



TOSCA

Technological and Operational Support for Car shAring



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Executive Summary

TOSCA (Technological and Operational Support for Car shAring) has been a research project co-funded by the Information Society Technologies Programme of the European Union. The key objective of TOSCA has been to promote the take-up of mature but insufficiently deployed leading edge technologies as well as innovative implementation and business concepts of car-sharing. The operational goals of TOSCA have been defined as follows:

- Transfer of innovative and technological tools of the car-sharing system in the City of Bremen (supplier) to the public transport operator ATC-Bologna (user).
- Development and implementation of a pilot application of car-sharing in the City of Bologna, based on the implementation and business concept of the car-sharing system in Bremen.
- Development of a business and technical implementation plan for three European cities: Barcelona, Bucharest and Strasbourg.
- Dissemination of the project results and best practice examples of car-sharing.

The present report evaluates whether the TOSCA project has been successful in meeting its objectives. Rupprecht Consult has been in charge of carrying out the assessment and evaluation of the TOSCA project. It is based on the Detailed Evaluation Plan (D4.1), which defined four expected impacts:

- Impact 1: User friendly car-sharing system (user perspective)
- Impact 2: Ease of operation (provider perspective)
- Impact 3: Economic viability of commercial car-sharing operation in Bologna
- Impact 4: Contribution to sustainability

For each expected impact, clear assessment objectives and operational indicators were identified and consequently evaluated.

Summary of key evaluation outcomes

The evaluation in the period between 1 July to 31 December 2001 was based on 378 bookings registered by the car-sharing system and 73 returned questionnaires (of a total of 97 sent out). In December 2001, CarATC, the Bologna car-sharing pilot application, had 97 subscribed customers, 8 car-sharing vehicles (plus one ATC test car), 1.716 booking hours and 10.511 km driven.

Growing numbers of users

During the evaluation period from 1 July to 31 December 2001 the number of subscribed CarATC users grew continuously. In December 2001, car-sharing Bologna had 97 subscribed users, however, not all customers used the service as only 57 actually made a booking during the whole pilot phase.

Core user group

The user group of CarATC is overrepresented by men between 24 and 35 years old and with a comparatively high education. Many of this group live alone or in small households and are full-time employees or self-employed.

Reason to join CarATC

The main motivation of using CarATC are practical reasons indicated by people who are used to public transport. Just as in other car-sharing schemes, the Bologna experience also shows a general trend that an originally ecological motivation, which used to be the driving force to set up car-sharing, is now less important than behind the convenience and cost aspect of the service today.

Reason to use CarATC

Car-sharing in Bologna has been used mainly for leisure activities as well as for shopping, thus for occasions when public transport is often not adequate or not practical. One in four respondents used car-sharing for work. This is a good complementary use, as these trips are mainly during the day, whereas the leisure trips usually take place after working hours or on the weekend.

Satisfied users

Nearly 60% of the customers were very satisfied or satisfied with the key issues of car-sharing: booking (via call-centre), IT-tools for car-sharing use, and billing.

Due to the fact that online booking was not available before 15 October 2001 and only 16 online bookings were made in total, the amount of data was not sufficient to conduct an evaluation of this key IT-tool.

New sustainable mobility pattern

Already after 6 months of pilot application a changed transport behaviour can be noticed which favours "green" transport modes. Most of the respondents used buses as main means of transport before joining CarATC. After having joined, the use of buses did not decrease, but the use of other motorised modes did. For half of the respondents private cars, motorcycles/mopeds and cars borrowed from family/friends were not any longer between the two most frequently chosen means of transport.

As previous research has shown, car-sharing has the potential to replace private cars. Assuming that CarATC was the reason for selling or not buying a car, respectively, the evaluation findings imply that there was a potential reduction of 36 to 59 cars in Bologna. This suggests that each of the eight CarATC cars had a potential to replace 6-8 cars. However, due to the pilot character of the Bologna car-sharing application, an actual measurable reduction of cars could not be expected within the duration of the project.

Highly recommended mobility service

Four in five CarATC users have recommended car-sharing to other persons or would do so in the future, mainly to friends and colleagues. This is an indicator for the overall satisfaction with the service and forms a good basis for the future. As car-sharing is not yet very well known in Bologna, 'spreading the word' by the pilot users is indeed very important to stimulate the overall demand.

CarATC use

October 2001 was the month with the highest demand, August, the holiday month in Italy, yielded the lowest figures. There were fewer bookings on weekends, however, the time of reservation was generally longer than during the week. On average, the reservation time of a CarATC vehicle in Bologna was 1:09 hours per day. This clearly indicates that there is still a high capacity of growth with the present car-sharing vehicles. Over the day, a certain usage pattern with peaks during rush hours could be observed.

The majority of the bookings met user's wishes. If not, this was mostly due to having to change to a different location. With two CarATC cars at each of the four locations during the pilot phase it was obvious that cars could not always be available at all locations at the times desired.

IT-tools

Most of the users were satisfied or very satisfied with both IT-tools (smart card and onboard computer). The same applies for reliability of the smart card concerning access to the car. Even though in total, only 16 bookings were made via Internet, 62 responses referred to reliability of the smart card concerning bookings. Half of those respondents indicated to be satisfied or very satisfied. This indicates a high potential of trust in IT tools even though many of the respondents lacked personal experience with using it.

Cost/Revenues

CarATC has not covered its costs during the pilot application phase. Only about 10% of the declared success criterion (income of about 50.000 € at the end of the experimentation phase) was realised.

The available financial data was insufficient for a detailed further analysis.

Experience has shown that car-sharing can be cost covering providing that it starts with a big fleet, with different vehicle types and several locations. Since the pilot application in Bologna started with few cars and locations the success criterion was obviously too ambitious.

Prospects

Three out of four CarATC users would remain in the programme under the current conditions, whereas four out of five users would either not agree to the new (higher) tariffs or are indecisive under the new conditions. Expectations of current customers mostly refer to low cost, diversified cost schemes, more locations and a greater variability in vehicles types.

Potential new user groups are women, elderly people (55+) and families with children, as well as students.

Key recommendations

The key recommendations on the basis of these results are:

- Establish a detailed business case
- Solve remaining technical and accounting problems as soon as possible
- Implement car-sharing strategy 'start big, grow quick'
- Increase number of car-sharing vehicles
- Make a wider variety of vehicles types available to users
- Increase the number of locations
- Adapt a diversified tariff structure
- Create more synergy with public transport (e.g. ticketing)
- Closely monitor actual car-sharing usage
- Target marketing towards potential user groups

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1 Introduction

TOSCA - **T**echnological and **O**perational **S**upport for **C**ar **sh**Aring – is take-up Project supported by the Information Society Technologies (IST) Programme of the European Commission. TOSCA's main goal is to promote IST-based car-sharing as an element of flexible and intermodal door-to-door mobility services. Within the project a car-sharing pilot application has been integrated as a supplementary service to public transport. In addition to the technology transfer from Bremen to Bologna, three follower cities have prepared business and implementation plans of car-sharing. TOSCA started in September 2000 and ended after 18 months in February 2002.

Among the various deliverables produced by TOSCA¹ the "TOSCA Take-Up Guide: Car-Sharing in Practice" gives a good overview of the project and summarises the valuable experience gained within this European take-up project. The present report is based on the methodology developed in the Detailed Evaluation Plan (D4.1) and summarises the assessment and evaluation results of the TOSCA project. The key target of the evaluation process has been to determine in how far the defined impacts were met by the TOSCA project.

1.1 The TOSCA Project

Car-sharing

Car-sharing is a mobility service, which completes the range of environmentally friendly means of transport (public transport, cycling and walking) as it reduces dependence on car ownership. It gives access to a fleet of cars, with easy and simple to use procedures, using the latest technology. In Bremen, and other car-sharing organisations, clients are given a smart card and a PIN code for car access. The booking of car-sharing cars is easy: A short phone call to the booking office or booking via Internet – both available 24 hours a day. Usually, different types of cars are available. Billing depends on the hours of car use and the mileage driven.

Car-sharing has the potential of offering almost the same flexibility as a private car with higher economic and ecological efficiency. For users driving up to about 10.000 kilometres² per year, car-sharing forms a financially attractive alternative to the private car.

Car-sharing, adopted on a wide scale, can help to reduce the number of vehicles on the road considerably. It has the potential to save resources and energy, to reduce polluting emissions, as well as to improve the quality of urban space through a reduction of (parked) vehicles. In addition, car-sharing customers can save money as they only pay when they drive.

Car-sharing is already in operation on a large scale in Austria, Germany, the Netherlands and Switzerland. Small-scale operations exist in other European countries, e.g. in France and Italy.

¹ More information on the TOSCA project and all public documents is provided at the project website: www.atc.bo.it/tosca/.

² Baum – Pesch, p. 45

TOSCA Project Objectives

TOSCA has had the overall intention to promote the idea of an integrated mobility concept, mainly through a technological transfer initiative from Bremen to the Bologna public transport operator ATC. Car-sharing is considered to be a complementary mobility service for the public transport customers, which is based on advanced technologies developed in European Programmes. TOSCA aimed to prepare for further take up in European cities.

In order to achieve these key objectives, the following operational goals were defined:

- Transfer the innovative and technological tools of the car-sharing scheme in the City of Bremen to the public transport operator ATC-Bologna.
- Develop and implement a pilot application of car-sharing in Bologna, based on the implementation and business concept of the car-sharing system in Bremen.
- Develop a business and technical implementation plan for three European cities: Barcelona, Bucharest and Strasbourg.
- Disseminate the project results and best practice examples of car-sharing.

