTIONNAIRE

Together with the other companies involved in the CyberMove project[6] task partners TNO prepared the interactive questionnaire, formulated the questions, developed the different responding paths (because of the interactivity of the questionnaire), and supervised the web design[7].

After testing, the Dutch version of the questionnaire went on-line in June. In July the questions have been translated into Portuguese, French, English and Italian. And with just little adjustments on the introduction of the questionnaire, these four new language versions went on-line in August.

Although the overall number of respondents came out big enough to do a sound and solid analysis, promoting the questionnaire has been a hard job to do by ourselves. That is why TNO Inro decided to make use of an internet panel for the Dutch questionnaire. The other companies did the promotion by themselves.

5.1 Building the questionnaire

The preparations for building the questionnaire have been divided into three parts: formulating the questions; anticipating on the answers; and the statistic significance of the results.

5.1.1 Formulating the questions

In CyberMove we want to relate specific potential user groups to specific concepts in their spatial settings; we want to learn more about the design of the cybernetic transport system that people can imagine; and we want to know the conditions under which people would use them. This information, of course, can differ for short and long term perspectives.

Although we do already know some answers when we look at recent research on transport patterns, travel motives and developments in (public) transport, we need also to collect data in addition to the user groups' and structured interview results from the CyberCars user needs investigation. The questions can be outlined by following the steps below:

1 *Social Setting:*
The personal information of the respondent to identify his/her social setting in relation to travel demand.
- main activity: job (full-time, part-time), school, ...
- responsibilities: wage earner, parent, ...
- income: household budget
- mobility: age, disabled, ...

[6] The other companies are Inria/Serpentine/GEA (all France), Instituto Pedro Nunes (IPL; Portugal), DITS (Italy) and Transportation Research Group (TRG; United Kingdom).
[7] The specialist work of web designing was done by small Dutch firm called GRiPP.

2 *Travel Demand:*
His/her attitude towards travel demand patterns, both for him/herself and for others.
- high demands on time, price, comfort (or combinations)
- travel motives

3 *Spatial Setting:*
Identification of the spatial settings the respondent is familiar with, to focus the scope of the questionnaire
- the site selection categories:
  - public applications citywide and city-centre (general vs. specific use)
  - private (airport, theme-park, large business, tourist resort, university campus
- travel pattern typology

4 *Environmental Behaviour and Spatial-Economic Development:*
Merging the external developments (growing environmental awareness, spatial-economic developments, et cetera) the respondent foresees, with the spatial settings chosen.
- changes that might occur which will transform the transport market
- changes that might help to create space for a CTS

5 *Design of a CTS:*
Design of a CTS
- given a set of qualifications from the definition, how would the respondent design it
- including the subjects mentioned above (user groups, transport patterns, travel motives, etc)
- transport concept, design of the vehicle, lay-out of the track, specs. of the system

6 *Value Added Services:*
What more can you ask?
- social safety
- tourist information
- discount advertisements
- weather reports
- internet access
- ergonomics
- luxury, coffee and tabloids

7 *User Information:*
When, under what conditions, the respondent will use his/her CTS
- after the respondent has build his/her own CTS, will he/she use it (or: should others do so)?
- what kind of modal shift does it mean
- willingness to pay, and so on

In the end there will be some questions added for methodological means. These questions also concern controlling purposes. For example people riding a bike do not travel daily a great amount of kilometres. Incredible answers have been removed from the database.

5.1.2 *Anticipating on the answers*

The answers provided by the respondents will provide information about the different CTS's (**B**) in relation to the spatial settings (**A**) -as categorised for the site selection. Each cell (**C**) in the database we will build contains personal information on these subjects. An explanation of the different cells is indicated in table 5.1.

Table 5.1: Format of answers table.

<table>
<tr><td colspan="5">B</td></tr>
<tr><td rowspan="4">A</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>C</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

A **Spatial setting:**
The transport concept in its setting: Where would such a vehicle be useful or used? Design of cybercar (may be location dependent and time-horizon dependent). Design of configuration - link with test sites and site selection categorisation possible. Other categorisations include urban, rural, distance and travel patterns.

B **Concept:**
Design of / reaction to the cybercar, the design of the infrastructure, the service provided (on-demand vs. very frequent service), fixed routes or dynamic network, the technology of the vehicle (propulsion system, electric vs. ??), the services provided in the vehicle (tourist information, travel time, shopping information, advertisements, internet), the vehicle capacity, requirements vs. wish-list for concept, speed, design of the vehicle in relation to vandalism, safety, personal safety, attractiveness, hours of operation.

C **Background information:**
About the socio-economic group and other relevant personal / activity characteristics, car ownership, current modes and associated purposes for transport, spatial characteristics of where the respondents work, live, shop, etc.

5.1.3 Statistic significance of the results

The internet-based survey raises important methodological questions regarding the targeted respondent group and its composition, the necessary sample size, and how the potential respondents would be contacted. These questions are:
- **Who** are the targeted respondents? What is the importance of their geographical location? Should there be a focus on commuters or should all trip purposes be covered?
- The **composition** of the target respondent group: Should the average person be represented, or is the internet-user as early-adaptor the exact type of respondent sought?
- What is the necessary **sample size** per country and in total?

Targeted Response Group
The targeted response group is a sample of the general population. Concentration of targeted respondents around the field trial and feasibility study sites is not desired. Reactions to the CTS in general are desired. However, a virtual site offers the same testing ground. Furthermore, a variety of virtual sites also offer the option of asking potential respondents what type of site is most suitable for a CTS. Geographic spread in the respondent group is not necessary, unless a different geographic location of the respondent will lead to different responses to the CTS.

Composition of the sample
In general, internet-based surveys produce the same results as other interview methods. Thus, similar coverage and sampling errors can be made. In this section, we focus on issues specific to internet surveys. If the subject of the survey is independent of internet usage, then it is possible that the wrongly-chosen sample size does not bias the results. However, there are two instances in which the choice for an internet-based survey can bias the results. These are:

- *The penetration rate of internet users within relevant subgroups in the population differs among these relevant subgroups:* In this problem, there are two issues. The first is the knowledge of the relevant subgroups. For example, does the opinion, acceptance of potential use of the CTS depend on socio-economic status, or something else? Secondly, assuming it is known which subgroups are relevant for the issue at hand, another issue is the knowledge of internet penetration within these relevant subgroups. If both of these quantities are known, it is possible to correct for the internet penetration differences by making use of weighting and inflation factors in the proper proportions. Conclusions based on the survey results can then be drawn about the population in general.
  In the case of the CyberMove internet survey, there is no a priori knowledge of which subgroups are relevant for a CTS. That is in fact what we want to learn. More detailed information about the penetration rate of internet users in these subgroups is beyond the realm of this survey. However, this does not diminish the need that care must be taken in the analysis that the results are not generalized for the whole population.
- *If the views of internet users on the subject of the survey differ from non-internet users on the subject of the survey:* This problem does play a role in the internet-based survey conducted by TNO. Internet users probably have a different opinion about CTS on average than non-internet users. However, it is conceivable that early-adopters, such as internet users, will be the first users of a CTS in the early stages of such systems. The results of the survey provide a legitimate view of the first phases of the introduction of a CTS. This does not diminish the need that care must be taken in the analysis that the results are not generalized for the whole population.

Sample size
Finally, "It's size (of the sample) that counts. This argument implies that numbers are more important than quality, or alternatively that large numbers alone are an indicator of quality (i.e. reliability). For example, Kehoe and Pitkow [1996] write about the Graphics, Visualization and Usability (GVU) surveys: "Since we use non-random sampling and do not explicitly choose a sample, having a large sample size makes it less likely that we are systematically excluding a large segment of the population. Oversampling is a fairly inexpensive way to add more credibility to a non-random web-based survey." [Couper, 2001]

The required sample size is dependent on the targeted response group, which results are desired and the conclusions that we desire to draw. Here two guidelines for sample size are presented. The first concerns conclusions for the target groups. For each group, sixty completed surveys are needed. These results are presented in cross tabulations. Cross-tabulations can be used to determine whether there is a relationship between the level of education and the desired location of CTS systems.

A second rule for determining the necessary size of a sample is to take 100 times the maximum of the number of rows and columns, in order to insure that all the cells in the cross tabulation are filled. Using the example in the previous paragraph, a choice of four levels of education and six locations is possible. The sample size must be at least 600 using this guideline. The question in the CyberMove internet survey with the greatest number of possible answer categories determines the required sample size. In the current survey the question with the most answer possibilities is the question 'which problems do you usually encounter?" with 13 possibilities. Using this method, at least 1.300 completed surveys must be collected in order to draw statistically significant conclusions.

Finally, not all surveys are included in the analysis. For example, incompletely filled-in surveys are usually not able to be used. In addition, surveys that have not been taken seriously by the respondent should also not be included in the database.

5.2 The questionnaire on-line

After discussions and improvements, the questionnaire has been designed and programmed for the internet.

5.2.1 The challenge

To reach respondents from all over Europe, partners that also participate in the CyberMove project translated the questionnaire into five different languages. In July 2002 a Dutch version of the questionnaire has been put on-line, preceding the other languages and testing the on-line questionnaire. In September 2002 the other languages followed. The questionnaire has been closed on October 30.

It was very difficult to get enough respondents (to reach the above mentioned sample size) with own efforts. TNO Inro has used many promotion activities to stimulate people to fill in the questionnaire. An overview of the promotion activities and the results are indicated in table 5.2. The results from the mentioned PR-activities in The Netherlands have been 171 respondents in total. That is why TNO decided to do business with a professional market research agency called "R&M Interactive" to enlarge the amount of respondents. R&M Interactive makes use of a Dutch internet panel.

TNO Inro signed a contract that guaranteed 2.000 filled out questionnaires. Part of the contract was a token of appreciation of EUR 3,50 for each of the respondents (2.000 at maximum). The other partners in the CyberMove project did not decide to make use of an internet panel. They promote the questionnaire by themselves. That is the reason why the Dutch respondents are overrepresented in the sample.

The fieldwork of R&M Interactive has been described in the next paragraph.

Table 5.2: Dutch promotion activities.

Promotion activity	***Result***
Announcement to main search engines	Search engines added a link to the questionnaire
Using a banner at the TNO Inro homepage to promote the questionnaire	Banner is put on the TNO Inro website
Sending the banner to other TNO institutes	None of the other institutes put the banner on their website
Sending the banner to other Dutch companies that are involved in the CyberMove project	None of the other Dutch companies put the banner on their website.
Sending the banner to Dutch ministries	None of the Dutch ministries put the banner on their website because company policies prohibited this kind of products
Asking the same companies, ministries and knowledge institutes to add a link to the questionnaire	None of them decided to add a link to the questionnaire on their website
Asking some magazines and websites about Public Transport to put a link on their homepage	One of them decided to add a link to their website
Mailing colleagues of TNO Inro to fill in the questionnaire	20% of the colleagues decided to fill in the questionnaire
An article about cybercars and the questionnaire has been put on the intranet of TNO	50 people (out of 5.000) decided to fill in the questionnaire
Colleagues of TNO Inro were asked to forward the link to other people	60 people decided to fill in the questionnaire
The questionnaire is announced in the mailing newsletter of the Dutch brand-magazine 'Verkeerskunde'	About 10 people (out of 5.000 – 10.000 people) filled in the questionnaire
Two time, both on Saturday, a little announcement has been published in three national newspapers	No more than 5 people responded to these advertisements

5.2.2 *The internet panel*

The following procedure has been used by R&M Interactive to carry out the fieldwork:

- Invitation by e-mail to (gross) sample of members of the R&M Interactive internet-panel;
    - This e-mail contains a hyperlink to the online questionnaire and a personal access code (this code prevents that members fill in the questionnaire more than once (for instance to get more than one incentive));
- In the first screen of the online questionnaire it is (among other things) explained that:
    - the study is carried out on behalf of the (well known) organization TNO;
    - After this introduction respondents can click a button to gain access to the main questionnaire.
    - The online questionnaire has been filled in already;
    - Panel members that have not completed the questionnaire receive a reminder by e-mail.

- R&M Interactive sends out a personalized e-mail to members of the R&M Interactive internet-panel. This mail contains (among other things):

  - o a hyperlink to an introduction screen (easy to remember URL: www.webvragenlijst.nl/tno);
  - o personal access code (this code prevents that members fill in the questionnaire more than once (for instance to get another incentive)).
- In this mail it is explained that:
  - o all answers remain anonymous and will only be used for research purposes;
  - o persons who fill in the questionnaire receive an incentive of € 3,50 (this amount will be paid to their own account or to the account of a charity organization of their choice);
  - o the lay out of the questionnaire differs somewhat from the lay out respondents are used to.
- Panel members that have not completed the questionnaire receive a personalized reminder by e-mail.
- The online questionnaire offers access to a so called help page that contains information about:
  - o how to fill in the questionnaire;
  - o an e-mail helpdesk (answers questions within 24 hours);
  - o call me now service.
- The online questionnaire also offers access to a so called privacy page that contains the following information:
  - o how to contact the research agency R&M Interactive;
  - o privacy statement;
  - o the research agency is a member of the organization of Dutch market research agencies (called MOA), the European organization of market research agencies (ESOMAR) and has ISO certification.
- The online questionnaire can be completed using a popular browser (Netscape Navigator/Communicator 4 or higher; Microsoft Internet Explorer 4 or higher; Opera).
- The online questionnaire can be filled in using a PC or Apple Mac computer.
- Before the fieldwork the online questionnaire is tested, using various types of browsers, at various resolutions on a PC and a Mac.