Targets

Within the TOSCA project, ATC Bologna implemented a car-sharing pilot application with nine vehicles (8 for customer use, 1 for internal staff use), placed at three car-sharing locations in the city centre. To ensure high quality customer services and environmental friendliness, the Bologna car-sharing scheme aimed at complying with the following emerging standards for car-sharing operations³:

- 24-hr-service and accessibility, in order to offer a real alternative to private car ownership
- Fee structure based on mileage, in order not to give an incentive to driving more than necessary ("pay as you drive" structure)
- Use of low emission vehicles (compliant with EURO III norm at least)

The implementation of the pilot car-sharing technology elements and the corresponding business concept were designed to help reach the targets defined below. These targets were projected for three years on the basis of the business plan estimates for the use of car-sharing in Bologna.

Table 1 Three year TOSCA business and sustainability targets

Business targets*	Sustainability targets*
<ul style="list-style-type: none"> • Achieve a number of 100 regular car-sharing customers. • Achieve an operational efficiency above 25 % compared to a base case of non-IST-based car-sharing. • Set up a car-sharing operation in Bologna with at least 15 car-sharing vehicles, which fully covers all operational costs within two and a half years. 	<ul style="list-style-type: none"> • Reduce the number of kilometres driven by the car-sharing customers by 160.000 kilometres annually⁴. • Increase the use of public transport means of the car-sharing customers by 25%. • Reduce the total number of registered vehicles in Bologna by 50 (gross reduction due to car-sharing). • Gain 500 m² of urban space⁵. • Reduce the CO₂ emission of the car-sharing customers by 32 tons annually (starting 2002).

* Targets were projected for three years.

³ These standards have been defined in Germany by the Independent Jury "Umweltzeichen" (Eco-Label) in May 1999 as requirements for the labelling of car-sharing.

⁴ Starting in the year 2002 and based on the experiences of the City of Bremen, it was assumed that each car-sharing customer would reduce the number of kilometres driven by about 1.600 km per year.

⁵ Based on: 50 vehicles x 2m x 5m.

ATC further specified the goals as follows:

- Address multiple car ownership with the goal that just one private car is kept and all additional cars are given up because of car-sharing (long-term goal).
- Convince 25% of the pilot car-sharing customers not to buy a car (first or additional one) (pilot application goal).
- Urban space conservation, which means freeing 360 m² surface from car occupancy (considering that each CarATC vehicle supposedly replaces 4 cars) (pilot application goal).
- About 20.000 km not driven during the pilot application phase resulting in an environmental benefit equalling 4 tons of CO₂ (pilot application goal).

Project structure

The project consortium combined valuable expertise in the field of car-sharing (see Table 2). The cities of Barcelona, Bucharest and Strasbourg were associated as follower cities.

Table 2 The TOSCA consortium

Name	Country	Status
ATC Bologna S.p.a.	Italy	Co-ordinator
Eurocities Access (formerly Car Free Cities)	Belgium	Member
Freie Hansestadt Bremen, Der Senator Bau und Umwelt	Germany	Member
INVERS GmbH	Germany	Member
POLIS a.s.b.l.	Belgium	Member
Rupprecht Consult - Forschung & Beratung GmbH	Germany	Member
Cambio	Germany	Sub-Contractor

1.2 Bologna Car-Sharing Pilot Operation

With a population of about 380.000 inhabitants, Bologna is the biggest city between Milan and Florence. It is an important transport node of the Italian peninsula and seat of the provincial Emilia Romagna government and of one of the first universities of the world. Bologna is known for its economic and administrative productivity and high quality of life standards, there is in fact a long tradition of providing services to citizens (e.g. educational, social, cultural, sports). Bologna was one of the first Italian cities to ban private car traffic from the historic city centre. Today, up to 250.000 vehicles are on the move every day and Bologna city is actively involved in transport planning.

Implementation Framework

Within the TOSCA project, the local public transport operator, ATC Bologna, implemented the car-sharing pilot application. ATC is a local reference company for a series of initiatives aimed at improving mobility management as it offers a wide range of innovative and alternative services. ATC is in charge of research, planning of and commercialising of innovative technological solutions for public transport, parking management in the area of Bologna and it is responsible for the depots for vehicles towed away by the police. ATC operates urban, suburban and interurban public road transport in the whole Bologna City area. About 100 million passengers are carried annually, tendency slightly increasing. The company is particularly keen on developing modern strategies and technological tools for managing the transport demand, and alert in supporting the newest transport models in order to guarantee a service becoming more effective and efficient.

The car-sharing idea originated and has been developed within this general context and has been supported by the fact that ATC has experience in fleet management, implementation of municipal

transport policy, as well as good access to an important car-sharing target group (public transport users), experience in awareness and public relations/marketing campaigns and capital investment for starting on a high professional level. The car-sharing pilot application carried out by ATC within the TOSCA project is called "CarATC" (in Italian also meaning "dear (*cara, it.*) ATC").

Strong and intense political sponsorship of the Mobility City Council plus an agreement with the Bologna taxi operator proved to be successful starting points for the service. The co-operation with the local taxi operator COTABO was essential to avoid conflict with private interests and to benefit from its experience. COTABO, in fact, not only provided the call-centre for booking, but also 24-hour fleet assistance (e.g. car maintenance, towing service, refuelling and vehicle cleaning).

At the start of the TOSCA project, ATC launched an information campaign to promote the car-sharing pilot application in buses and at the most strategic Bologna Municipality info-points. Radio and television broadcasts as well as newspaper articles promoted the new service. Direct contacts were obtained through a telephone "CarATC hotline".

After the end of the TOSCA project, ATC plans to continue the car-sharing service. The TOSCA evaluation results will be integrated and exploited as part of the future ATC car-sharing strategy in Bologna. During the project lifetime the Italian Ministry of the Environment started to offer considerable financial support for future car-sharing in Italy, which is organised under the Italian Car-sharing Initiative, ICS. It is planned to implement a national call-centre for booking and to use the same technical tools throughout the country. Successful application to these funds will enable ATC to continue and broaden the car-sharing service in Bologna.

Fig. 1 COCOS System Overall View

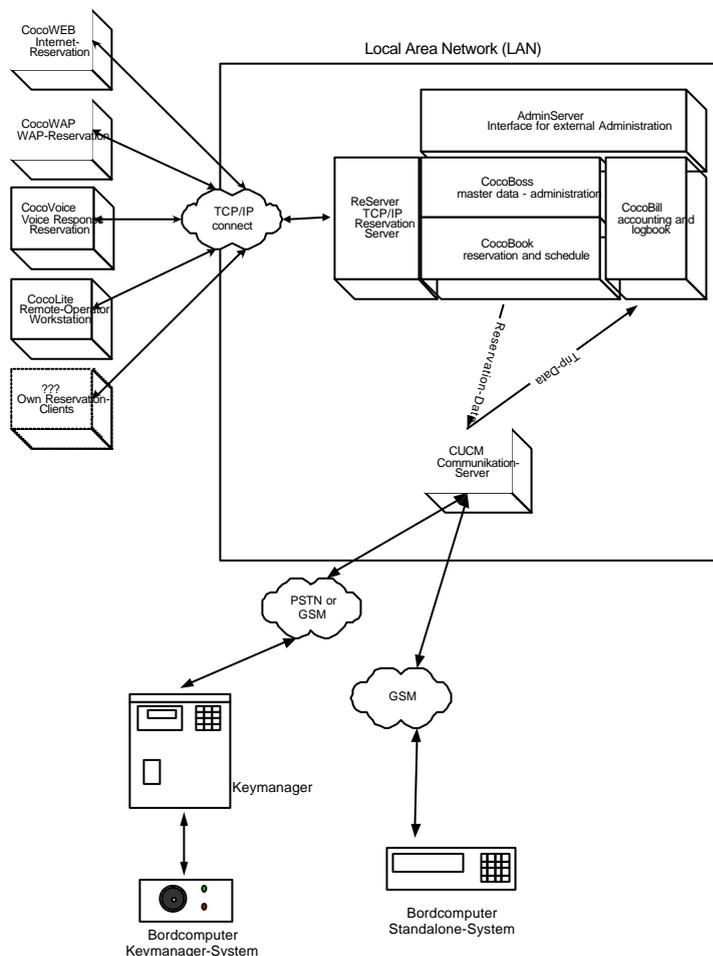
Technology

A car-sharing pre-study was carried out in Bologna in 1998. On this basis the technological implementation parameters were determined and their functionality tested during the pilot phase of the TOSCA project, which started in June 2001.

The COCOS Standalone System (**C**ar-sharing **O**rganisation and **C**ommunication **S**ystem developed by INVERS) was selected as car-sharing technology. It is based on an on-board computer, a contact less card reader and a GSM modem. All devices are inside the car. As the locations do not require any fixed structure, it allows for high flexibility in (starting new) car-sharing stations.

As back office software, the COCOS'2000 standard package and additionally the attached Internet Software CocoWeb were used. This software configuration provides a LAN-based distribution of administration clients, reservation and billing clients as well as an Internet-based self-service reservation client. The included communication software CUCM performs the GSM communication. The operative system used is a Microsoft Windows NT server (with updated service pack) and the web server is Microsoft IIS 4.0. The database engine is Microsoft jet engine (MS Access97).

Before the pilot application started, the car-sharing technology system was verified and adjusted.



Source: INVERS

Fleet and Locations

During the car-sharing pilot application phase, one type of vehicle was available: the Smart (759 cc, 30 KW).

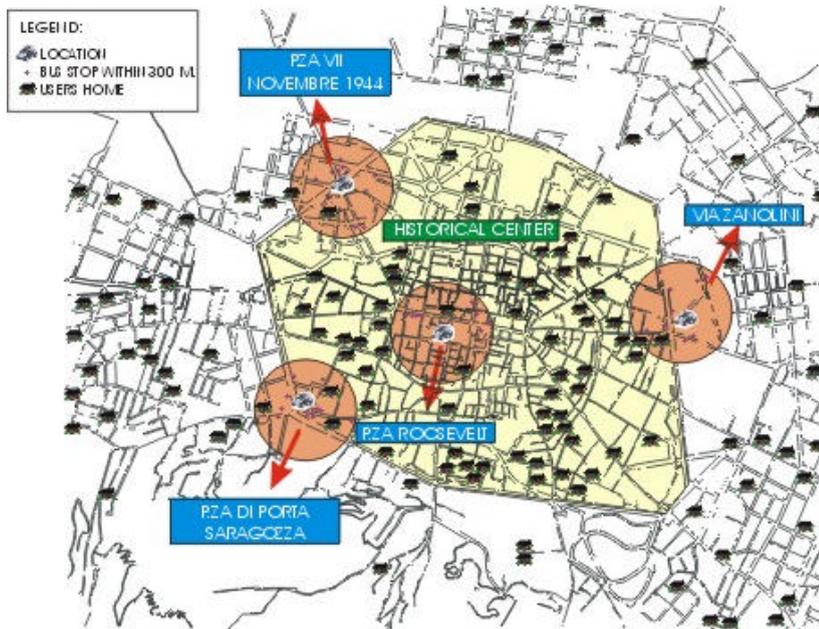
The Smart was chosen for its ecological engine (eco diesel; EURO3) and the reduced dimensions of the car itself. Nine vehicles were offered to ATC by the Smart car dealer in Bologna free of charge for the whole experimentation period.

The historical city centre of Bologna was identified as the most suitable area for car-sharing locations, due to high population density, limited vehicle circulation, few parking places and high garage costs. Moreover, many companies are located in the historical centre that could use car-sharing instead of or as supplement to the company fleet.

Near the historical centre further attractive areas were identified, such as Porta Saragozza, Porta S.Donato and S.Orsola General Hospital, due to large numbers of residents, parking restrictions and location of points of attraction.

ATC selected the following four car-sharing locations for the TOSCA car-sharing pilot project:

Fig. 3 Car-sharing locations Bologna pilot



populated area

- **P.zza Roosevelt :**
Situated in the historical centre, in a very crowded area
- **P.zza VII Novembre:**
Close to the main railway station, situated on the main access roads from the North
- **Via Zanolini/ Porta S.Donato:** Located in the University area, close to the S. Vitale railway station
- **P.zza di Porta Saragozza:**
Close to the engineering faculty, few parking spaces available, highly

Fig. 2 ATC car-sharing vehicle



Photo: ATC

Source: ATC

Tariff Structure and Booking

Bookings could be made via the call-centre or online 24 hours a day for a minimum of at least one hour of use. The call-centre was operated by the taxi company COTABO, online booking was available as of mid October 2001 (www.CarATC.bo.it).

During the car-sharing pilot application a simplified tariff structure was used. The cost of the car-sharing service was calculated according to mileage and time of use: Each driven km cost 1,29 Euro, each hour of usage cost 0,26 Euro. Registration was free of charge and the customers did not pay any deposit or admission fees during the pilot application.

ATC will use the TOSCA survey results to investigate user acceptance concerning different tariff structures. Depending on the results, ATC will consider implementing a more diversified tariff structure (e.g. for working days and for weekends) in the future.

User Groups

A focused information campaign aimed at selecting potential car-sharing users, was conducted. ATC aimed to contact especially the following potential users:

- **Students:** Bologna, one of the oldest European University locations, is hosting a large number of students,
- **Residents:** Many residents, especially those living in the historical city centre, have to struggle finding parking lots everyday ⁶,
- **Small Business Sector:** Many business offices and enterprises (e.g. lawyers, commercial offices, banks, post offices) are located in the city centre.

Different steps were taken to select user groups. The very first approach was to address a personal letter to all associations of occupational groups (e.g. professionals such as doctors, architects, engineers), to the University halls of residence and to hotelkeepers. Parallel to the information campaign a focused user needs survey was held to investigate potential users' actual mobility patterns.

Once the contract had been signed, the users needed to agree to give bank permission to CarATC. This served as guarantee for correct payment to CarATC. In December 2001, 97 customers had registered to use the car-sharing service.

⁶ About 10.500 parking lots are reserved for 'special categories', such as the Police, disabled people and for goods discharge. "CarATC" users have the advantage of free parking and fewer mobility restrictions in comparison to private car users.

2 Data Measurement and Analysis

2.1 Overall Evaluation Framework

The evaluation is based on the TOSCA Detailed Evaluation Plan (Deliverable 4.1). Methodologically, TOSCA followed the Six-Step-Approach for building evaluation into an IST Project⁷ and built on the established practice of technology evaluation in past programmes, especially in TAP and ESPRIT. Extensive desk research on evaluation guidelines (ANIMATE, CONVERGE, and VATAM) has been conducted, and actual project evaluation plans in previous European RTD Programmes have been analysed, in order to draft a generic model for assessment tasks in TOSCA as input for forming agreement concerning the TOSCA evaluation. The Detailed Evaluation Plan included the following elements:

- Identification of all operational goals
- Definition of expected impacts and appraisal groups (i.e. users/non-users affected),
- Definition of evaluation methodologies, reference cases and success criteria.

The assessment and evaluation was carried out by Rupprecht Consult - Forschung & Beratung GmbH. ATC Bologna S.p.a. was responsible for data measurement. ATC and INVERS provided the data required for evaluation (Deliverable 3.1)⁸ in close co-operation with and very substantial support by Rupprecht Consult, responsible for the overall evaluation process.

2.2 Data sources

The time period for system data analysis was six months from 1 July to 31 December 2001 (referred to as 'evaluation phase' in the following text). The survey data covers the period from July to October 2001.

The following data sources were used for the assessment and evaluation:

- **System Data**

The automatically registered system data for the time period from 1 July to 31 December 2001 was used for evaluation. This COCOS system data was provided by INVERS.

A plausibility check revealed extremely large use figures for Car1 as well as for user numbers 1011, 1164 and 1165. A request to ATC revealed that this data referred to ATC internal use and tests only. Therefore this data was excluded from further analysis, and is not included in this report. The 'cleaned' data includes 378 data entries (of originally 910), i.e. only "real users" are included in the evaluation of project results.

For 32 of the 378 bookings the system data was zero (0) kilometres. In four of these cases, trip time also equalled zero. It has to be assumed that these were cases in which the customers did not show up for their reservations. For the remaining zero-kilometre bookings, short trip times have been recorded. This could either be cases in which the car was opened and closed with the smart card while it was parked or due to system parameters (e.g. less than 600m are registered as 0 km distance).

In the following text the abbreviation "INVERS" indicates that the source of information is the system data provided by INVERS.

⁷ Source: European Commission (1999), Annex 1 "Description of work"

⁸ Delays in the provision of measurement data subsequently delayed the assessment and evaluation process and report.

- **Survey Data**

The survey data was gained through the TOSCA pilot user survey which was sent out by the beginning of December 2001⁹. Data entry was closed by mid January 2002. 73 filled in questionnaires were returned out of a total of 97 questionnaires that were sent out. This equals a return rate of 75%.

In the following text the abbreviation "Q-TOSCA" indicates that the source of information is the TOSCA questionnaire data; a small "q" indicates the number of the question on the questionnaire.

- **Operational and Statistical Data**

Information regarding number of CarATC users, errors in usage, technical errors and statistical background data was provided by ATC.

In the following text the abbreviation "ATC" indicates that the source of information is data delivered by ATC.

Reference Cases

The impacts of the pilot application had to be compared to existing data from other contexts of car sharing implementation in order to compare the results of TOSCA application vis-a-vis other experiences.

As the car-sharing system was transferred from Bremen it had been planned to use data from the Bremen car sharing operator Cambio for the reference case of the Bologna car-sharing pilot application. However, due to the sensitivity of commercial data Cambio eventually refused to deliver detailed reference case information. As far as possible this was compensated by car-sharing evaluation data especially from Dresden, but also from Switzerland and partly from the ZEUS project (in Bremen). In the following a brief background of the reference cases is given:

- **Dresden¹⁰**

stadtmobil Dresden started on 25 April 1998 with 22 vehicles at six locations and 57 customers. The survey was carried out in March 1999 when car-sharing Dresden had 38 vehicles at 11 locations with 635 members. 317 questionnaires were evaluated, which equalled a return rate of 50%.

In March 2000, *stadtmobil* Dresden had 43 vehicles (increased to 50 vehicles in seasonal peaks of demand, e.g. in summer) at 11 locations. The number of members had risen to 1.032.

- **Switzerland¹¹**

Mobility CarSharing Switzerland has more than 30.000 users. On 1 September 1998, Mobility CarSharing Switzerland, the Swiss federal railway (Schweizer Bundesbahnen SBB) and Energie 2000 jointly launched the combined mobility service: as world premiere public transport and car-sharing became available on a single card.

The reference data refers to the results of a survey of 1.074 actual and potential Swiss car-sharing users (on paper and by telephone) held in 1998.

⁹ Data measurement was held up by the fact that online booking - a key function of IT-based car-sharing - was not available before 15 October 2001. To include at least some experience of online booking in the data analysis, the TOSCA questionnaire was not sent out to the pilot users before the beginning of December.

¹⁰ Perner, T. et al. (1994)

¹¹ Muheim, P. – E. Rheinhardt (2000)

- **Bremen¹²**

A survey was carried out for the ZEUS project by the University of Bremen. ZEUS was an EU funded project in which eight European cities collaborated towards the broad popularisation of energy-efficient, environmentally friendly vehicles.