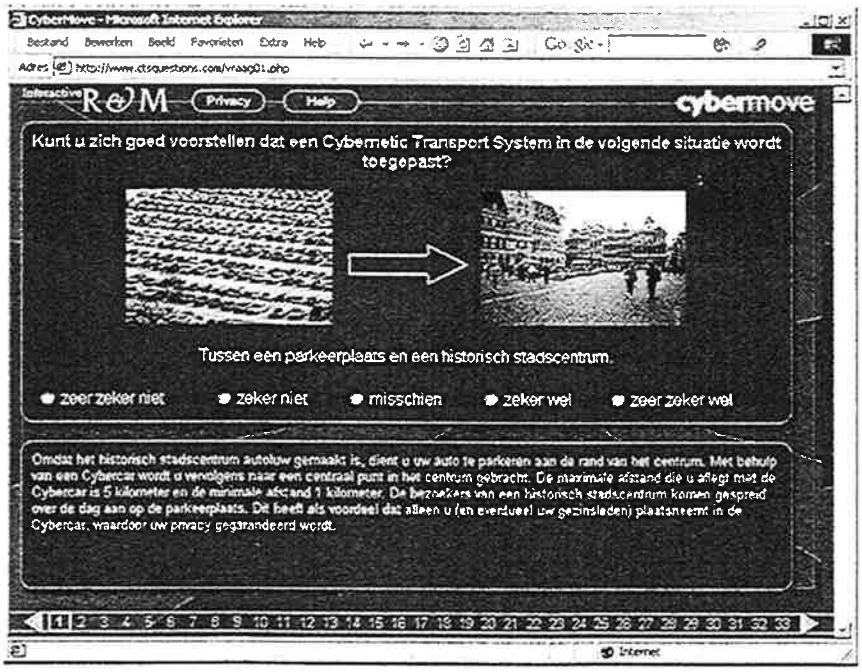


Figure 4.1: Screenshot CyberMove questionnaire R&M Interactive.

The sample consists of 2.066 members of the R&M Interactive internet-panel. This panel has the following characteristics:
- approx. 12.000 members;
- recruitment by nationally representative telephone and postal surveys;
- panel members participate in surveys approx. once a month;
- panel members have access to a dedicated website (www.internet-panel.nl) and receive e-mails always from the same person.

In table 5.3 some characteristics about the response are summarised.

Table 5.3: Response rate R&M panel.

Gross sample	**3.000**
- mail bounced	0
Net sample	**3.000**
- refusal (respondent sends e-mail, mail or gives phone call)	2
- online questionnaire partly filled in	571
- does not log in to online questionnaire	363
Sample complete questionnaires	**2.066**
Response rate	**69%**

6 STATED PREFERENCE OF THE RESPONDENTS

The main question the interactive questionnaire had to answer was whether or not a CTS is a promising transport mode.

6.1 The ideal CTS

What are the most promising applications for a CTS? This chapter describes the results of the internet questionnaire, where the main focus is on how promising the application of this innovative transport system for the city of tomorrow can be.

Most people picture a CTS at airports, but at the same time they are more interested to explore the possibilities of a CTS in their daily trips. In the beginning, respondents react reserved to the idea of CTS's, but at the end of the questionnaire, practically everyone is enthusiastic of the idea of using a cybercar in their chosen application. That is, of course, a promising perspective.

The most remarkable conclusion is that the cleanness of the vehicles and stops is rated more important than for instance safety. Apparently, most people are annoyed by the current degeneration of some public transport systems. Furthermore, they want to be able to stop the vehicle by pressing a button, but are less concerned about a door opening device to leave the vehicle in emergency situations.

Unexpectedly, camera surveillance is not rated as important as in-vehicle tourist information

The perfect CTS needs:
- a bus shelter at the stop;
- actual travel information at the stop;
- a toilet at the stop;
- a scheduled transport service;
- a modern appearance;
- vehicles with 5 to 10 seats;
- a non-transparent vehicle (only windows); and
- doors on both sides.

At origin and/or destination the cybercars have to stop within 5 walking minutes of their target.

More than half of the respondents are willing to pay 2 Euro per trip.

6.2 The ideal CTS compared to the field trials and feasibility studies

If we compare these 'condensed' results to the selected sites for field trials and feasibility studies, what can we expect?

The specific characteristics of the sites are listed in table 6.1. An attempt has been made to classify the sites to the virtual sites used in the internet questionnaire. The stated transport problems in the description are listed, as is the complementary the CTS will offer. In the last column a comparison is made between the described CTS and the 'perfect' CTS of the internet survey results. Only the differences that are apparent are included (i.e. none of the descriptions is mentioning the presence of a toilet at the stop, but none of them is explicitly describing CTS stop facilities either).

Table 6.1: Site comparison with the ideal CTS.

Site	*Type of virtual site*	*Transport problems*	*Complementary*	*Differences*
Rivium (NL)	Central car park or underground station to business park.	Lack of parking space, low frequency and slow public transport. No bicycle route.	Short waiting times. High door-to-door speed.	Demand responsive transport service.
Ouchy (CH)	Recreational area (most similar to holiday park).	Not public transport service.	Provides public transport.	Individual vehicles.
Antibes (F)	Central car park to historic city centre.	Lack of parking space. Historic centre not suitable for cars. No reserved lanes for bus services.	Provides high frequency service: currently not possible. Service reaches high density. Historic urban area.	Demand responsive transport service.
Crissier (CH)	Central car park/station to shopping centres (most similar to central business district).	Car accessibility at commuter peak hours. Accessibility at shopping hours.	*(Not clear, maybe higher frequencies?)*	Man driven platoon service.
Copenhagen (DK)	Central car park to historic city centre. Station to central business district.	Lack of parking space. City not suitable for cars.	Fast public transport, not hindered by other traffic or traffic lights.	Driver needed for MaxiRUF.
EPFL (CH)	Station to university.	Long walking distances due to decentral location of public transport stops.	Is intended to replace walk trips from public transport to university buildings.	Individual vehicles, driving in platoons during peak hours.
Nancy (F)	(Not clear: no car park nor station seems connected to both sites)	City not suitable for cars?	Alternative for walking or current city shuttle?	Man driven platoon service (in pilot application).
Werfenweng (A)	Holiday park	Long walking distances inside village and between parking lot and resort. Snow.	alternative for walking	Individual vehicles, driving in platoons during high demand periods.

Remarkably, most of the sites will offer individual vehicles, while one of the outcomes of the survey is that travellers prefer collective vehicles. The platooning service during peak hours that four of the sites offer seems therefore unnecessary, although in Crissier and Nancy the platoons are introduced because of the presence of cybercar drivers. At exactly those two sites the description is not clear about the surplus the CTS is offering to the current transport supply.

The most described transport problems can also be found in the results of the survey: to car users the lack of parking spaces and the crowded access roads are annoying, while public transport users don't like delays, waiting and crowded vehicles. That kind of problems can be found frequently in the third column.

7 ANALYSIS OF THE DATABASE

The database contains lots of information. The figures of most importance are being presented in this chapter.

7.1 Methodology

We wanted to relate specific potential user groups to specific concepts in their spatial settings; we wanted to learn more about the design of the CTS people could imagine; and we wanted to know the conditions under which people would travel with them.

To answer this question, one major condition seems to be unquestionable: *a CTS does provide a higher value than other transport modes; why else should we bother?*

This prerequisite can be subdivided into three conditions:
- the transport system connects the right places (**the spatial setting**), so that enough potential passengers can be obtained;
- the transport system has sufficient transport speed, suitable prices, sufficient comfort, reliability and safety (**the quality**), and
- the transport system contains the right accessories (**the design**).

These conditions have been the main focus in the questions of the internet survey. Potential users have been asked about their social setting, their travel demand characteristics, interesting spatial settings, preferences for the design, et cetera.

These are the steps that have to be taken to design the CTS with a winning transport typology:
1. Rank the most preferred application;
2. Apply the opinion of end users on the design of the concept;
3. Assess the likelihood that people will use the concept related to their modal split of today, and
4. Combine these results with personal characteristics, like gender, age, nationality, et cetera.

The output of this excersition has been written down in chapter 6.

The analysis is divided into three subcategories of tables: general personal characteristics of the respondents, spatial setting and design of the CTS. We tried to keep the number of tables as low as possible, just to single out the most interesting results.

7.2 Personal characteristics of the respondents

With more than 2.000 questionnaires completed, sound and solid conclusions could be derived from the database.

7.2.1 *How many people have filled in the questionnaire in the different countries?*

In table 7.1 the number and origin of respondents that have filled in the questionnaire has been indicated. Most people come from The Netherlands (78,9%), but also France has a remarkably high share (8,8%). Related to the population, Portugal (1 on 128.000) and Switzerland (1 on 166.000) are of the same order of magnitude as France (1 on 237.000). Comparison: in the Netherlands 1 on 7.000 inhabitants have filled in the questionnaire.

Table 7.1: Number of respondents and origin of respondents.

Origin respondents	*Number of respondents*	*Population*	*Share*
Austria	1	8.169.929	0,0%
France	252	59.765.983	8,8%
Germany	7	83.251.851	0,2%
Israel	18	6.029.529	0,6%
Italy	42	57.715.625	1,5%
The Netherlands	2.252	16.160.000	78,9%
Portugal	79	10.084.245	2,8%
Switzerland	44	7.301.994	1,5%
United Kingdom	78	59.778.002	2,7%
Other countries	82		2,9%
Total	2.855		100,0%

The 82 respondents from other countries come from Belgium (38), USA (11), Japan (9), Brazil (4), Ireland (4), Denmark (3), Sweden (3), Greece (2), Spain (2), Australia (1), Czech Republic (1), Hong Kong (1), Martinique (1), New Zealand (1) and Uruguay (1).

The minimum number of required respondents is approximately 2.000, based on the statistic minimum value of significant figures (see also 5.1.3). This minimum is calculated on the maximum number of categories in a question, and the segmentation of personal characteristics of the respondents. As a result, the 2.230 filled in Dutch questionnaires are enough to draw conclusions for this country's situation. However, the numbers of the other countries are too low to compare the results individually between countries. Therefore, the choice is made to describe the results for the complete survey, and make no distinction for the different countries, and no country specific conclusions will be drawn. In the case that the Dutch results are remarkably different from the rest of the country's results, it will be noticed in the text.

7.2.2 *What types of persons were interested and took time to fill in the internet survey?*

Most respondents which filled in the internet survey are in the age groups 18 to 29 and 30 to 49 years (about 76%). When these values are compared to the population statistics of the Netherlands (figure 7.1 – right picture; this is allowed because most respondents come from the Netherlands), it seems that especially the age groups 18 to 29 and 30 to 49 years are slightly overrepresented in the survey. The youngsters and elderly people are underrepresented. This is also seen in figure 7.1

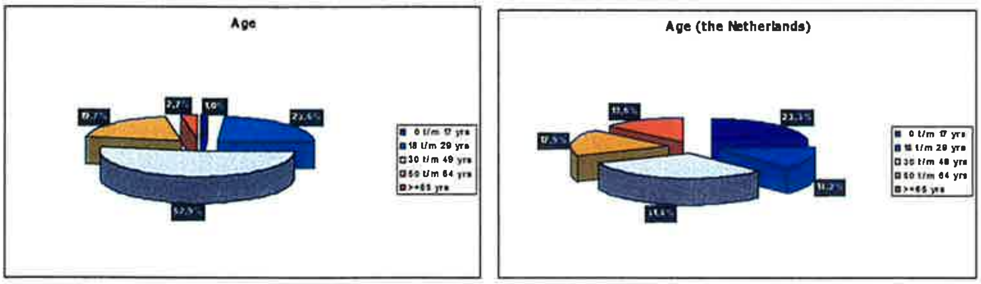


Figure 7.1: Distribution of age survey (n = 2856) and population statistics the Netherlands (source CBS).

More men than women filled in the questionnaire (figure 7.2). About 61% of the respondents are male. The respondents mostly live in a multi person household (75,9%; see figure 7.3).

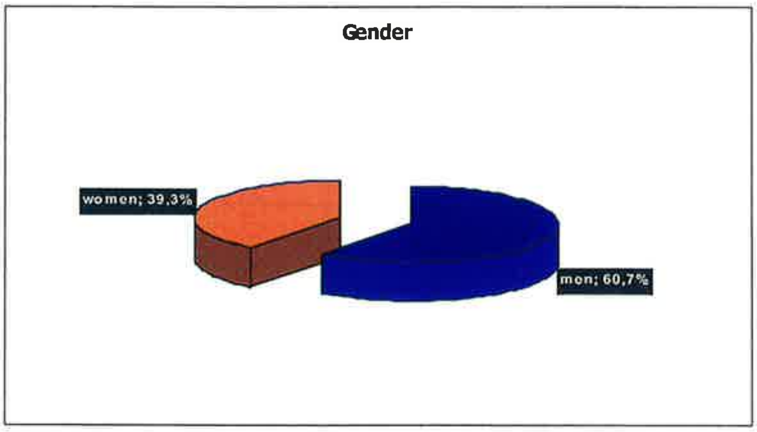


Figure 7.2: Distribution of gender (n = 2857).