The questionnaire was sent to 227 clients and 1001 persons interested in the offer 'Bremen Card plus AutoCard' (combined offer of public transport and car-sharing) in October 1998. 130 clients (57.3%) and 314 interested persons (31.4%) answered.

¹² ZEUS (2000a/b); More information on the ZEUS project under: <http://www.zeus-europe.org>
IST 1999 20856

2.3 CarATC use

Of the originally 9 car-sharing vehicles only 8 were actually available for public use. The analysis is based on these 8 vehicles as used by "real" (i.e. non-ATC internal) users.

A detailed assessment and evaluation of the number of users and usage patterns is given under Indicator 3. Table 3 provides a general overview of use of CarATC during the evaluation phase of the project.

Table 3 Overview car-sharing system data from 1 July – 31 December 2002

Users - Bookings		Cars - Booking		
Number of users (pilot)	57	Total number of cars	8	
Mean frequency of bookings per user	6.6	Total number of bookings	378	
Minimum number of bookings	1	Mean number of bookings per car during pilot	47	
Maximum number of bookings	40	Car 5, car with maximum bookings	68	
Total number of bookings	378	Car 9, car with minimum bookings	11	
25% of users booked ... times	1	Cars - km		
50% of users booked ... times	3	Total driven km	10.511 km	
75% of users booked ... times	8	Mean driven km per car during pilot	30 km	
		Car 5, car with maximum mileage	2.327 km	
		Car 9, car with minimum mileage	270 km	
Trips - km		Reservations - Trips		
	Pilot		Reser- vations	Trips
Number of trips (km>0)	346	Number of reservations/trips (time>0)	361	374
km mean per trip	30 km	Mean reservation/trip time	4:45	3:28
km median	22 km	Standard deviation of reservation/trip time	4:25	3:29
km stdv	33 km	Minimum reservation/trip time	1:00	0:01
km minimum trip length	1 km	Maximum reservation/trip time	52:45	35:34
km maximum trip length	346 km	Total reservation/trip time	1716:30	1302:22
Total km	10.511 km	25% of bookings/trips were less than ... hours	2:30	1:42
25 % of trips were less than ...	11 km	50% of bookings/trips were less than ... hours	3:15	2:47
50 % of trips were less than ...	22 km	75% of bookings/trips were less than ... hours	5:15	3:59
75 % of trips were less than ...	39 km			

Source: INVERS

3 Detailed Evaluation Results

The TOSCA project was carried out between 1 September 2000 and 28 February 2001. After 10 months of preparation, installation and testing, the Bologna car-sharing pilot application officially started on 18 June 2001.

Before this public start of the pilot application, the expected impacts and appraisal groups as well as the evaluation methodology were defined in the TOSCA Detailed Evaluation Plan (Deliverable 4.1). Based on this plan, data measurement was performed by ATC and INVERS. The assessment and evaluation was carried out by Rupprecht Consult - Forschung & Beratung GmbH. Its results are presented hereafter, starting with an analysis of the car-sharing user group, followed by a presentation of the results per each of the four impacts:

Impact 1: User-friendly car-sharing system (user perspective)

Impact 2: Ease of operation (provider perspective),

Impact 3: Economic viability of commercial car-sharing operation in Bologna and

Impact 4: Contribution to sustainability.

3.1 CarATC User Profile

In December 2001 CarATC had 97 customers. Eight Smart cars were (and still are) located in four locations with 2 vehicles each for pilot application use. The ninth Smart was left at ATC for staff use (car #1).

To identify the actual pilot user group, some socio-demographic data is presented. This not only helps to decide whether ATC has been successful in attracting the targeted user groups, but may also provide the basis for further targeted customer recruitment.

Age

According to the survey data, CarATC was mainly used by young adults. Almost half of the respondents were between the ages of 24 and 35 (cf. Fig 4). Only one respondent was older than 55, whereas in the total of Bologna's population the older inhabitants have a comparatively large share. This result is well in line with the general car-sharing user profile, e.g. in Dresden similar results could be observed. Here, too, the car-sharing customers are younger than the city's average population.¹³

The reason may be that younger people are more open to new services, especially when new technology is applied. This may on the contrary be a barrier for older people. Besides, young adults generally tend to have fewer financial resources and thus welcome the possibility of using a car without owning it. Possibly the higher awareness of environmentally friendly transport concepts may also favour car sharing use in this age group. In Bologna, the choice of the Smart, as the only available vehicle, with a particularly "trendy" image has certainly emphasised this general trend.

Occupation

The results of the survey analysis reveal that the majority of the responding users were employed (cf. Fig 6). Approximately half of the respondents was working full time, one quarter of the total being self-employed, whereas there was only a small share of students (8 respondents).

In Dresden a high proportion of students (25%) were attracted (with a special student ticket), the majority was employed full-time (53%).

It is striking that there was a relative small share of students in a university city like Bologna. CarATC has apparently not yet succeeded in attracting one of the targeted user groups. This leaves a high

¹³ Perner et al., p. 24-25

potential of future users which could be attracted to car-sharing by targeted marketing and by special tariff conditions for students, e.g. reduced public transport and car-sharing fares like the German "Semester ticket" in combination with special fares as in Dresden.

Another targeted user group, the 'users from the small business sector', seems to have been reached. 25% of the respondents were self-employed and some of the 48% employed full-time may also belong to this category. This is particularly satisfying, as it can be assumed that this user group has a financial background, which allows long-time car-sharing membership. But most of all, car-sharing vehicles for business purposes are normally booked during daytime and therefore perfectly complement private users' demand who generally book car-sharing vehicles after work or on weekends.

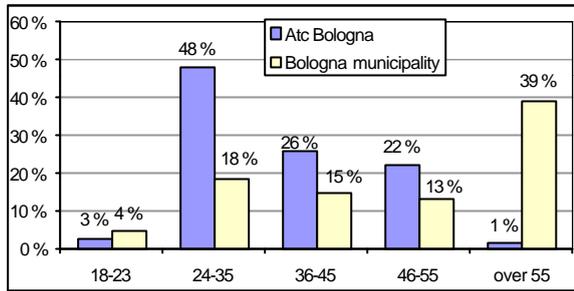
Education

More than half of the sample had a university degree (56%), about one third (38%) had a high school degree as their highest degree (cf. Fig. 5). This corresponds well to the overall user profile in Dresden where the majority of the users was well educated, too (57% university, 25% high school).

As established by many investigations in other contexts the awareness of new forms of mobility is higher among well-educated people. Therefore also in Bologna the higher responsiveness implies that well educated people tend to reflect more on their mobility patterns and on preconceptions regarding monetary, organisational and ecological costs and benefits of alternative modes of transport. While the income of this group is above average, they tend to be less motivated by financial benefits only.

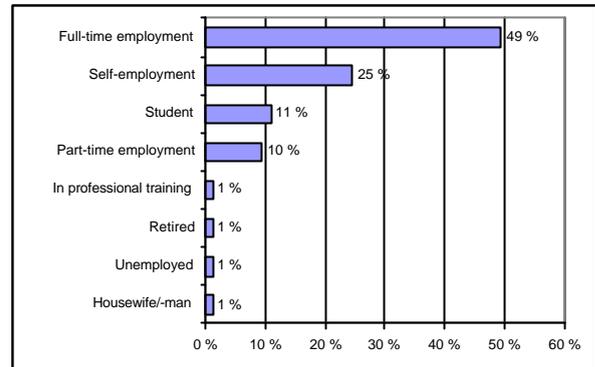
Low costs of car-sharing certainly remain one of the most important selling points to many user groups. However, the evaluation findings imply that ATC marketing should avoid being only cost orientated but highlight the role of car-sharing users as "social pioneers" or "trendsetters". This strategy could well apply to other potential user groups as well: to attract "ambassadors" in social settings still underrepresented as customers.

Fig. 4 Age Groups of TOSCA survey respondents



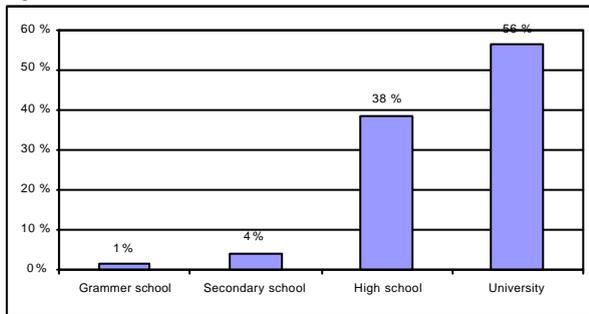
Source: Q-TOSCA q.13 n=73; Statistical information by ATC

Fig. 6 Occupation of TOSCA survey respondents



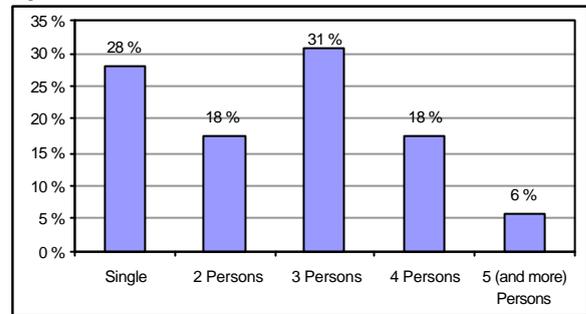
Source: Q-TOSCA q.17 n=73

Fig. 5 Education



Source: Q-TOSCA q.16 n=73

Fig. 7 Size of household



Source: Q-TOSCA q.14 n=68

Size of household

According to the user questionnaire, the ATC-offer was particularly attractive to singles and members of households with up to 3 persons (cf. Fig. 7). Of the 3-person-households in the survey, only about one half had children under the age of 17 (10 of 21 cases). On the basis of Italian household structures one could assume that adult children still living with their parents accounted for the other 3-person-households. It is equally probable that there is a direct link between the limited size of the car-sharing car (Smarts) and the fact that many respondents were singles and the average age was low.