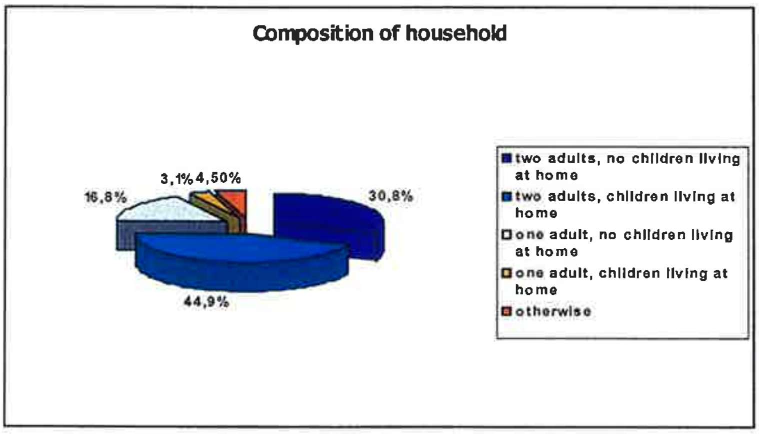


Figure 7.3: Distribution of the composition of household (n = 2847).

The average person questioned has a quite high education level. More than 80% of the respondents have followed higher or intermediate vocational education (figure 7.4).

Most people have a good internet experience as well. About 99% of the persons use the internet regularly or frequently (see table 7.2).

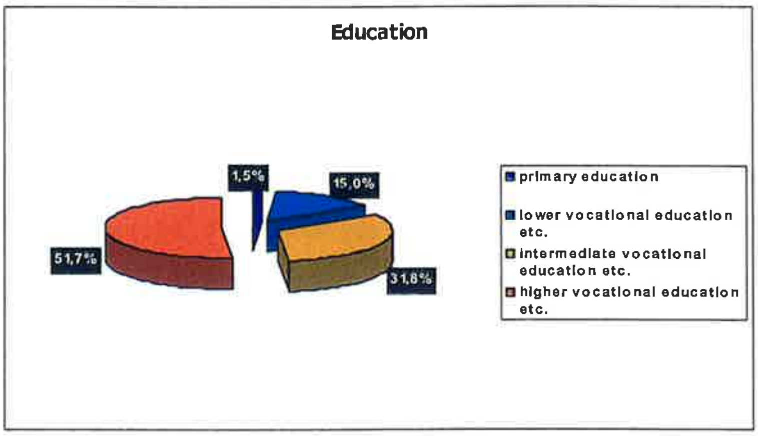


Figure 7.4: Distribution of education (n = 2847).

Table 7.2: Internet experience of respondents.

Internet experience	*Number of respondents*	*Share*
First time	4	0.1%
Seldom use	21	0.7%
Regular use	729	25.6%
Frequent use	2089	73.4%
Otherwise	4	0.1%
Total	2847	100.0%

7.2.3 *Transport behaviour of the respondents*

The transport mode with which the most kilometres are travelled, is (not surprising) the car; over 70% of the respondents are car users (car driver and car passenger; figure 7.5).

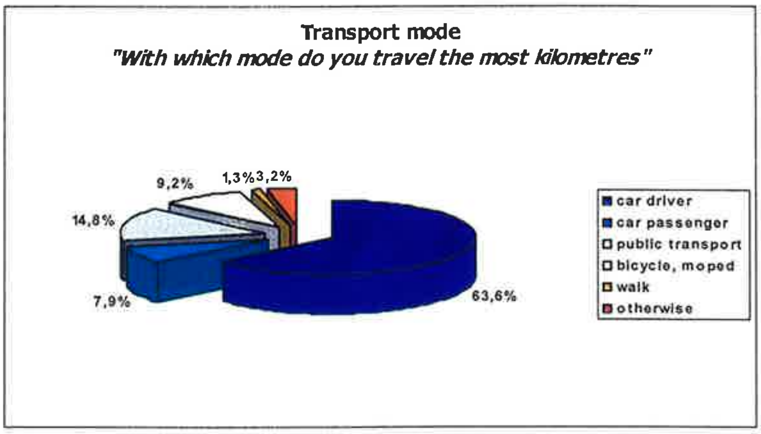


Figure 7.5: Distribution of transport mode (n = 2847).

The 9,2% of respondents that answered bicycle or moped is very high, given that the question is about kilometres travelled and not, for instance, number of trips. It is quite a challenge to travel more kilometres by bike than by car in this century. It is therefore assumed that most respondents translated the question to *by what means do you travel the most?*

When the current transport modes of the respondents are compared with each other (related to their country) it is remarkable that Dutch respondents mainly travel by car or bicycle/moped. 85% of the respondents travel by means of these modes. In the other countries people primarily travel by car or Public Transport (87%). The Netherlands is internationally well known as a bicycle country. This is also seen in the transport modes. 11% of the Dutch respondents travel mostly by bike; in the other countries only 4% travel by this transport mode (figure 7.6).

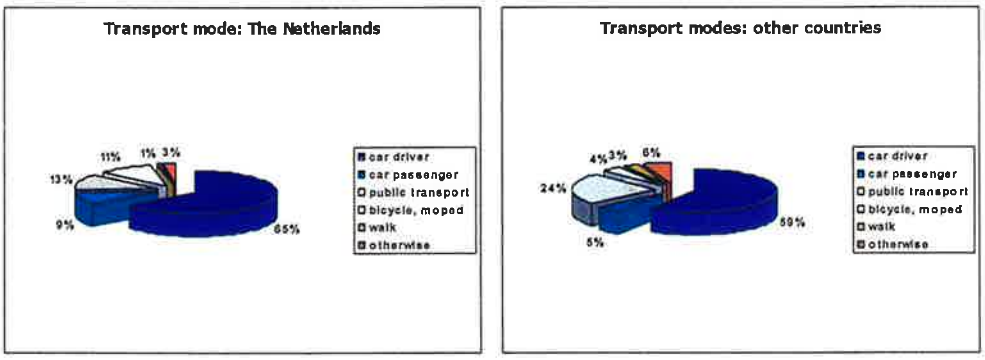


Figure 7.6: Distribution of transport mode related to country (n = 2247 for NL and n = 600 for other countries).

Table 7.3 contains a comparison between the filled in transport mode and the observed modal split in kilometres in The Netherlands in 2000 (source: OVG; only 18 years and older). Even in this table the share of bicycle users in the questionnaire seems high.

Table 7.3: Current Dutch distance modal split of respondents in relation to 'national trip distance modal split' in the Netherlands.

The Netherlands	*Share NL respondents*	*Share NL inhabitants*
Car driver	64,8%	55,9%
Car passenger	8,7%	19,8%
Public transport	12,3%	14,2%
Bicycle, moped	10,6%	6,4%
Walk	0,8%	1,4%
Other	2,7%	2,3%
Total	100,0%	100,0%

7.2.4 *How the respondents are spatially spread?*

This information is only available for the Dutch situation. Figure 7.7 shows clearly that the spatial spread is quite representative over the Netherlands. In the parts with a high population density, mostly in the western part, a higher number of respondents can be found. Only the Rotterdam – The Hague area is overrepresented, probably because of the proximity to the TNO office. Colleagues and friends of the Dutch CyberMove team mostly live nearby.

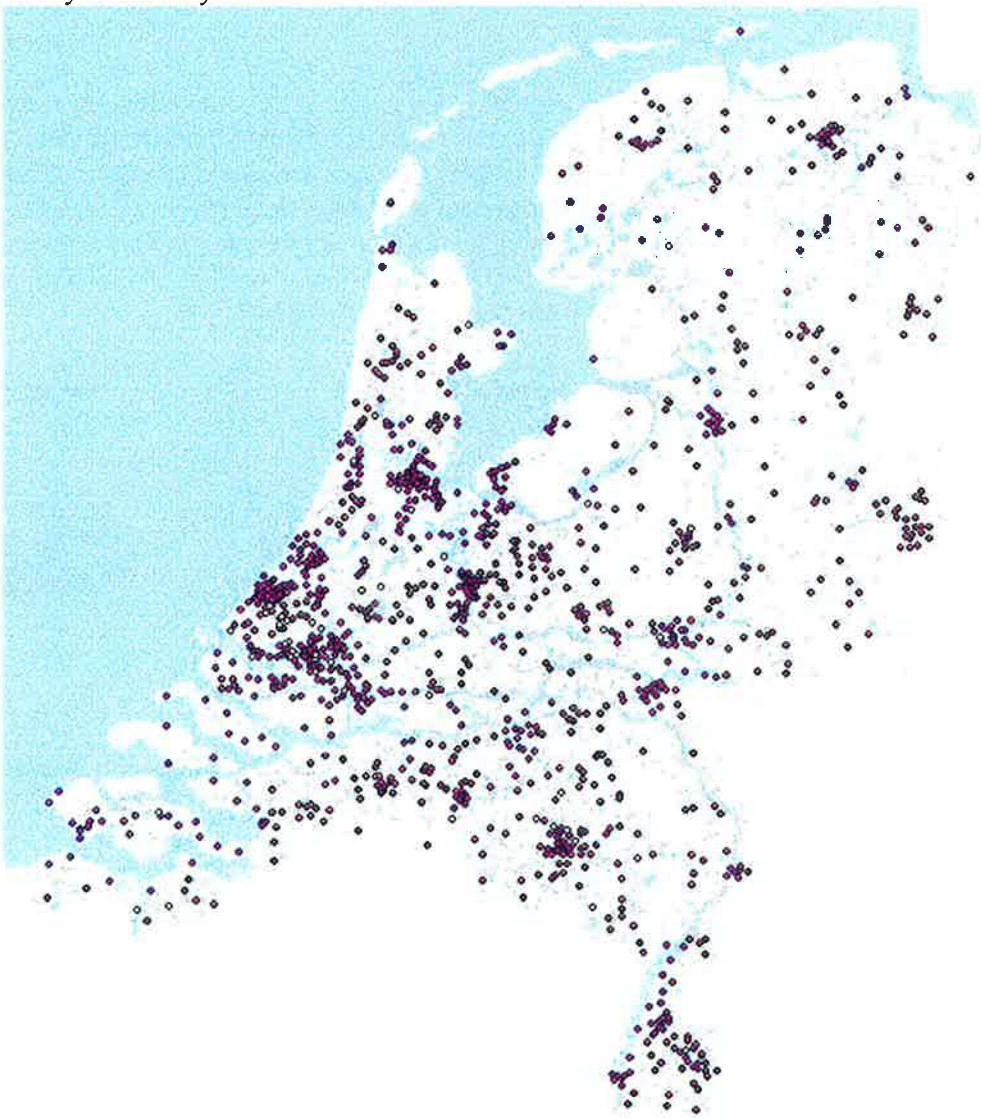


Figure 7.7: Spatial spread in the Netherlands: each dot represents a postal code of at least one respondent; the yellow dots represent five or more respondents.

7.3 Spatial setting of the CTS

In the imagination of the respondents a CTS can most logically be found at airports. Next best are station to university and car parks to the historic city centre. The more tourist related sites, in this case at the holiday park, are rated lowest. This is also represented in table 7.4.

Table 7.4: Where do the respondents visualise CTS?.

	Scale					*Score*[8]
Site	absolutely not	probably not	Maybe	probably yes	yes, absolutely	scale 1 to 5
Between central car park and departure terminal at airport	24	127	390	1.197	1.123	4,14
Between station and university	25	147	581	1.307	799	3,95
Between central car park and historic city centre	53	105	589	1.342	773	3,94
Between central car park and business park	34	137	620	1.328	741	3,91
Between central car park and central business district	42	179	662	1.271	707	3,85
At holiday park	109	454	873	943	480	3,43

Although most respondents visualise CTS's at airport terminals, but they prefer to fill in the questionnaire about other sites: between car park and historic city centre or central business district are the most popular (table 7.5). This could indicate that people can imagine a CTS best at airports (maybe because they have seen such a transport system there), but at the same time like the idea of using a CTS on a more regular basis. The flying frequency of most people is much lower than the frequency of, for instance, travelling to work.

Table 7.5: What sites did the respondents choose to fill in the questionnaire?

Site	*Number of respondents*	Share	Share Yes!
Between central car park and historic city centre	785	27,4%	98,7%
Between central car park and central business district	748	26,1%	97,1%
Between central car park and departure terminal at airport	367	12,8%	98,4%
Between central car park and business park	361	12,6%	97,0%
Between station and university	248	8,7%	96,8%
Not useful for any trips	183	6,4%	81,4%
At holiday park	170	5,9%	97,6%
Total	2.262	100,0%	96,8%

The Share Yes! column contains the share of respondents that, at the last question of the questionnaire, answered that they would use the CTS, if it was arranged in the way they

[8] Formula of the score calculation: ((absolutely not * 1)+(probably not * 2)+(maybe * 3)+(probably yes * 4)+(yes, absolutely * 5)) / 5

indicate in the survey. These shares are so high that in the remaining of this analysis no difference is made between would be and would not users. It can be interpreted that filling in the questionnaire makes people enthusiastic of the idea of using a CTS.

The gender related preferences are not very diverged. Women have chosen slightly more for transportation at a holiday park and at central business districts than men. Men have chosen slightly more for business park transportation (see table 7.6).

Table 7.6: Chosen site related to gender.

	Gender		
Site	Male	Female	Popularity
Between central car park and historic city centre	28%	26%	27,4%
Between central car park and central business district	25%	28%	26,1%
Between central car park and departure terminal at airport	13%	12%	12,8%
Between central car park and business park	14%	10%	12,6%
Between station and university	8%	9%	8,7%
Not useful for any trips	6%	6%	6,4%
At holiday park	5%	7%	5,9%
Total	100%	100%	100,0%

Not surprisingly the percentages of the 30 through 49 age group do most resemble the percentages of the aggregate result on site choice. The reason is that more than half of the persons that filled in the survey are in this age group. Young people are more inclined towards using a CTS at holiday parks and university campuses (table 7.7). Elderly people prefer to use the CTS to historic city centres and central business districts. As people grow older, they tend to choose the city centre and central business district more and more, while the university gradually becomes less popular. The other sites have a less apparent trend over the age groups.

Table 7.7: Chosen site related to age.

	Age					
Site	0-17	18-29	30-49	50-64	65+	Popularity
Between central car park and historic city centre	14%	20%	28%	34%	39%	27,4%
Between central car park and central business district	10%	20%	29%	27%	33%	26,1%
Between central car park and departure terminal at airport	3%	12%	13%	13%	12%	12,8%
Between central car park and business park	3%	13%	14%	10%	3%	12,6%
Between station and university	35%	22%	4%	4%	3%	8,7%
Not useful for any trips	3%	8%	5%	7%	5%	6,4%
At holiday park	31%	3%	7%	5%	7%	5,9%
Total	100%	100%	100%	100%	100%	100,0%

In the next tables, the transport modes are combined to the following division:
- *CAR*: car drivers, car passengers and motorbike users;
- *BIKE*: bicycle and moped users;

- *WALK*: travellers by foot, and
- *PT*: public transport users (train and bus/tram/subway).

A grey box indicates that it is not possible to choose that answer in the questionnaire.

Table 7.8 and 7.9 are very interesting ones: they show what sites people chose in relation with their current modal split to this kind of sites. Table 7.8 contains the choice of sites reasoning from the transport modes (vertical sum). Car users choose the sites that are difficult or expensive to reach by car. Bike users choose more or less the same; walkers mostly choose the sites where it is usual to walk (like a holiday park), whereas public transport users prefer the sites that are difficult or expensive to reach or where it is common to travel to by public transport.

Table 7.8: Chosen site related to current modal split to similar sites (vertical sum).

	Current modal split to similar sites				
Site	Car	Bike	Walk	Public transport	Popularity
Between central car park and historic city centre	30%	25%	19%	34%	29,5%
Between central car park and central business district	29%	39%	19%	23%	27,9%
Between central car park and business park	17%	11%	2%	10%	13,6%
Between central car park and departure terminal at airport	15%	1%	8%	16%	13,4%
Between station and university	4%	19%	8%	18%	9,2%
At holiday park	5%	6%	44%		6,2%
Total	100%	100%	100%	100%	100%

Table 7.9 contains the original transport modes of choosers of each site (horizontal sum). Most respondents use the car to go to their destination. Only for trips to the university people use public transport more frequently. This is explainable because mostly students (mostly not owning a car) travel by public transport to the university.

Table 7.9: Chosen site related to current modal split to similar sites (horizontal sum).

	Current modal split to similar sites				
Site	Car	Public transport	Bike	Walk	Total
Between central car park and business park	74%	18%	8%	1%	100%
Between central car park and departure terminal at airport	66%	30%	1%	3%	100%
Between central car park and central business district	62%	20%	14%	4%	100%
Between central car park and historic city centre	59%	28%	9%	4%	100%
At holiday park	49%		10%	41%	100%
Between station and university	25%	49%	21%	5%	100%
Average modal split	59,0%	24,8%	10,4%	5,7%	

Table 7.10 shows for each site chosen for which trip purposes travelling to the site have been mentioned. Most figures in the table are logical, most eye-catching is the 50% that chose *other* in relation to central business district. A part of the explanation is that the surveyed persons couldn't choose *shopping* while answering for *central business district.* The architecture of the survey didn't allowed this.

Table 7.10: Chosen site related to trip purpose.

	Trip purpose									
Site	Shopping	Cultural visit	Work	(Work) appointment	Relax	Follow lectures	Leisure travel	Holiday	Business travel	Other
Historic city centre	46%	17%	8%	2%	23%					3%
Business park			76%	21%						3%
Holiday park	19%				27%			47%		7%
University			39%	7%		47%				7%
Airport	1%		6%	4%	1%		65%		18%	5%
Central business district			32%	18%						50%

7.3.1 *Transport problems which CTS could overcome*

In the next four tables, the encountered problems are indicated for the transport modes CAR, BIKE, WALK and PT. Note that not everyone was faced with the same list of possible problems: this was depending on the transport mode that has been chosen. For instance, car users couldn't answer *low frequencies* or *effort* as experienced problems. The possibilities per transport mode can be seen in the columns in the tables.

The main problem car users encounter at sites are occupied parking places and very high parking costs (table 7.11). Also crowded access roads are seen as a main problem. Less car users encounter no problems. This is only applicable at holiday parks, but mostly it is not allowed or common to use a car at this site.

Remarkable is that the distribution of historic city centre and central business district for car users is almost the same. Therefore we can assume that respondents that travel by car see those two sites nearly as similar.

Table 7.11: Encountered problems by CAR users related to site.

Site	*Encountered problems by CAR users*										
	Very high parking costs	Occupied parking spaces	Crowded access roads	Parking far away destination	Long waiting at traffic lights	No egress transport modes	No problems	Vehicle not allowed at holiday park	Other	Distance to recreational activities too long	Popularity
Historic city centre	29%	27%	19%	10%	10%	4%	1%		0%		30%
Central business district	28%	25%	20%	9%	12%	4%	3%		1%		29%
Business park	10%	24%	31%	8%	13%	6%	6%		2%		17%
Airport	34%	14%	24%	17%	3%	5%	3%		1%		15%
Holiday park		33%					15%	32%	3%	18%	5%
University	10%	17%	33%	6%	20%	8%	5%		2%		4%
Total	867	834	744	346	342	142	104	36	30	20	100%

The Netherlands is a densely populated country. That is why it is to be expected that most people that travel by car have parking problems in The Netherlands. In figure 7.8 the differences related to parking problems between people from The Netherlands and people in other countries are indicated. The expected conclusion can be drawn from the questionnaire. People in The Netherlands indicate more often that they come upon parking problems. 29,5% of the respondents from The Netherlands indicate that they come across at least parking problems (whereas the respondents from other countries indicate that 27,5% of them come across at least parking problems). However the difference is very small.

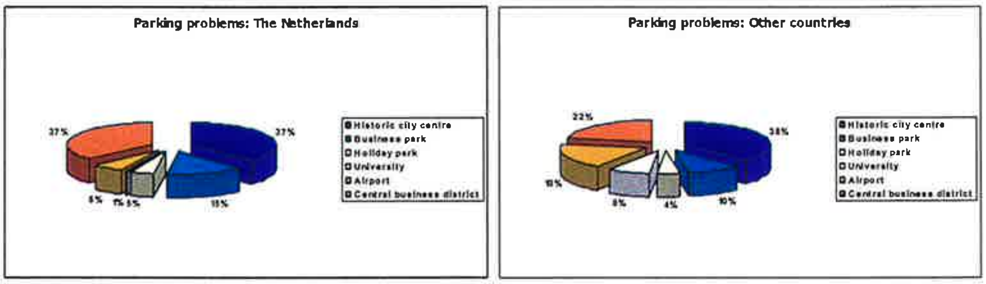


Figure 7.8: Distribution of parking problems related to country (n = 666 for NL and n = 168 for other countries).

Bike users have especially troubles with bad weather conditions. Effort or image (both likely arguments for people for not using a bike) is not a problem for them (otherwise they wouldn't have chosen for bikes). It is remarkable that bike users encounter problems with bike park facilities at business parks. The positive side of it is that bike or moped theft is not seen as a major problem at that site (table 7.12).

Table 7.12: Encountered problems by BIKE users related to site.

	Encountered problems by BIKE users									
Site	Bad weather conditions	Bike or moped theft	Long waiting at traffic lights	No problems	No bike park facilities	Effort	Other	Distance to recreational activities too long	Image	Popularity
Central business district	27%	22%	16%	17%	9%	6%	3%		0%	29%
Historic city centre	25%	19%	20%	11%	14%	6%	5%		0%	25%
University	39%	17%	17%	6%	6%	9%	5%		1%	19%
Business park	28%	9%	15%	17%	23%	6%	2%		0%	11%
Holiday park	25%	8%		33%	8%	13%	4%	8%		6%
Airport	40%	20%	20%	0%	20%	0%	0%		0%	1%
Total	144	90	82	70	57	34	19	2	1	100%

For walkers, effort is a more important issue than for bike users (table 7.13). Walking is not always avoidable, while biking is. The most important problem for walkers is bad weather conditions, although they have the relatively largest *no problems* group of all transport modes.

Table 7.13: Encountered problems by WALK users related to site.

	Encountered problems by WALK users							
Site	Bad weather conditions	No problems	Slow speed	Distance to recreational activities too long	Effort	Long waiting times at traffic lights	Other	Popularity
Holiday park	21%	22%	12%	30%	10%		4%	44%
Historic city centre	21%	21%	22%		16%	16%	45 %	19%
Central business district	29%	17%	14%		7%	19%	14 %	19%
University	56%	13%	19%		6%	6%	0%	8%
Airport	0%	31%	13%		38%	13%	6%	8%
Business park	33%	67%	0%		0%	0%	0%	2%
Total	52	47	29	29	27	18	13	100%

Most mentioned Public Transport problems are the typical service related aspects of this kind of transport: delays, waiting and crowding (table 7.14). The necessity of changing vehicles, the lack of egress transport modes and the low frequencies are highly scoring problems as well. Boarding difficulties and image problems are not rated high: people who travel by Public Transport don't bother much about this, otherwise they wouldn't have chosen this mode (compare bikers).

Table 7.14: Encountered problems by Public Transport users related to site.

	Encountered problems by PT users													
Site	Delays	Waiting	Crowding	Change of train, mode	No egress transport	Low frequencies	Bad weather conditions	No problems	Crowded access roads	Other	Difficult boarding	Long waiting at traffic lights	Image	Popularity
Historic city centre	18%	19%	18%	12%	12%	12%	6%	5%	4%	15%	22%	1%	0%	34%
Central business district	15%	18%	16%	12%	8%	8%	9%	4%	3%	3%	2%	2%	1%	23%
University	19%	16%	17%	11%	9%	9%	7%	1%	4%	2%	2%	2%	1%	18%
Airport	22%	17%	14%	17%	7%	7%	4%	4%	1%	3%	4%	0%	2%	16%
Business park	21%	17%	16%	10%	11%	8%	7%	1%	5%	2%	1%	2%	1%	10%
Holiday park														
Total	334	322	301	225	174	166	126	62	61	38	37	27	12	100%

7.4 Design of the CTS

Respondents were asked for several aspects on the layout of the concept, including the stop, the vehicle itself and added services.

7.4.1 Design of the stops

The first question asked was about the design of the stops: *'What should a CTS stop look like?'* Respondents have a clear idea of what they want. More than half of the respondents, namely 53% (n= 2840), wants a bus shelter, 36% prefers stops designed as a waiting room and only 11% of the respondents prefers a stop marked by a pole in the ground (see figure 7.9).

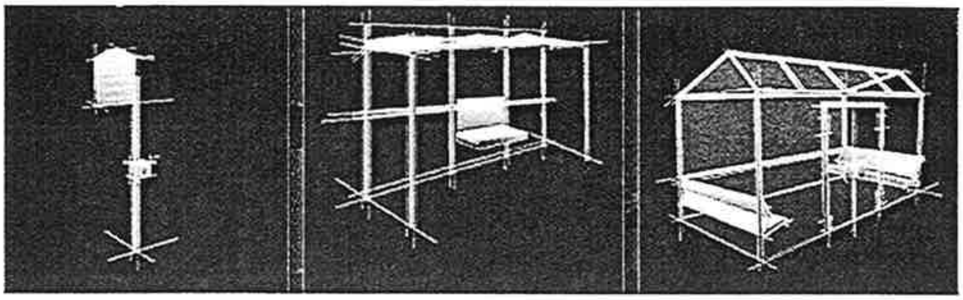


Figure 7.9: Design of the stop: a pole in the ground, a shelter or a waiting room.