In Dresden, where a wider range of cars is available, a high proportion of households with more than 3 persons took part in car-sharing (36%); 24% singles and 30% 2-person households¹⁴.

In Bologna, a potential future customer group are thus larger households with more that 3 members where car-sharing could take over the role of a second car, provided that the necessary types of vehicles are available. This clearly supports ATC's plans to offer a more diverse fleet in the future.

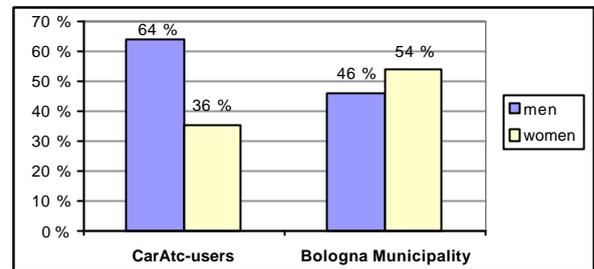
¹⁴ Perner et al., p.22-23

Gender

64% of the respondents to the TOSCA survey were men, and 36% women. In comparison to the population of Bologna in general (54% female, 46% male), proportionally more men made use of the car-sharing service in Bologna.

In Dresden this type of data was not collected with the survey, however, one third of the contracts with *stadtmobil* are held by women¹⁵.

Fig. 8 Gender of TOSCA survey respondents



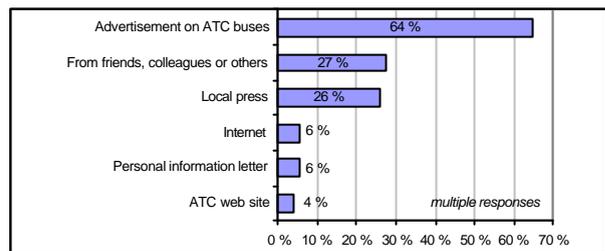
Source: Q-TOSCA q.12, n=73; ATC

In the future, there is a potential for ATC to attract more women to car-sharing, e.g. by a more targeted marketing. Moreover, as indicated before, 2-/4- and more person households are currently not those who use CarATC most frequently. It might be assumed that often the family car of these households is used by the husband, whereas the wife and the other family members use other modes of transport. As a higher share of women than men are public transport customers, ATC might also reach these women more easily.

Channels of information

ATC launched an information campaign, which resulted in most of the CarATC users having been informed about the new service offer from advertisements on ATC buses. More women than men mentioned these ads. Personal contacts (word of mouth) and local press were also important sources of information, whereas the Internet and the personal information letter sent by ATC have not contributed significantly to the acquisition of new users.

Fig. 9 "How did you find out about CarATC?"

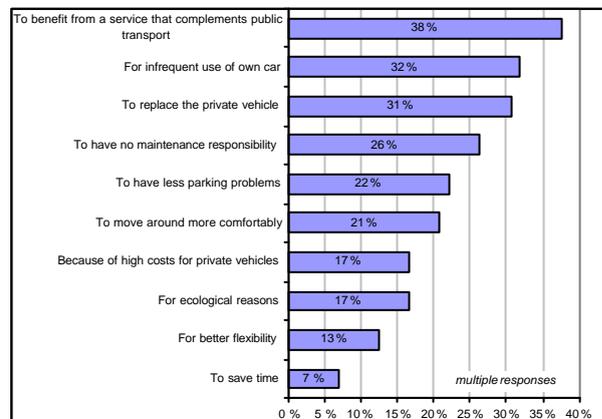


Source: Q-TOSCA q.1 n=73

Reason to join car-sharing

As most users were informed about CarATC through advertisements on ATC buses it is not surprising that the statement 'To benefit from a service that complements public transport' was by 38% considered to be the most important motivation to participate in the car-sharing scheme (28 entries). Infrequent use of one's own car and the chance to replace the private vehicle eventually were also reasons mentioned frequently. In Bologna, ecological reasons ranked third from last.

Fig. 10 "Why did you become a CarATC user?"



Source: Q-TOSCA q.2 n=72

¹⁵ Perner et al., p. 27

In the open part of the question the respondents cited most often that the reason for participating in CarATC was “because I do not own a car” (4 entries), followed by curiosity concerning this new offer (3 entries).

The main motivation of using CarATC were practical reasons given by people used to public transport. CarATC users viewed a private car more as an impediment to personal mobility and car-sharing as a complementary and practical form of transport.

In contrast to this finding, in Dresden nearly half of the respondents joined car-sharing for ecological reasons (48%), but cost saving (79%) and the variety of vehicles (60%) were the most important reasons to join the system¹⁶. In Switzerland, more than one quarter of the customers, who joined a car-sharing organisation before 1994, did so for environmental reasons. However in 1997 the share of those explaining their participation with ecological reasons had dropped to 6%. Pragmatic reasons have become by far more important: the dense net of car-sharing locations, a wide variety of vehicles in the fleet and the 24-hour-service for reservation and advice have become the main motivations of membership

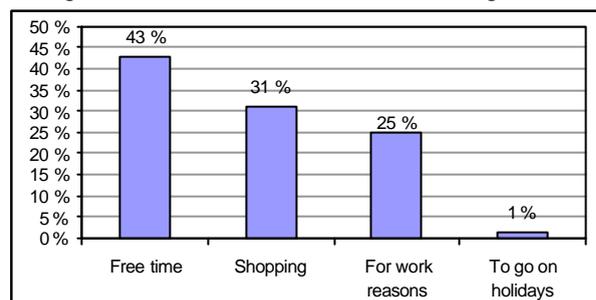
Overall, there is a clear trend that the original ecological motivation that once was the driving force to set up car-sharing, now seems to stand back behind the cost and convenience aspect of the service. In Bologna, this general tendency is most noticeable.

Main reason for using CarATC

Apparently, car-sharing was used mainly for leisure activities (43%) as well as for shopping (31%), thus, as a supplement for occasions when public transport is often not adequate or not practical.

This also indicates that for the majority of trips (e.g. commuting), car-sharing users will continue to rely on public transport.

Fig. 11 “What is the main reason for using CarATC?”



Source: Q-TOSCA q.55b n=68

In the open question of the questionnaire, an important reason mentioned for car-sharing was ‘access to the limited traffic zones’ in Bologna (7 entries) and the possibility of parking without parking fees (4 entries). These statements confirm that “convenience” was the most important motive for car-sharing in Bologna.

Swiss results are similar as about 70% of the private customers said “going out/leisure time” was the main reason for use of car-sharing vehicles, followed by “heavy (grocery) shopping” with 50%.

In Bologna, one quarter used car-sharing for work purposes. This was especially important for persons from outside Bologna as well as for the self-employed. This supports the statement made earlier (under the point occupation) that ATC succeeded in attracting the targeted users from the small business sector.

In **summary**, the evaluation showed that the core user group of CarATC is overrepresented by young and well educated men who are living as singles or in small households and who are full-time working or self-employed. The dominance of this group in the user profile is generally quite well in line with other car sharing experiences, but is exaggerated in Bologna.

¹⁶ Perner et al., p. 26-27

3.2 User friendliness

Within the TOSCA project, the Bologna car-sharing pilot application “CarATC” has been implemented with eight Smart cars, placed at four car-sharing locations in Bologna. It was expected that the car-sharing system in Bologna would be user friendly, offering car-sharing customers:

“... vehicle flexibility without the private, social and environmental cost of individual car ownership.”¹⁷

To ensure this, convenient use for the customers is vital, especially regarding booking, IT tools, vehicle availability and accessibility of car-sharing location.

As satisfied car-sharing customers are the basis for a sustainable service it was essential to analyse their wishes, requirements and perception of the service quality. With the evaluation of Impact 1 the car-sharing customers ‘got a voice’ and the chance to express their opinion on their experience during the car-sharing pilot application. This information was not only important for TOSCA project evaluation, but also for the future development of Bologna car-sharing, as it provides the basis to decide whether services need to be adapted.

For the evaluation of impact 1 ‘User friendly car-sharing system’, the following indicators were used:

- Perceived customer satisfaction with car-sharing service
- Perceived customer satisfaction with booking in terms of vehicle availability
- Perceived customer satisfaction with IT tools

Indicator 1.1: Perceived customer satisfaction with car sharing service

Previous car-sharing experience has clearly shown that the easier car-sharing locations can be accessed, the more the service is used. In addition, a car-sharing fleet with many cars and a high variety of different types of vehicles is important.

Accordingly, this indicator measured customer satisfaction with the car-sharing service in Bologna in terms of:

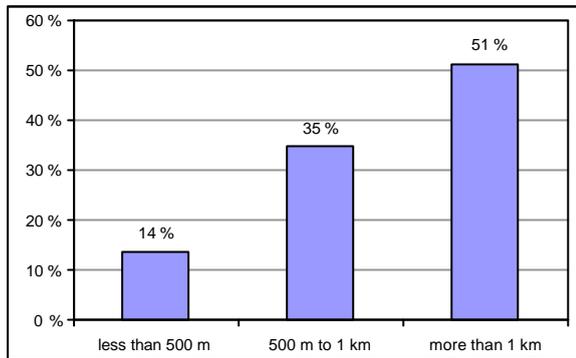
- Geographical location of car-sharing pickup points
- Variety of vehicle types

Distance to car-sharing location

The geographical location of car-sharing pickup points has to meet user needs very closely. The longer it takes to reach a car-sharing pickup point, the fewer customers will use it. For this reason it is essential to analyse customer satisfaction with location of the car-sharing pickup points. In total, 8 pickup points were available.