Not surprisingly table 7.15 shows that elderly people are more inclined to choose for the more comfortable waiting room than the younger age groups.

Table 7.15: Chosen stop related to age.

	Age						
Chosen stop	Unknown	0-17	18-29	30-49	50-64	65+	Total
Bus shelter	33%	52%	61%	52%	49%	45%	53%
Waiting room	33%	38%	28%	37%	43%	47%	36%
Pole in the ground	33%	10%	11%	11%	8%	8%	11%
Total	100%	100%	100%	100%	100%	100%	100%
Respondents	3	29	671	1505	557	75	2.840

The stops can be furnished with additional services like a machine with snacks, a toilet, an internet unit, a telephone, a map of the area, screens with all kinds of actual travel information, a bicycle shed and so on. Figure 7.10 contains those additional services.

Figure 7.10: Additional services at the stop.

Information services (a screen with all kinds of actual travel information and a map of the area) are most popular (see table 7.16). Toilets and ATM's (= cash dispensers) are also often chosen, but an internet unit is not seen as a necessary service (only 13% of the respondents filled in this service). The people that opted for the spatial setting 'between central car park and historic city centre' find it important that a screen with information about the area is presented. Cyclists want a bicycle shed at the stop. Most cyclists have chosen for an unguarded shed (40%) instead of a guarded (services are not free) one.

Table 7.16: Appreciation of the service.

	Choices				
Service	% Respondents	First choice	Second choice	Third choice	Weighted[9]
Screen with all kinds of actual travel information[10]	71%	1063	603	347	2,36
Map of the area[7]	70%	720	853	420	2,15
Bicycle shed (guarded, services are not free)***	33%	32	33	26	2,07
Toilet[7]	45%	423	386	471	1,96
Bicycle shed (unguarded)[11]	40%	27	42	42	1,86
ATM[7]	40%	292	363	495	1,82
Screen with information about the area[12]	41%	53	137	132	1,75
Machine with snacks[7]	21%	99	151	341	1,59
Telephone[7]	21%	79	189	342	1,57
Internet unit[7]	13%	52	83	224	1,52

The respondents were asked if they will use the appreciation of the selected service of their first choice. Most people appreciate the services (very) positive and indicate that they will use them. Only a telephone at the stop is indicated relatively very often (15%) as 'it doesn't bother me, but I don't think that I will use it very often.

7.4.2 *Distance to the stops*

The vehicles have to stop within 5 minutes walking time of origin or destination, according to figure 7.11. If the walking time is greater than 5 minutes, acceptance drops dramatically to about 30% of the people, and only 6% of the respondents accept walking times longer than 10 minutes.

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[9] Formula on the weighted calculation: ((first choice * 3)+(second choice * 2)+(third choice*1) / (first choice+second choice+third choice)

[10] Presented to all respondents (n = 2841)

[11] Only presented to bike users (n=275)

[12] Only presented to respondents that opted for the spatial setting 'between central car park and historic city centre' (n=785)

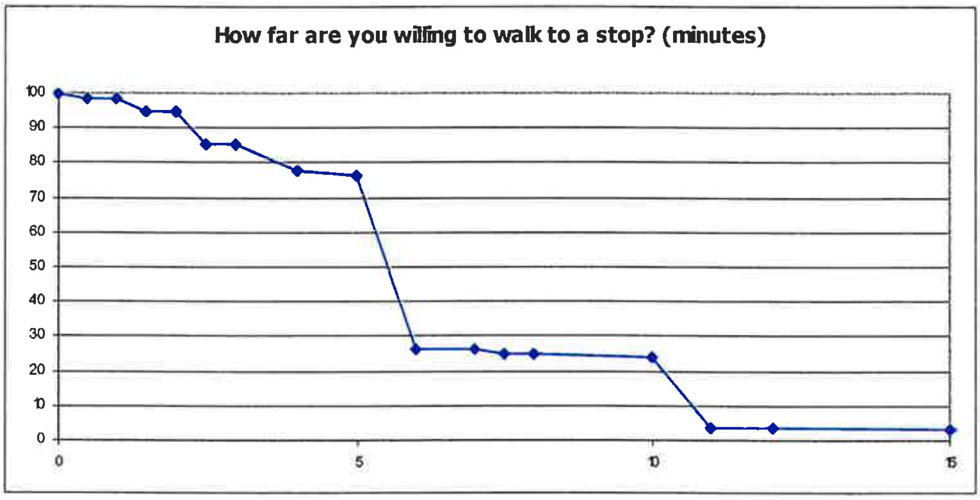

Figure 7.11: Distance to the stops.

7.4.3 *On-demand or scheduled transport service*

A cybercar is an on-demand transport service: the vehicle will be available on request, and more vehicles are available when the demand is higher. However, in some cases scheduled services with fixed times can provide more reliability because of the fixed times. The scheduled service is presumable therefore more appreciated by the respondents: 54% of the respondents (n=2841) opts for scheduled services and 46% prefers on-demand transport.

It is to be expected that people who do not want to wait a long time at the stop prefer an on-demand service. In table 7.17 the maximum waiting time is indicated for people who have chosen for scheduled or on-demand services. The hypothesis is confirmed in the questionnaire. People that have chosen for on-demand service mainly will wait for a maximum of 5 minutes.

Table 7.17: Chosen transport service related to maximum waiting time.

	Maximum waiting time (minutes)				
Transport service	0-5	6-10	11-15	> 15	Total
Scheduled service	32,4%	17,5%	3,6%	0,4%	53,9%
On-demand service	32,9%	10,9%	2,0%	0,2%	46%
Total	65%	28%	6%	1%	100%

In table 7.18 and 7.19 the maximum waiting time related to transport service is indicated for respondents from the Netherlands and respondents from other countries. It is clear that people from the Netherlands mostly prefer scheduled services (58%), whereas people from other countries aim an on-demand service (61%). This makes clear that a Cybernetic Transport System cannot be the same in all the countries. The design of the system has to be context dependent.

Table 7.18: Chosen transport service related to maximum waiting time (only Dutch respondents)

Transport service	*Maximum waiting time (minutes)* 0-5	6-10	11-15	> 15	Total
Scheduled service	34,6%	18,9%	4,1%	0,4%	57,9%
On-demand service	29,3%	10,6%	2,0%	0,2%	42,1%
Total	63,8%	29,5%	6,1%	0,6%	100%

Table 7.19: Chosen transport service related to maximum waiting time (only respondents from other countries)

Transport service	*Maximum waiting time (minutes)* 0-5	6-10	11-15	> 15	Total
Scheduled service	24,5%	12,4%	1,7%	0,3%	38,9%
On-demand service	46,4%	12,1%	2,3%	0,3%	61,1%
Total	70,9%	24,5%	4,0%	0,7%	100%

In order to find out how the public reacts to cybercars and to obtain information on the desires and expectations potential users have regarding this new transportation concept, group discussions were held at TNO Inro at an earlier stage of the study. One of the results of these Focus Groups was that people prefer the appearance of a cybercar within 5 minutes and that the cybercars are available on demand by mobile telephones. The first result is also seen in the questionnaire. Most people only like to wait for 5 minutes at maximum (65% of the respondents).

The second result of the Focus Groups is not seen in the questionnaire. Only 46% of the respondents prefer on-demand transport and 44% of them have chosen for a call system via (mobile) telephone. The other persons have opted for a call system via a telephone at the stop (figure 7.12).

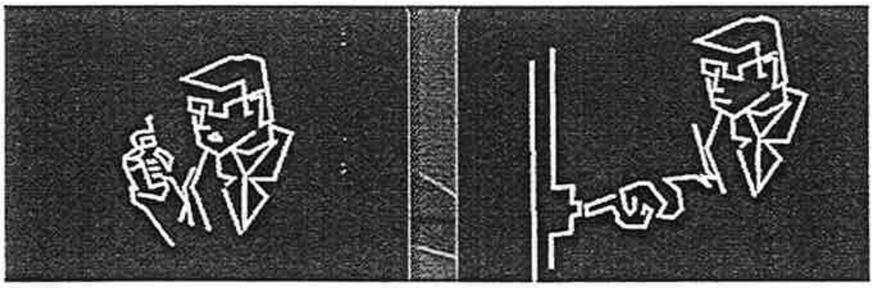

Figure 7.12: Call system via (mobile) telephone and call system via a telephone at the stop.

7.4.4 *Design of the cybercar*

Design of the CTS incorperates the design of the exterior and the interior of the cybercars. The exterior of the vehicle can be classical or modern, and the cybercars can be designed for individuals (you do not have to share the cybercar with other people) or for collectives (you have to share the cybercar with other people). In figure 7.13 the options are depicted.

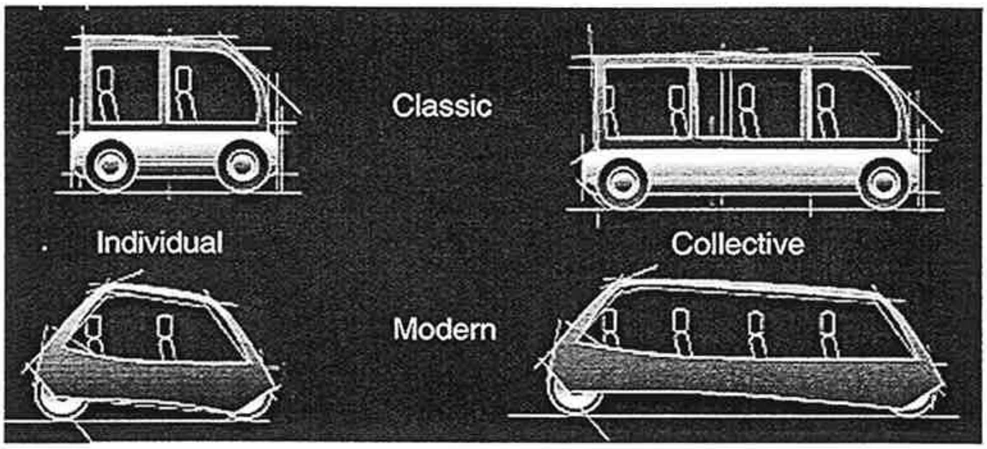

Figure 7.13: Design of the cybercar: Classic Individual, Classic Collective, Modern Individual and Modern Collective.

The modern design for the vehicle is most appreciated. 68% of the respondents have chosen for a modern design. It is remarkable that most of them have opted for a collective cybercar.

Table 7.20: Design of the vehicle.

	Design of the vehicle				
	Classic, individual	Classic, collective	Modern, individual	Modern, collective	Total
Percentage	10%	22%	30%	38%	100%
Respondents	287	617	854	1.081	2.839

To know more about 'collectivity' the people were asked to say more about the number of seats they prefer. Note that only people who have said that they find it (very) important that seats are available have filled in this question. It appears that people that have opted for an individual vehicle still have chosen for relatively large vehicles (table 7.21). Approximately 50% of them have chosen for vehicles with less than 5 seats; the others have opted for a vehicle with 5 to 10 seats. Respondents that like a collective vehicle mainly opted for a vehicle with 5 to 10 seats.

Table 7.21: Number of seats.

	Number of seats			
	Less than 5 seats	5 to 10 seats	More than 10 seats	Total
Classic, individual	45%	52%	3%	100%
Classic, collective	1%	73%	26%	100%
Modern, individual	52%	46%	2%	100%
Modern, collective	1%	72%	26%	100%

A hypothesis is that a vehicle with a classic design better fits in a historic city centre and a vehicle with a modern design better fits at an airport. From the results of the questionnaire this conclusion cannot be drawn. There is not a strong preference for a certain type of vehicle at the chosen useful site. The distribution in table 7.18 (design of the vehicle) is also seen when the opted type of vehicle is related to the chosen site.

To know more about the preferred design of the vehicle, questions are asked about personal security in relation to the transparency of the vehicles. In figure 7.14 (layout of the cybercar: transparent or not) the different options are given; the cybercar has a totally open design for maximum transparency or the cybercar contains windows but the vehicle is not completely transparent. Most people have opted for the not transparent version of the cybercar (71%). There is hardly any difference between the different designs of the cybercar. Only the modern collective cybercar has a little higher share of transparency (35%) than the average.

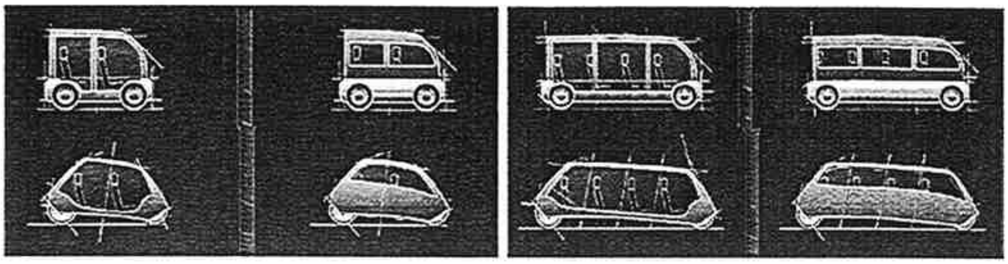

Figure 7.14: Layout of the cybercar: transparent or not.