¹⁷ Source: ZEUS Project (2000), p. 74

Fig. 12 "How far do you have to travel to reach the closest Car-Sharing parking?"



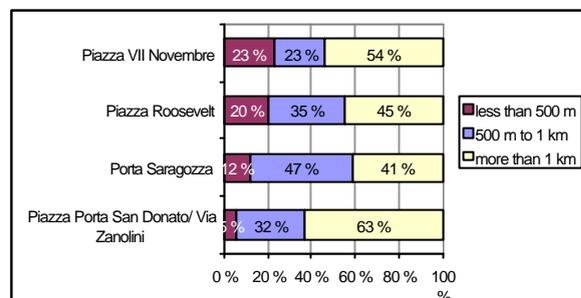
Q-TOSCA q.8 n=69

The 69 respondents that gave information on the distances travelled and the locations mostly used, were represented relatively equal over the four options/locations (13-20 persons each). Apparently, Via Zanolini was most difficult to reach. Porta Saragozza to the contrary lay within a distance of one kilometre or less of where users lived that preferred to use this location.

In comparison, in Switzerland there is a considerably higher density of pick-up points. Two thirds of the users can reach their location within less than 10 minutes.

More than half of the survey respondents had to travel a distance of more than one kilometre to reach the closest car-sharing location. 14% could walk to a location in short time (i.e. distance of less than 500 m). More than one third had to pass a distance of 500 m to one kilometre and had to decide whether to walk or use some kind of vehicle (bicycle, moped, public transport).

Fig. 13 Distance travelled to CarATC location

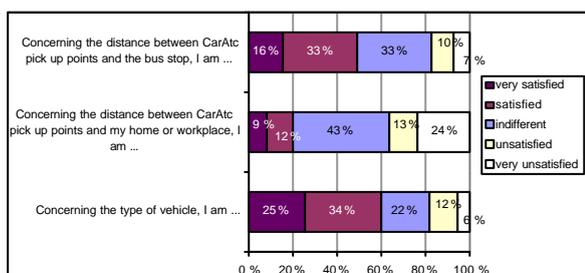


Q-TOSCA q.7/8 n=69

TOSCA survey respondents were predominantly satisfied or very satisfied with the distance between CarATC locations and the nearest bus stop (49%). About one third claimed that the distance between locations and home/work was too far (see Fig. 14). When asked for comments, 8 of a total of 36 people giving statements demanded more CarATC locations (e.g. at the train station) and a better solution for parking (open question No.19).

The results reveal that the pilot locations were fairly well located, but they also support ATC's plans to open more locations to reach a wider distribution over the Bologna area. This will not only improve access of current users (esp. those 51% travelling 1 or more km), but will also attract new customers.

Fig. 14 "What do you think about CarATC service?"



Source: Q-TOSCA q.9A/B
n-pickup=69; n-home=68; n-vehicle=67

Satisfaction with vehicle type

A diverse fleet of vehicles (including Smarts, family cars, vans etc.) is an important element of a fully implemented car-sharing service. During the pilot application, Smarts were the only vehicles available. Smarts are marketed in Italy as a "trendy", innovative car, which is fun to use. However, it offers only two full seats. It was therefore analysed in how far the customers were satisfied with this vehicle type (or, in line with the CarATC slogan "Just use a vehicle when you need one", if they would have needed another vehicle type).

People approved of the Smart cars. One quarter of the respondents was very satisfied with this type of car, 59 % were either satisfied or very satisfied. Especially those using CarATC for work purposes were very satisfied with the Smart.

In Dresden 56% of the users (in a multiple response question) indicated that the possibility to use different kinds of vehicles was a substantial reason for their joining *stadtmobil*. In Switzerland, an attractive vehicle fleet is also an important success criterion.

Considering the importance of a diverse vehicle fleet, the Bologna results are especially positive. The Smarts seem to meet the requirements concerning the purposes CarATC customers decide to use car-sharing for. By offering a wider variety of vehicle types, CarATC could increase its overall attractiveness. In the open question (no. 19) this possibility was actively requested by 8 of the 36 respondents.

More vehicle types would enable potential customers to make their choice according to their specific transportation and travel needs at a given moment:

- Minibuses for the transportation of bulky goods or large amounts,
- Station wagons for tours with the family,
- Small cars for single journeys,
- Convertibles for fun tours and limousines for prestige reasons.

A wider choice of vehicles would thus considerably increase the market potential of car-sharing in Bologna.

Indicator 1.2: Perceived customer satisfaction with booking

Clearly booking is the key action for car-sharing use and should thus meet user needs very closely. It plays an important role, being the main interface between user and the service operator. Users have the chance of direct contact, not only for booking but also to ask for information or to express specific requirements.

With the development of the wireless application protocol (WAP) the advantage of the widespread mobile phone use could be combined with the advantages of the Internet. However, for 'simple' bookings the telephone might still have the highest flexibility and the comparatively lowest costs for the user.

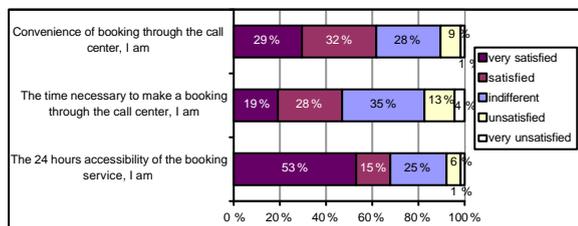
Customer satisfaction with booking was assessed by CarATC customer satisfaction with the call-centre booking service, online booking as well as the availability of the vehicle.

Booking via call-centre or online

In Bologna, customers could either book via the call-centre or online (www.CarATC.bo.it) 24 hours a day for a minimum of at least one hour of use. The call-centre was operated by the taxi company COTABO.

Unfortunately online bookings could only be made as of 15 October 2001. As a result only 16 bookings of all 378 registered by the system were listed to have been made online. The vast majority (92%) of the bookings were made via the call-centre. For 17 bookings (4%), no medium has been registered due to GSM disruptions (most probably as the car was parked in "radio silence" areas), reservation data was not recorded (but trip data was; see also Indicator 2.2.).

Fig. 15 "What do you think about CarATC service – concerning the cars booking through the call-centre?"



Almost two thirds of the TOSCA survey respondents were satisfied or very satisfied with the call-centre service.

24-hour availability was ranked as being very satisfactory by 53% of the users.

The time needed for booking via Call-Centre was judged to be satisfying or very satisfying also by about half of the respondents (47%).

Q-TOSCA n=68 (each)

Almost no outrightly negative statements were made on the call-centre booking service.

The results also indicate that ATC's cooperation with COTABO for the call-centre service has been successful. Overall, the TOSCA success criterion (positive balance of good marks) was met.

Although only 8% of all bookings were in reality made online, 60 TOSCA survey respondents made statements on booking via the website. Of these, 45% were satisfied or very satisfied with the convenience of online booking. Almost the same share was satisfied or very satisfied with the time needed for online booking, only a few (18%) were unsatisfied or very unsatisfied. Concerning the accessibility of the online booking service, about one third each was satisfied/very satisfied, indifferent or unsatisfied/very unsatisfied (strong dependence on possibility to use a computer with Internet access). Apparently online booking is a desired service! However whether its little use was only due to its short duration of availability could not be established.

The limited number of online bookings and consequently the lack of valid statements is a drawback for the evaluation of an IST project like TOSCA. It is therefore strongly recommended that ATC carries out an analysis of online booking at a later state.

Availability of vehicles

Inherent in the system of shared cars is the fact that requested bookings may not always be met. CarATC user satisfaction concerning vehicle availability was assessed through the following options:

1. Reservation could be carried out according to customer's wish.
2. The vehicle was available at the requested location, but at a slightly different time than requested by the customer.
3. At the desired time the vehicle was not available at the requested location, but at another location.
4. The reservation was not successful, because no vehicle was available around the demanded time at any 'agreeable' location.

65% of the TOSCA survey respondents indicated that bookings were always according to their wishes.

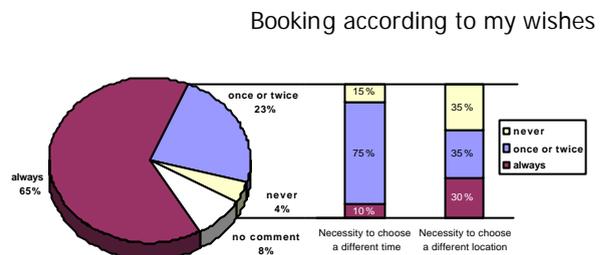
Where booking according to customer's wishes was not possible, it was mostly a matter of having to change to a different location.

In Switzerland, in comparison, the probability of successful booking at the time desired was approx. 95%.

With two CarATC cars at each of the four locations during the pilot phase, it was obvious that cars could not always be available at all locations at the times desired.

Since good availability of cars is a major success criterion for car-sharing, ATC needs to extend the number of cars (or more flexibly balance demands between pick-up points) in order to reach a higher degree of availability.

Fig. 16 "What do you think about CarATC service – concerning the availability of the vehicle?"

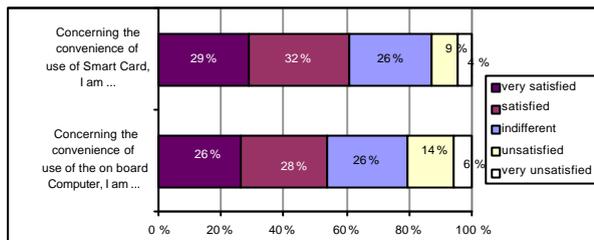


Source: Q-TOSCA q.9D
n-wishes=69; n-time=64; n-location=64

Indicator 1.3: Perceived customer satisfaction with IT tools

Transfer of IT tools was an important goal of the TOSCA project. For this reason, customer satisfaction with the reliability and convenience of use of the IT tools (smart card for booking, vehicle access, invoicing etc.) was analysed.