Most people (75%) have chosen for a cybercar with doors on both sites (figure 7.15), probably because of the fact that getting in and out will be faster with doors on both sides. However, with doors on both sides people can get out at street side, which is not very safe.

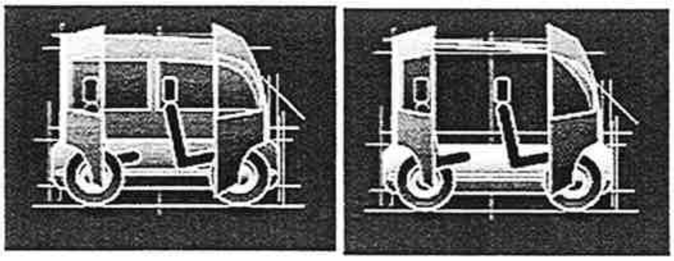

Figure 7.15: Layout of the cybercar: doors on one side or doors on both sides.

7.4.5 *Requirements with respect to the cybercar*

Respondents were asked to indicate the importance of different aspects with respect to the cybercars. In other words: do the cybercars have to be clean and vandalism proof, do they have to be equipped with operating information, camera supervision, tourist information, et cetera?

The most remarkable conclusion is that the cleanness of the vehicles and stops is rated more important than for instance safety. See table 7.22. Apparently, most people are annoyed by the current degeneration of some public transport systems. Furthermore, people find it very important to be able to stop the vehicle by pressing an emergency button. People find it also very important that the vehicles are vandal and vandalism proof. In this respect, it is remarkable that for instance camera surveillance is not rated very important. Tourist information in the vehicle is rated as relatively unimportant, while tourist information at the stop was appreciated much.

Table 7.22: Importance of requirements with respect to the interior layout of the cybercar.

Aspect	*Weighted*[13] *Score*
Clean	4,7
Emergency stop button	4,4
Vandal proof	4,4
The Cybercar must be vandalism proof	4,3
The vehicle should be easily accessible for people with wheelchairs or pushchairs	4,3
Seats	4,3
The Cybercar must give me a feeling of personal safety and security	4,2
Telephone for emergency situations	4,1
Space for luggage, pushchairs, wheelchairs	4,1
Speech synthesis	4,0
Door-opening device	3,9
Operating information	3,9
Camera supervision	3,8
Speech recognition	3,7
Screens providing real-time traffic information	3,3
Tourist Information	2,6
Standing room	2,3

7.4.6 *Money and payment methods*

The respondents were asked to indicate how many Euro they were prepared to pay for a journey by cybercar. Figure 7.16 indicates how many people (in %) will travel by cybercar at a certain price level. It appears that 40 till 50% of the people are willing to pay 5 Euro or less for a journey by cybercar. When the prices will be a little bit higher most of the people are not prepared anymore to travel by cybercar.

[13] Score: Very important=5, Important=4, Neutral=3,Relatively unimportant=2, Not important=1)

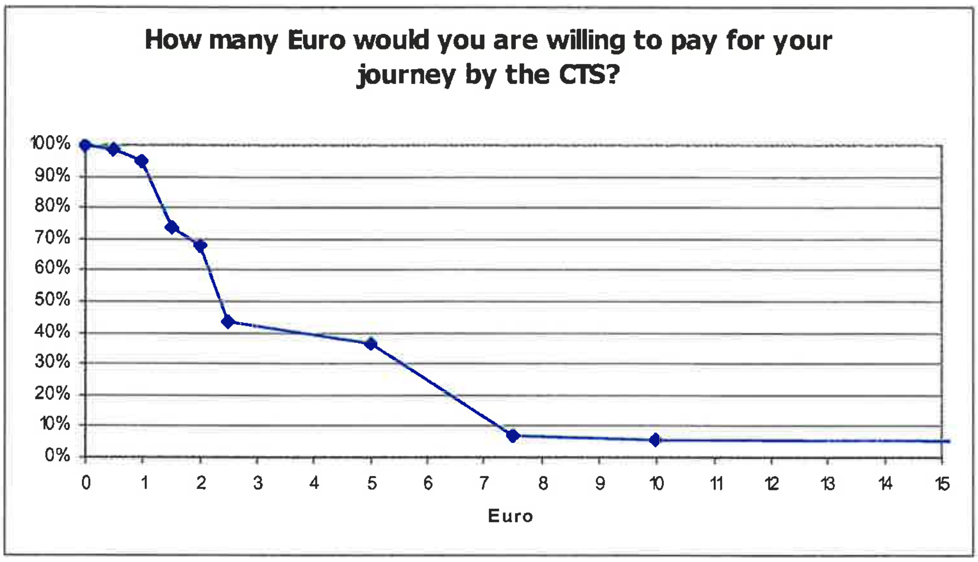

Figure 7.16: Willingness to pay for a ride by cybercar.

Table 7.23 indicates the willingness to pay per kilometre, by transport mode and site. From this table it becomes clear that car users and public transport users in general are willing to pay less than bicyclists or walkers. Moreover there are some (huge) differences between the sites, e.g. bikers are willing to pay only 9,4 Eurocent per kilometre at a holiday park, whereas they are willing to pay 41,1 Eurocent per kilometre at the central business district. This table indicates that it is not possible to establish one price per kilometre for all cybernetic transport relations.

Table 7.23: Willingness to pay per kilometre (Eurocent).

	Site						
Mode	Historic city centre	Business park	Holiday park	University	Airport	Central business district	Total
Car	12,9	10,7	18,0	13,6	10,5	19,0	12,9
Bike	41,7	16,5	9,4	24,5	14,7	41,1	26,7
Walk	29,3	66,7	39,5	15,1	7,3	45,9	24,3
PT	14,1	10,0		8,9	10,9	16,9	12,0
Total	14,4	10,9	20,2	11,2	10,5	20,1	13,4

Because it is difficult to say how many Euro people are willing to pay for a transport system at a virtual site, they were also asked if they can indicate if the amount they will pay for that trip is more, less or the same as the current price they pay for a comparable trip. Surprisingly 47% of the respondents indicate that they are willing to pay more for the same trip (table 7.24).

Table 7.24: Are people willing to pay more, less or the same?

Willingness to pay in relation to current price comparable trip	*Percentage*	*Respondents*
More	47%	1.320
Same	32%	896
Less	22%	619
Total	100%	2.835

Figure 7.17 indicates that there are hardly any differences between the willingness to pay more, less or the same, related to the different sites. Only at the university people are willing to pay more than average (56,5% of the respondents is willing to pay more) for a journey by cybercar.

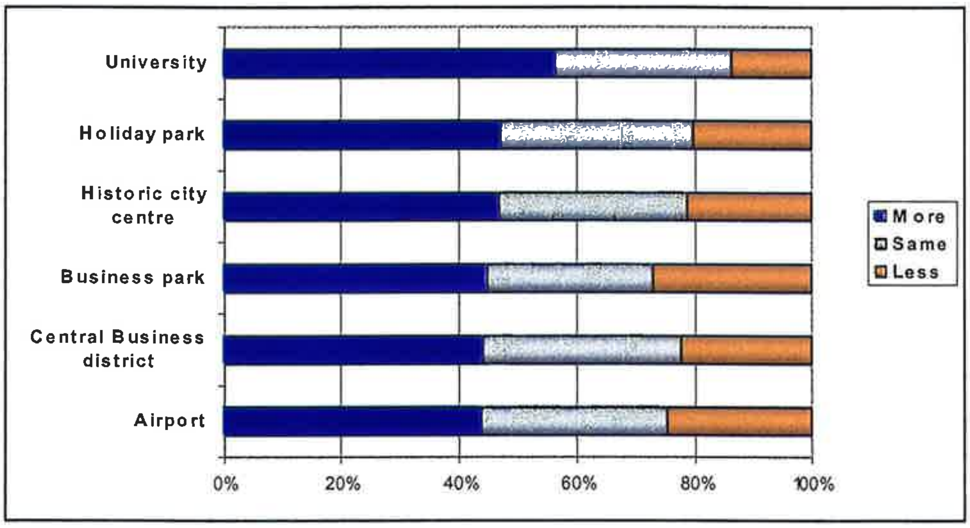

Figure 7.17: Willingness to pay related to site

The respondents were also asked to indicate which payment method they prefer. Multiple answers where possible. In average the respondents have chosen for 2,7 payment methods. Most popular is a payment method by means of chip/pin transaction. Also a payment by cash is a favourite. Only a few people have opted for a dedicated ticket for the CTS or payment by mobile phone. Especially the last one is surprising. Payment by mobile phone is very flexible, but possibly people do not trust this payment method.

Table 7.25: Payment mode.

Payment mode	*Times chosen*	*Percentage of total*
Chip/pin transaction	1.663	22%
Cash	1.123	15%
Multi-journey ticket	984	13%
Credit card	913	12%
Season Ticket	863	11%
Combination parking-transport (-entrance) ticket	802	11%
Dedicated ticket for the CTS	568	8%
Mobile Phone	523	7%
Other	106	1%
Total	7.545	100%

In figure 7.18 the different moments that people can pay for the journey can be seen. Most people like to pay their ticket in the cybercar. An innovative payment method by means of a bill afterwards is not preferred very much. In general people like flexibility. Sometimes, e.g. when they are in a hurry, they prefer to pay in the cybercar. At another moment they have more time and they like to pay at the stop. This is also seen in the results of table 7.26. The options 'in the cybercar' and 'at the stop' are relatively close to each other.

Table 7.26: Where and at which moment would you prefer to pay for the trip?

	Where and at which moment would you prefer to pay for the trip?			
	Weighted[14]	First Preference	Second Preference	Third Preference
In the cybercar	2,23	1.074	981	487
At the stop	2,16	940	1.172	529
At an advance booking address	1,76	406	353	774
Via a bill afterwards	1,65	418	332	1.048

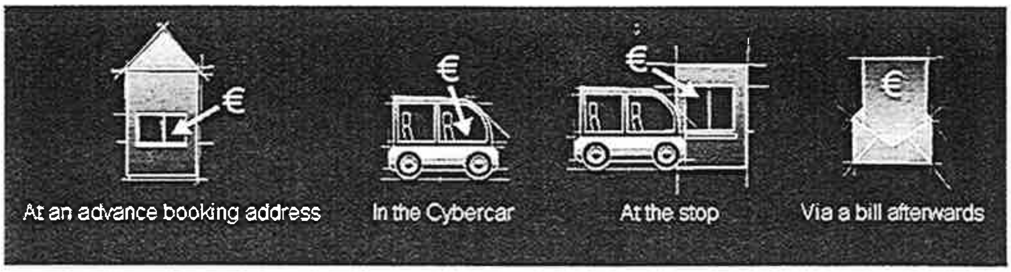

Figure 7.18: Moments people prefer to pay for the journey.

[14] Formula of the weight calculation: ((first preference * 3)+(second preference * 2)+(third preference * 1)) / (first preference + second preference + third preference)

7.5 Potential demand

Practically everyone is enthusiastic about the idea of using a cybercar in his or her chosen application! Even almost one out of three respondents indicates that he or she will use the cybercar almost always or always, and only 3% of the respondents won't use it. In figure 7.19 this is depicted.

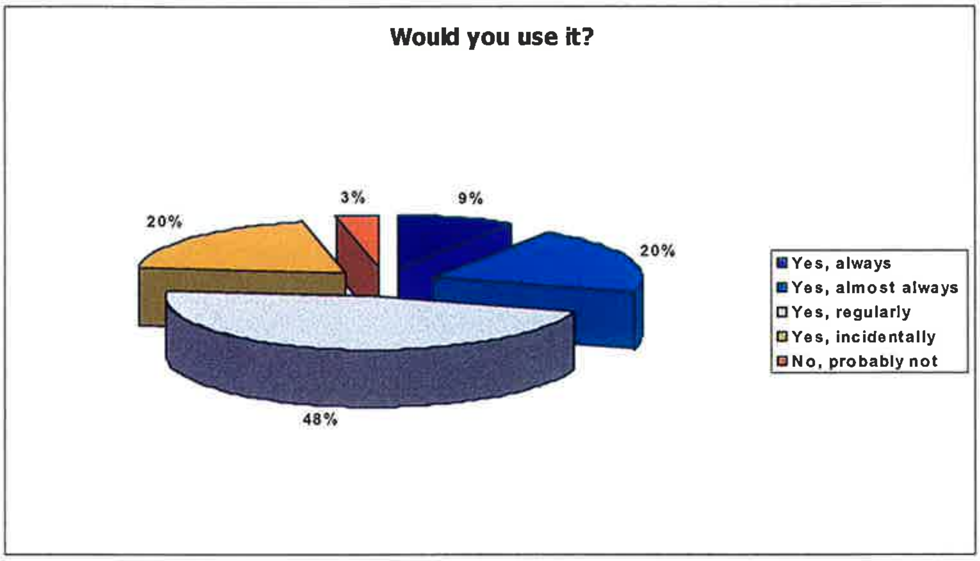

Figure 7.19: Would you use the cybercar in your chosen application? (n=2839).