Fig. 17 “What do you think about CarATC service – concerning the convenience of use of the Smart Card and onboard Computer?”



Source: Q-TOSCA q.9E n=69 (each)

Convenience of use

Almost two thirds of the respondents (61%) managed well with the smart card. About one quarter (26%) assessed the convenience to be neither good nor bad. Only just over one out of ten had problems using it.

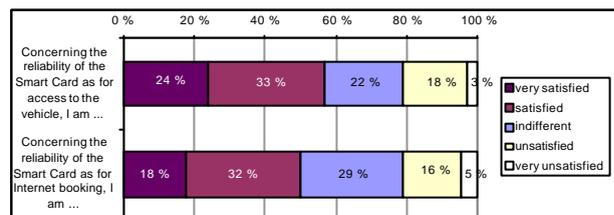
In comparison, the onboard computer has caused slightly more problems. Whereas indifference was at the same level here as with the smart card, satisfaction was somewhat lower, but still more than half of the respondents (54%) were satisfied or very satisfied.

Perceived reliability of IT-tools

Concerning the reliability of the smart card for access to the car, more than half of the respondents (57%) were satisfied or very satisfied.

Paradoxically, only 16 bookings were made via Internet in total, but 62 persons answered the question regarding the reliability of the smart card concerning bookings. Half of those respondents indicated to be satisfied or very satisfied.

Fig. 18 “What do you think about CarATC service – concerning the reliability of the Smart Card and onboard computer?”



Source: Q-TOSCA q.9F n-internet=62; n-access=67

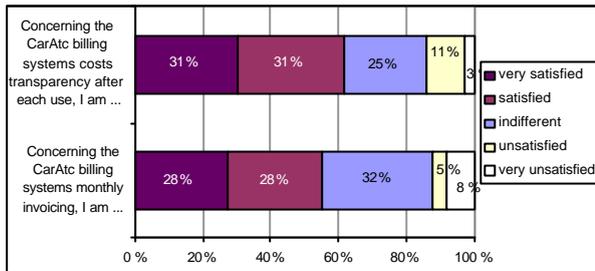
Clearly this indicates more an expectation than it is based on concrete experience of use. However - even if it this finding needs to be interpreted carefully - it can be considered as an indication of relatively high trust in IT tools.

For both IT-tools, smart card and onboard computer, a positive balance (satisfied or very satisfied) was reached concerning the convenience of use. The same applies for reliability of the smart card concerning access to the car. This is not only a positive, but also very important result, as the success of IT-based car-sharing greatly depends on high levels of convenience and reliability of technological tools perceived by customers.

Billing

CarATC usage data was automatically recorded by the system and transferred to the operator. There the data could be related to the customer and summarised in a bill. The bill listed the cost of every journey individually, with the time and distance used. Additionally to the automatic registration, the pilot user had to list the data into a logbook (as a back-up in case of system failure).

Fig. 19 “What do you think about CarATC service – concerning the cost transparency and monthly invoicing?”



Source: Q-TOSCA q.9G n=65 (each)

This system-supported cost transparency received positive feedback from the customers. 62% of the respondents were very satisfied or satisfied.

The same applies for the accounting system concerning the monthly invoicing: 56% were very satisfied or satisfied.

Regardless of the technical problems which the operator encountered with booking (see indicator 2.3), around 60% of the pilot users gave positive marks to the billing system.

This is truly a positive result for this highly technical and thus for the customer not really controllable procedure. Therefore, the analysis proves that users trust the billing technology and appreciate the transparency created by it.

3.3 Ease of operation

TOSCA aimed to achieve a “trouble-free” IT-based car-sharing operation in Bologna. Consequently, the ease of operation was analysed (out of provider view). Besides it was the aim to establish whether the Bologna pilot application was in line with experiences from other INVERS car-sharing implementations.

ATC registered the requests for support in the predefined categories: Technical defects, errors in use and accounting defaults. These will be compared to the total number of realised bookings to assess the ease of CarATC operation.

For the evaluation of Impact 2 ‘Ease of operation’ the following indicators have been used:

- Number of technical defects
- Number of errors in use
- Number of accounting defaults

Indicator 2.1: Number of technical defects

As the COCOS system automatically recorded CarATC usage data and transferred it to the operator, good communication between the on-board-computer in the vehicle and the head-office was essential.

During the evaluation phase, 17 GSM faults occurred (4% of a total of 378 bookings). In these cases reservation data could not be transferred as the car had been parked in an area without GSM connection. Nevertheless a CarATC user could still open the vehicle with the smart card, drive the car and the trip time was recorded.

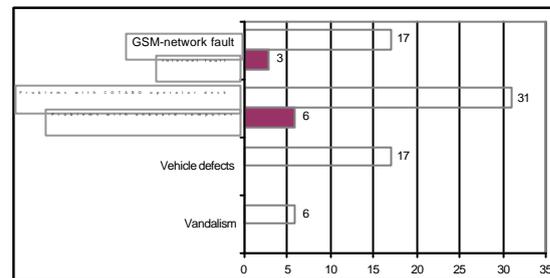
The difficulty of GSM transmission had already been encountered during the implementation and test phase. Apparently not all underlying problems were solved before the pilot application opened to the public. For commercial car-sharing, GMS problems need to be limited to the minimum if not solved all together.

In addition, 31 defects were due to modem faults or software errors on the call-centre operator desk. During reservation operations for example the CocoBook system showed interrogation marks instead of a blue box for entering data or the system displayed windows in German. Presumably these errors are inherent in an international take-up project and cannot fully be eliminated beforehand. Good customer support during the pilot phase, however, has limited the trouble caused by these errors.

Problems with the vehicles were reported 17 times, mainly consisting of empty batteries. 6 errors resulted from problems with the onboard computers. Systems in cars had to be reset 4 times. It can be assumed that part of these problems will be reduced as more CarATC customers get used to the service and the system.

The cars were object to vandalism in 6 cases, e.g. graffiti sprayed on, side mirrors being destroyed or fuel tap stolen. As long as CarATC vehicles were parked on the street, these problems could only have been influenced indirectly by more police (or other) vigilance. Rising awareness of the car-sharing service and growing numbers of customers may result in tighter links (of Bologna citizens) to CarATC and its vehicles will possibly result in better treatment of the cars. These problems may also partly be linked to an increased frequency of maintenance and could thus be influenced by ATC.

Fig. 20 Number of registered technical defects



Source: ATC

As no present reference case is available, an interview was held with experienced INVERS system support staff. From the view of INVERS, the number of defects was quite high during the TOSCA pilot application and could have been reduced by more demand on INVERS technical support (which was available), especially in the transfer of know-how for set-up of cars.

Indicator 2.2: Number of errors in use

34 errors in use were protocolled at ATC/COTABO. One of the problems that occurred most frequently was that the car could not be locked (9 incidents). When cars could not be locked, users had often forgotten to close windows and/or doors or the user could not release the key from the switchboard. In most cases the users had not closed the trunk of the car. This is a well-known problem of the Smart and its special rules of handling.

When cars could not be opened (3 incidents), an empty battery was the reason. In these cases the customers forgot to switch off the reading light in the car's dashboard. This is also a well-known problem with Smart cars.

Another problem that occurred more frequently was that booked cars were not parked at the car-sharing locations (9 incidents). In these cases customers contacted COTABO to find out where the vehicle was, but not always the last user had informed COTABO. In 6 cases, cars had been parked in no-parking areas.

INVERS pointed out that the type of vehicle, Smart, was also a reason for the encountered errors. The handling of this car is quite different from the handling of 'normal' cars. Therefore, car-sharing users who do not use a Smart car frequently are not familiar with the special mode of handling. For this reason, many other car-sharing organisations do not use Smart cars in their fleet.

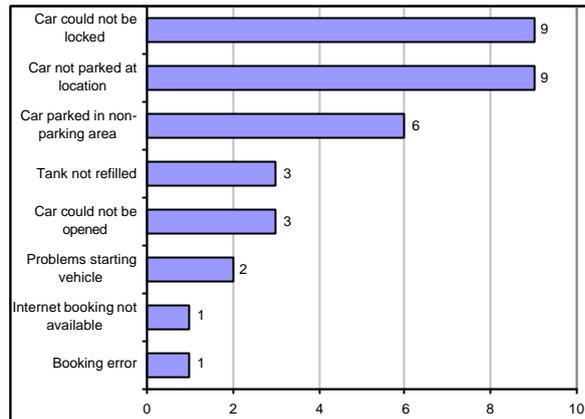
Of all the problems reported during the evaluation period only very few were due to the TOSCA IT-tools. IT-related errors were specific to the start-up phase and are not expected to have any significance during full operation. It can be assumed that all other registered types of errors arise out of the fact that customers are not yet quite familiar with the CarATC system and the Smart cars. The more users get accustomed to the service, the more these errors should diminish. It is recommended that ATC should accelerate this process by good customer information at the beginning (like the customers information evening that took place) and continued communication with customers during the initial stages of their CarATC membership.

Indicator 2.3: Number of accounting defaults

Accounting faults occurred in 15% of the bookings (Source: ATC), mainly because the billing software had a problem with the processing of the data on driven km. Quite often km data were set to zero even though the user had driven the car.

Furthermore, the CarATC system was programmed in a way that the car was reserved already 15 minutes before the actual booking to avoid booking overlaps. However, the accounting system also invoiced these extra 15 minutes. As soon as ATC noticed the problem, the invoices were corrected manually, comparing data from logbook records and the information provided by call-centre operators! So all invoices sent to users were correct, but the effort of ATC was considerable.