The enthusiasm for the cybercar is slightly less at the applications 'at holiday park' and 'between central car park and central business district', and people who filled in the questionnaire for the airport application are slightly more interested than average in using the cybercars. Very promising is that people not enthusiastic of the idea of using a cybercar at the beginning of the survey (no chosen application), are much more enthusiastic at the end of the questionnaire: only one out of five of those respondents still indicates that he or she won't use it.

Table 7.27: Usage of the cybercar related to chosen application.

	Would you use the cybercar in your chosen application?					
Application	Yes, always	Yes, almost always	Yes, regularly	Yes, incidentally	No, probably not	Weighted[15]
Between central car park and business park	11%	22%	55%	10%	3%	3,27
Between station and university	11%	26%	42%	17%	3%	3,25
Between central car park and historic city centre	10%	22%	47%	20%	1%	3,20
Between central car park and departure terminal at	13%	21%	41%	24%	2%	3,19

[15] Formula on the weighted calculation: ((yes, always*5)+(yes, almost always*4)+(yes, regularly*3)+(yes, incidentally*2)+(no, probably not*1))

airport						
Between central car park and central business district	6%	20%	53%	18%	3%	3,09
At holiday park	8%	12%	51%	27%	2%	2,96
No	4%	7%	30%	40%	19%	2,39
Total	9%	20%	48%	20%	3%	

The amount of enthusiasm depends on the current mode of transport. People currently travelling by public transport are more enthusiastic about the CTS than car drivers or car passengers. And people currently travelling by bike or walking won't give up the exercise according to table 7.28: they are also (very) enthusiastic but they won't use the CTS for all their trips. So it can be concluded, based on these stated preferences that the CTS won't compete those regular modes of transport that much.

The respondents that said that they wouldn't use the CTS (n=91) were asked for the reasons for not using this system and for the conditions under which they would be using the CTS. 7% wants a driver in the cybercar, 36% indicate that external factors (like parking problems etc.) have to become worse, 34% have other preconditions and 24% won't use the CTS in any circumstances.

Table 7.28: Usage of the CTS related to current mode of transport.

Current transport mode	*Would you use it?* Yes, always	Yes, almost always	Yes, regularly	Yes, incidentally	No, probably not	Weighted[16]
Public transport	14%	26%	45%	14%	1%	3,38
Car driver	9%	21%	51%	15%	3%	3,19
Other	12%	25%	35%	20%	8%	3,14
Car passenger	8%	22%	44%	24%	2%	3,10
Walking	3%	12%	49%	34%	1%	2,81
Bicycle, moped	3%	12%	48%	33%	3%	2,79
Total	9%	21%	49%	19%	2%	

Finally, the respondents were asked if they could imagine that the CTS they put together could also be successful or useful at other locations. Most of the respondents could. The airport was most often seen as the most useful location (see figure 7.20).

[16] Formula on the weighted calculation: ((yes, always*5)+(yes, almost always*4)+(yes, regularly*3)+(yes, incidentally*2)+(no, probably not*1))

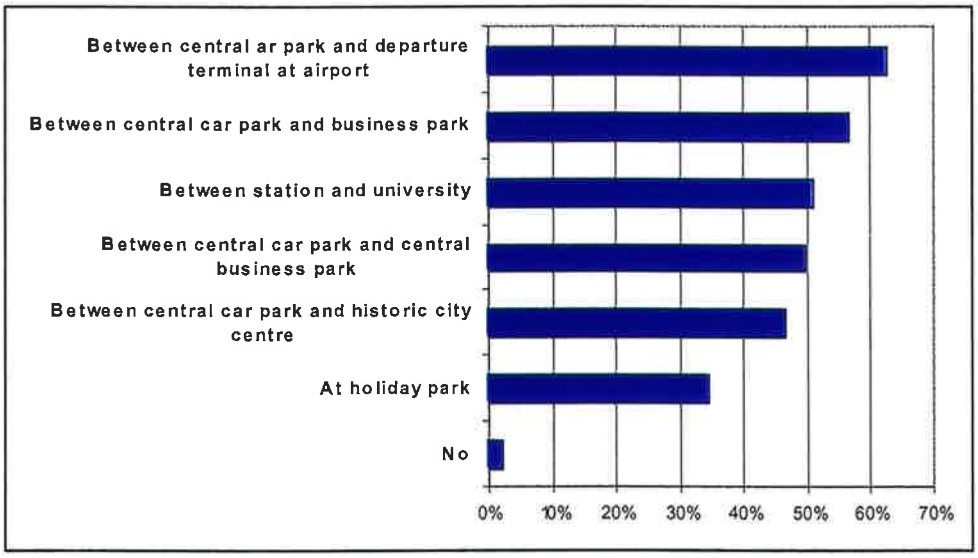

Figure 7.20: Can you imagine that the CTS you put together could also be successful or useful at other locations?

7.6 Summary of the results

Respondents prefer a Cybernetic Transport System that could be used daily; between a central car park and a historic city centre (27%) or the central business district (26%). Most people travel at the moment by car to these locations (about 60%). The trip purpose is mainly shopping or working. Car users encounter some problems when they travel by car to the historic city centre or the central business district. The main problems are very high parking costs, occupied parking spaces and crowded access roads. Respondents have indicated that they are interested in using a CTS; more then 70% of the car drivers have indicated that they will use the CTS regular or almost always.

From the results it becomes clear that respondents prefer a stop with a bus shelter. 53% of the respondents indicated that they prefer a bus shelter over a waiting room (36%) or pole in the ground (11%). However it appears that elderly people prefer a pole in the ground. Moreover the stop has to be furnished with some additional services. The top three of additional services consists of (1) a screen with all kinds of actual travel information, (2) a map of the are and (3) a bicycle shed (guarded, services are not free).

More than 75% of the respondents find a walk of 5 minutes to/from a stop acceptable. When the distance to the stop increases to 10 minutes, only 30% of the respondents are willing to accept the walking time. Therefore the ideal CTS have a stop within 5 minutes walking time of the origin/destination.

In principal a cybercar provides on-demand transport. This means that more vehicles are available when the demand is greater. However, in some cases scheduled service can provide more reliability because of the fixed departure timers. From the questionnaire it is not clear which service respondents prefer. People from the Netherlands mostly prefer scheduled services (58%), whereas respondents from other countries aim an on-demand service (61%). This makes clear that a Cybernetic Transport System cannot be the same in all countries. The design of the system has to be context dependent.

The cybercar preferable has doors on both sides and according to the respondents the vehicle should contain 5 to 10 seats. Remarkable is that the technology mostly offer one or two person vehicles. The willingness to pay is dependent of the current travel mode. Car and public Transport users are willing to pay a less amount per kilometre than walkers or bikers.

A most remarkable conclusion is that the cleanliness of the CTS is rated higher in importance by respondents all over the world than –for example- safety. Apparently most people are annoyed by the current degeneration of some public transport systems. Or they assume that it is safe – it goes without saying.

8 AGGREGATED CONCLUSIONS

Some aggregated conclusions could be drawn upon this research to support the CyberMove project.

8.1 About the innovative transport concept itself

The interactive questionnaire has examined whether or not the combination of changing quality requirements in the urban area and a new way of transporting people with automatic vehicles would lead to the CTS as a likely solution. This is done by offering the respondents – in their imagination - a CTS for the transfers they usually make and asking them to design it according to their own wishes. Notably nobody showed any difficulties with imagining passenger transport by means of a CTS.

Although, afterwards, still a slightly uncertainty remains about the recognition of the indicated transfers that supposed to illustrate the different transport typologies, the respondents indicated that the transfers in the direction of the (historical and business) city centre seemed to be most conceivable.

The reasons why respondents indicated that they like to use a CTS in the direction of the (historical and business) city centre are among other things the problems they have with parking (expensive and mostly occupied). Moreover they indicate that access roads are very crowded. When they travel by (regular) public transport, they complain about the quality of this mode of transport, e.g. delays, crowding and difficult boarding. In short, there are enough reasons to introduce a new transport system that solves all those problems.

Most people are enthusiastic about the idea to introduce a CTS. It does not matter if the potential end-user is young or old, lives in a single or multi person household, is low or high educated. Mostly everyone has indicated that they are interested in the use of a Cybernetic Transportation System.

When this new transport system is really introduced, respondents indicate that this mode of transport has to offer some physical and operational attributes, for example:
- the prerequisite that a CTS has to be safe and available;
- purity and client friendliness of the vehicles have been considered to be of great importance;
- the system has to make use of collective vehicles. Most of the CyberMove pilot sites will offer individual vehicles however;
- maximum waiting time of 5 minutes;
- the level of services of a CTS needs to be in line with the regular transport modes (travel and route information, frequency and/or call system, and payment easiness), and
- opposite to Public Transport behavior, people seems to be willing to incorporate (part of) saved parking fees into the tariff of a CTS.

8.2 Policy recommendations

On the basis of the results of the questionnaire only one recommendation is possible for the government as well as for business. This recommendation is that more field trials be carried out because potential end users have indicated clearly that they are interested in this mode of transportation. Moreover it is important that these new field trials will introduce some of the new services/designs that are indicated in the internet-questionnaire (e.g. vehicles with 5 to 10 seats instead of small vehicles).

At the same time more research needs to be done among potential end-users to find out if they recognize the CTS being the materialisation of their wishes. And also whether or not they are prepared to tune their behaviour to make use of the CTS.

Further more development of the CTS has to be related to the strategic views on the use of urban areas, not so much related to the technological feasibility as well as to the supply and demand characteristics of transport.

Last but not least, preparing a business case for the implementation of the CTS might contribute to a better view on the commercial viability and accelerated deployment of the CTS.

8.3 Evaluation of the method of research

The questionnaire has proven to be an excellent tool to get a sound and solid insight in the way respondents imagine a CTS, apply it to their own specific transfers, and design it according to their own wishes.

At the same time one has to admit that an internet questionnaire generates insufficient response, whereas the use of a panel (established for marketing purposes) results in a representative target group and the necessary quantities.

A last remark, also related to the interactive questionnaire, is that the amount of enthusiasm for CTS might be caused by the design of the questionnaire (e.g. using picture and colours instead of plain text). However, most respondents indicated that they really liked to use a CTS. In the questionnaire there has been a possibility to add some comments. Most respondents have used this possibility and expressed their amount of enthusiasm towards this innovative transport concept.

8.4 Further research needed

More research is needed to find out about the quality standards for daily passenger transport by cybercars.

More research is needed on the willingness to pay for the CTS and the arguments that are being used in this matter, both by end users, municipalities and providers.
More research is needed to find out in which way the opinion of respondents that are familiar with a field trial differs from other respondents and how the presence of a field trial contributes to an acceleration of the deployment of the CTS.

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Websites:
http://www.cybermove.org

APPENDIX: THE QUESTIONNAIRE

Question 1

Can you imagine that a Cybernetic Transport System will be used in the following situation?

Between a central car park and a historic city centre.

- ❑ Absolutely not
- ❑ Probably not
- ❑ Maybe
- ❑ Probably yes
- ❑ Yes, absolutely

Because a historic city centre is in most cases a car-free zone, you have to park your car at the edge of the centre. By means of a Cybercar you are transported to a central point in the city centre. The distance you travel by Cybercar is a minimum of 1 and a maximum of 5 kilometres. The arrival times of visitors to the central car park are spread out over the day. This has the advantage that the only passengers in the Cybercar are you (and possibly your family), so you have your privacy.

Question 2

Can you imagine that a Cybernetic Transport System will be used in the following situation?

Between a central car park and a business park.

- ❑ Absolutely not
- ❑ Probably not
- ❑ Maybe
- ❑ Probably yes
- ❑ Yes, absolutely

When you visit a business park you run the risk that almost all the parking places are occupied and you have to look for a long time to find one. Employees of the business park parked their car in the morning, so taking many of the spaces. To avoid wasting time looking to a parking place, you park your car at the edge of the business park. Subsequently you take the Cybercar to the company you want to visit. This journey covers at least 1 kilometre and at most 5 kilometres. Because the arrival times of visitors to the business park are spread out over the day, the only passenger in the Cybercar is you, so you have your privacy.

Question 3

Can you imagine that a Cybernetic Transport System will be used in the following situation?

At a holiday park.

- ❑ Absolutely not
- ❑ Probably not
- ❑ Maybe
- ❑ Probably yes
- ❑ Yes, absolutely

The holiday park is a car-free zone intended to increase the liveability on the park. However, because the distances between your holiday home and various recreational activities is rather long (between 1 and 5 kilometres), you can use a Cybercar to travel between them. These Cybercars bring you from any place to any destination. Only you (and possibly your family) are passengers in the Cybercar, so you have your privacy. This is possible because Cybercar usage is spread out over the day.

Question 4

Can you imagine that a Cybernetic Transport System will be used in the following situation?

From the station to the university.

- ❑ Absolutely not
- ❑ Probably not
- ❑ Maybe
- ❑ Probably yes
- ❑ Yes, absolutely

Regular public transport (like busses and trams) are crowded in the morning when travelling to the university. This is caused by the fact that both students and employees start work and classes at the same time. Public transport brings you to the stop closest to your destination, but most likely not directly to your ultimate destination. By means of a Cybercar you could travel directly to your destination. Because many travellers have to be transported at the same moment, you share the Cybercar with other travellers who also have the university as their destination. The journey by Cybercar is at least 1 kilometre and at most 5 kilometres, depending on your destination.

Question 5

Can you imagine that a Cybernetic Transport System will be used in the following situation?

From the station to the departure terminal of an airport.

- ❑ Absolutely not
- ❑ Probably not
- ❑ Maybe
- ❑ Probably yes
- ❑ Yes, absolutely

If you make use of a plane for a journey and travel by train to the airport, you have to bridge a distance of about 1 to 5 kilometres between the train station and the departure terminal. To make this trip easier you can make use of a Cybercar on this route. Because travellers arrive in large bunches at the station, you share the Cybercar with other people.

Question 6

Can you imagine that a Cybernetic Transport System will be used in the following situation?

From a central car park to the central business district.

- ❑ Absolutely not
- ❑ Probably not
- ❑ Maybe
- ❑ Probably yes
- ❑ Yes, absolutely

Many city centres are car-free zones, or at least the number of parking places is limited. This is why you park your car at a central car park at the edge of the city centre. From this central car park you travel by Cybercar to your own company in the centre of the city. This journey is at least 1 kilometre and at most 5 kilometres. Because all employees of the companies in the city centre start approximately at the same time, you share the Cybercar with other people who work in the city centre.

Question 7

Considering your own situation, which trip would best be facilitated by a Cybernetic Transport System?

- ❑ Between a central car park and a historic city centre
- ❑ Between a central car park and a business park
- ❑ At a holiday park
- ❑ From the station to the university
- ❑ From the station to the departure terminal of an airport
- ❑ From a central car park to the central business district
- ❑ I do not find a Cybercar useful for any trips
- ❑

You indicate that you do not find a Cybercar useful for any trips. However we would like to know more about your ideas concerning the design of a Cybernetic Transport System.

Do you want to answer some questions about the general design of the system?

- ❑ Yes
- ❑ No

Question 8

How do you usually travel ...

- to a historic city centre
- to a business park
- at a holiday park
- to the university
- to the departure terminal of an airport
- to the central business district

If you make use of more than one transport mode in one journey, please mark the mode by which you travel the longest distance.

- ❑ By car, as a driver
- ❑ By car, a as passenger
- ❑ By motorcycle
- ❑ By bus
- ❑ By train
- ❑ By tram
- ❑ By underground / subway
- ❑ On foot
- ❑ By moped
- ❑ By bicycle
- ❑ Other, namely ___

What is the reason that you usually travel …
- to a historic city centre
- to a business park
- at a holiday park
- to the university
- to the departure terminal of an airport
- to the central business district

- ❑ For shopping
- ❑ For a cultural visit
- ❑ For work
- ❑ To relax
- ❑ For a (work)appointment
- ❑ To go on holiday
- ❑ To follow lectures / classes
- ❑ To have holiday
- ❑ For a business trip
- ❑ Other, namely ___

Question 9
Which problems do you usually encounter during your trip or at your destination?
(multiple answers are possible.)

- ❑ Parking spaces are usually occupied
- ❑ Parking costs are very high
- ❑ Car parks are far away from the destination
- ❑ Crowded access roads
- ❑ Long waiting times for traffic lights
- ❑ No transport to final destination
- ❑ Bad weather conditions like rain and snow
- ❑ Change of trains, mode, etc.
- ❑ Delays
- ❑ Waiting
- ❑ Crowding
- ❑ Infrequent public transport
- ❑ Getting on is difficult
- ❑ Image
- ❑ Effort
- ❑ Slow speed
- ❑ No bicycle shed or storage area
- ❑ Theft of mopeds
- ❑ Theft of bicycles
- ❑ Vehicle may not enter the holiday park
- ❑ Distances to recreational activities are long
- ❑ I do not come across problems
- ❑ Other, namely ___

Question 10
A Cybernetic Transport System can prevent some of your usual travel problems. That is why we would like to know more about your personal wishes about these systems. First, we would like to know more about the location and design of stops.

How far are you willing to walk to a stop?
… minutes walking

And how close should the Cybernetic Transport System bring you to your destination?
… minutes walking from my destination

Question 11
Which of the following pictures represents best what a stop should look like?
- ❑ Stop is marked by a pole in the ground
- ❑ Stop is a bus shelter
- ❑ Stop is a waiting room

Question 12
The stop can be furnished with additional services.
Which three are your favourites?
(indicate the order of importance)
- First choice:
- Second choice:
- Third choice:

-- make a choice --

- ❑ Machine with snacks
- ❑ ATM
- ❑ Toilet
- ❑ Monitor with all kinds of actual travel information
- ❑ Monitor with information about the area
- ❑ Map of the area
- ❑ Telephone
- ❑ Internet unit
- ❑ Bicycle shed (unguarded)
- ❑ Bicycle shed (guarded, services are not free)

Question 13
How do you appreciate a … at the stop?

- ❑ Very positive, I think that I will use it a lot
- ❑ Positive, I think that I will use it sometimes.
- ❑ It doesn't bother me, but I don't think that I will use it very often.
- ❑ Disturbing, I don't need all these services

In principal a Cybercar provides on-demand transport. This means that more vehicles are available when the demand is greater. However, in some cases scheduled service can provide more reliability because of the fixed departure times.

Which do you prefer?
- ❑ Via a fixed schedule
- ❑ Via a call system

Question 14
Which call system do you prefer?

- ❑ Call system via (mobile) telephone
- ❑ Call system via a telephone at the stop

Question 15

Now that you have provided information about stops, we would like to know more about the design of the Cybernetic Transport System. It involves the design of the exterior and the interior of the Cybercar in relation to its application.

Which of the following pictures comes closest to your vision of a Cybercar?

	Individual	**Collective**
Classic	Classical design, You (and possibly your family) do not have to share the Cybercar with other people.	Classical design, You have to share the Cybercar with other people (other than family).
Modern	Modern design, You (and possibly your family) do not have to share the Cybercar with other people.	Modern design, You have to share the Cybercar with other people (other than family).

Question 16

Which of the following pictures provides the greatest personal security?

- ❑ The Cybercar has a 'totally open' design for maximum transparency.
- ❑ The Cybercar contains windows, but the vehicle is not completely transparent.

Question 17

Do you prefer doors on one side or on both sides of the Cybercar?

- ❑ Doors on one side.
- ❑ Doors on both sides.

Question 18

Can you indicate how important you find the following aspects with respect to the design of the Cybernetic Transport System?

- The entrance must be designed such that people with wheelchairs and baby carriages can also make use of the Cybercar.
- The Cybercar must be vandalism proof.
- The Cybercar must give me a feeling of personal safety.

- ❑ Not important
- ❑ Relatively unimportant
- ❑ Neutral
- ❑ Important
- ❑ Very important

Question 19

This question is about the interior of the vehicle. How important do you find it that the interior of the Cybercar meets the following requirements? It should have:

- ❑ Seats
- ❑ Standing room

- ❑ Space for luggage, baby carriages, wheelchairs
- ❑ Monitors providing actual traffic information
- ❑ Tourist information
- ❑ Emergency stop button
- ❑ Door-opening device
- ❑ Operating information (is the Cybercar active, where does it go to, speed, etc.)

– unimportant
– important

Question 20

This question is about the interior. How important do you find it that the interior of the Cybercar meets the following requirements? It is / has

(continue)

- ❑ Clean
- ❑ Vandalism proof
- ❑ Camera supervision
- ❑ Telephone for emergency situations
- ❑ Speech recognition (Interface provides audio signal when CTS approaches my stop.)
- ❑ Speech synthesis (System provides audio and visual information so that the seeing-impaired can also use the Cybercar)

Question 21

How many seats are necessary?

- ❑ Less than 5 seats
- ❑ to 10 seats
- ❑ More than 10 seats

Question 22

You have given a profile of your ideal Cybernetic Transport System. The choices you made are represented below.

– to a historic city centre
– to a business park
– at a holiday park
– to the university
– to the departure terminal of an airport
– to the central business district

How many Euros are you prepared to pay for (this part of) your journey by this Cybernetic Transport System?

… Euro per trip

Is this more or less than you pay at the moment for this trip?

- ❑ More
- ❑ Less
- ❑ As much as

Question 23

How do you want to pay for the use of the Cybernetic Transport System?

(multiple answers are possible)

- ❑ Cash

- ❑ Multi-journey ticket
- ❑ Credit card
- ❑ Chip/pin transaction
- ❑ Season ticket
- ❑ Combination parking – transport (– entrance) ticket.
- ❑ Dedicated ticket for the Cybernetic Transport System
- ❑ Mobile phone
- ❑ Other, namely ___

Question 24

Where and at which moment do you prefer to pay for the journey?

(indicate in order of importance)

- ❑ At an advance booking address
- ❑ In the Cybercar
- ❑ At the stop
- ❑ Via a bill afterwards

– First preference:
– Second preference:
– Third preference:

-- make a choice --

Question 25

How long do you travel on average from door to door ...?

– to a historic city centre
– to a business park
– at a holiday park
– to the university
– to the departure terminal of an airport
– to the central business district
... minutes

How many kilometres is this trip ... (on average)?

– to a historic city centre
– to a business park
– at a holiday park
– to the university
– to the departure terminal of an airport
– to the central business district
... kilometres

Question 26

You indicate that you normally travel ... minutes ...

– to a historic city centre
– to a business park
– at a holiday park
– to the university
– to the departure terminal of an airport
– to the central business district

Can you indicate how many minutes your travel time from door to door must be for you, to make use of a Cybernetic Transport System?
... minutes

How long are you willing to wait (at most) for the Cybercar for a trip between 1 and 5 kilometre, if you should make use of a Cybernetic Transport System?
A maximum of ... minutes

Question 27
Imagine that the Cybernetic Transport System (as you designed it) will be introduced.
Would you use it?

- ❑ Yes, always
- ❑ Yes, almost always
- ❑ Yes, regularly
- ❑ Yes, incidentally
- ❑ No, probably not

Question 28
Under which circumstances would you use the Cybernetic Transport System?

- ❑ If the Cybernetic Transport System improves (for example a Cybercar must have a driver)
- ❑ If other factors deteriorate for example, the time to find a parking place is more than a quarter of a hour)
- ❑ Under no circumstances
- ❑ Other, namely ___

Question 29
Would you make use of the Cybercar more often or as often as you currently do ...?

- to a historic city centre
- to a business park
- on a holiday park
- to the university
- to the departure terminal of an airport
- to the central business district

- ❑ More often
- ❑ As often as I currently do

Can you imagine that the Cybernetic Transport System you put together could also be successful or useful at other locations?
(multiple answers are possible)

- ❑ No
- ❑ Yes. Between a central car park and a historic city centre
- ❑ Yes. Between a central car park and a business park
- ❑ Yes. At a holiday park
- ❑ Yes. From the station to the university
- ❑ Yes. From the station to the departure terminal of an airport
- ❑ Yes. From a central car park to the central business district

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Question 30

Is the Cybernetic Transport System missing anything? Do you have additional comments?

Question 31
Finally, we would like to ask you some questions that are important for the statistical analysis of the questionnaire.

What is your year of birth?
19___

Gender?
- ❑ Male
- ❑ Female

Where do you live?
- ❑ The Netherlands
- ❑ Germany
- ❑ United Kingdom
- ❑ Italy
- ❑ Portugal
- ❑ France
- ❑ Israel
- ❑ Switzerland
- ❑ Austria
- ❑ Other, namely ___

What is your postal code?

Do you have paid work?
- ❑ Yes. … hours per week
- ❑ No

Do you have a car in your household?
- ❑ No
- ❑ 1 car
- ❑ 2 cars
- ❑ 3 cars or more

Question 32
How often do you use the car?
- ❑ Never
- ❑ Seldom
- ❑ Regular
- ❑ Always

By what means do you travel the most kilometres?
- ❑ As a car driver
- ❑ As a car passenger
- ❑ By motorcycle
- ❑ By bus
- ❑ By train

- ❑ By tram
- ❑ By subway
- ❑ On foot
- ❑ By moped
- ❑ By bike
- ❑ Other, namely ___

What is the highest level of education you completed?

- ❑ Primary education
- ❑ Lower vocational education, lower general secondary education, advanced elementary education
- ❑ Intermediate vocational education, higher general secondary education, high school, intermediate business education
- ❑ Higher vocational education, university

Question 33

What is the composition of your household?

- ❑ Two adults without child(ren) living at home
- ❑ Two adults with child(ren) living at home
- ❑ One adult without child(ren) living at home
- ❑ One adult with child(ren) living at home
- ❑ Other

How often do you use the internet?

- ❑ First time
- ❑ Seldom
- ❑ Regular
- ❑ Often