Fig. 21 Number of errors in use



Source: ATC

INVERS indicated that the accounting errors were not reported to their technical support, e.g. the 15-min 'overlap-prevention' time can be programmed being charged to the user. A later analysis of the data showed that all missing trip data was caused by wrong parameter settings in the installation phase. According to INVERS, this can be avoided if the set-up and test of cars is performed according to the set-up-protocol. This indicates that the organisation of the set-up procedure may well not have been faultless. To overcome these problems, additional training of the technical administrator staff is recommended.

The evaluation results reveal that for the pilot customers billing was nothing to complain about. Yet, the results also indicate that billing during the pilot phase was not trouble-free. High effort on the ATC accounting side was necessary to process invoicing to the users. To implement a commercially viable car-sharing operation in Bologna these accounting problems certainly have to be overcome.

In general, INVERS indicated that the number of errors in this project was comparably high and could have been reduced by more demand placed on the INVERS technical support for know-how transfer. This was especially true for the installation of car-sharing technology in cars and the detection of malfunction due to wrong parameter settings. Inherent in a transfer project from Germany to Italy may be the communication problems (due to the language) between the responsible staff on both sides.

The evaluation results underline the fact that know-how transfer, which is needed for a reliable operation, needs to be carried out thoroughly, including "human factors" elements. To ensure trouble-free functioning after the CarATC pilot, ATC should reconfirm the correctness of the mentioned technology aspects of the transfer.

3.4 Economic viability of commercial car-sharing operation

Based on the implementation and business concept of the car-sharing system in Bremen (and many other cities), the pilot application in Bologna stands a good chance to establish an economically viable commercial car-sharing operation in the future. As CarATC is a supplementary service to ATC's 'classic' public transport operation, a win-win situation for both services is aimed at. This, of course, will need a time period, which is considerably longer than the six-month evaluation period of TOSCA.

For this reason, 'economic viability' in the TOSCA evaluation was defined in terms of covering marginal operational costs, under the condition that new customers will be acquired and existing customers are committed to use ATC's extended services.

In a later stage of the Bologna car-sharing operation beyond TOSCA, 'economic viability' should be understood 'as the absence of outside funding (EU and national/local funding), sufficient number of regular customers and vehicles to allow long term operation of a commercial car-sharing service (under market conditions)'.

For the evaluation of Impact 3 the following indicators were used:

- Actual use patterns of pilot users
- Income during the pilot application
- Future interest of pilot customers in car-sharing service

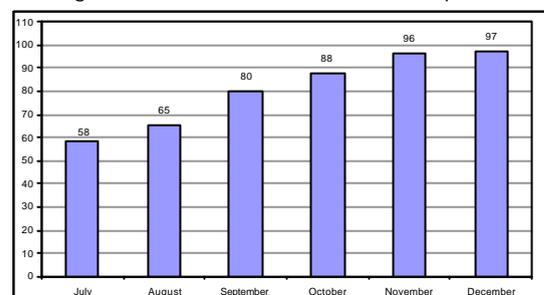
Indicator 3.1: Number of users and use patterns

Number of CarATC users

During the evaluation phase from 1 July to 31 December 2001 the number of subscribed CarATC users grew continuously. In December 2001 car-sharing Bologna had 97 subscribed users, all of these had given ATC a bank permission, which was a precondition of membership.

However, the system data reveals that not all customers actually used the service as only 57 (different user numbers) made a booking during the whole pilot phase.

Fig. 22 Number of subscribed users per month



Source: ATC

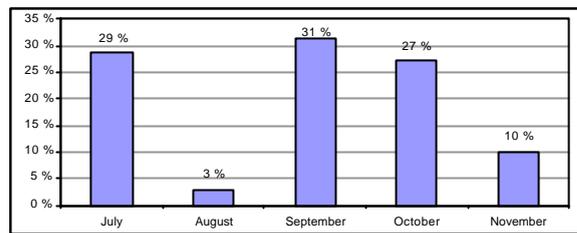
Thus, the success criterion of 100 regular users has theoretically been met with regard to subscribed users. Considering 'regular' users (those who actually make bookings), this target has apparently not been reached with 57 active users at the end of the evaluation period.

In Switzerland, 5.000 persons joined the new service within the first six months and in Dresden nearly 2.000 users were attracted within 22 months (around 90 persons per month). However, both operations started on a much larger scale.

Starting date of CarATC use

In the TOSCA survey the users were asked when they first started to use CarATC. According to the respondents, July, September and October were the months with a high increase in CarATC use (19-22 each), whereas in August, only a few new customers joined (2 persons). Only part of November (and no data for December) was included in the evaluation due to the return date of the survey

Fig. 23 "When did you start using CarATC?"



Source: Q-TOSCA q.3 n=70

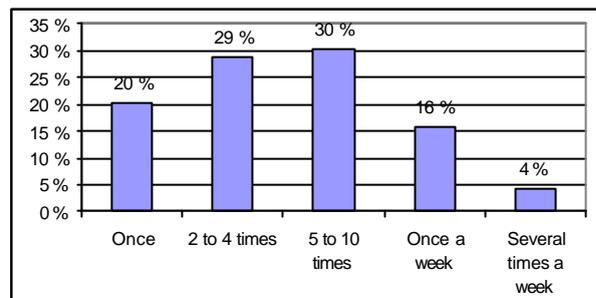
Apparently, there was a considerable time lag between registration and "first use". Whether this points to a communication problem (e.g. users not being aware of their status) or certain inertia due to trial conditions, could not be established.

Frequency of car-sharing

Every fifth respondent used car-sharing once or more often per week. Only few (4%) used car-sharing more than several times per week. One fifth of the pilot customers used CarATC just once during the evaluation period.

This indicates that the majority of the pilot users continued to use CarATC. However, only a fairly small group of regular users of 20% to perhaps 30% could be established during pilot operation.

Fig. 24 "How many times have you used CarATC overall?"

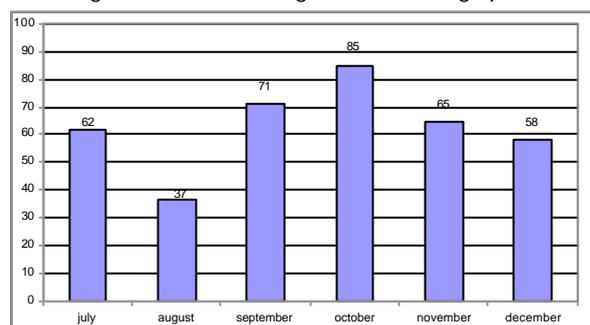


Source: Q-TOSCA q.4 n=69

Number of bookings

In total, 378 user bookings were registered by the car-sharing system during the evaluation period from 1 July to 31 December 2001. October was the month with the highest request. August, the holiday month in Italy, had the fewest bookings. Apparently the Smart cars were not used for leisure or holiday purposes, presumably because many customers had left Bologna, but possibly also due the small vehicle size. Once the fleet is more diverse the low use during summer may be overcome.

Fig. 25 Number of registered bookings per month



Source: INVERS n=378

In Dresden, on the contrary, peaks of request were in summer and extra vehicles were added to the fleet at this time¹⁸.

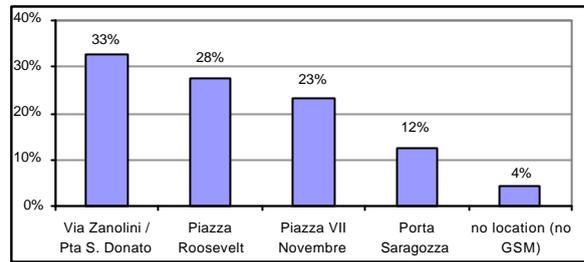
It is not clear whether the reduction in bookings in Bologna indicates a potential slow down in interest after the peak in October. ATC should therefore closely monitor use figures.

¹⁸ Perner et al.

Bookings per location

The registered booking data shows that one third of all bookings were made from Via Zanolini, followed by Piazza Roosevelt. Due to customers' request, in July 2001 Porta Saragozza was offered as new location, which is not found as frequently in the booking data. However respondents indicated to have used the four Bologna car-sharing locations almost evenly.

Fig. 26 Number of bookings per location



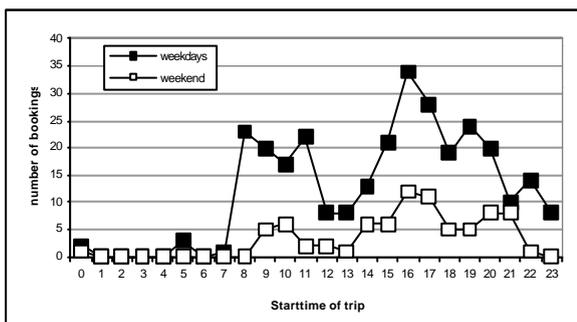
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Source: INVERS n=378

Use per month, weekday and hour of day

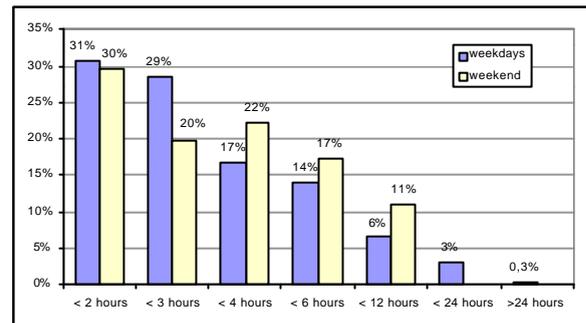
There were less bookings on weekends, but the bookings were in general longer than during the week. This time pattern might arise from shorter work or shopping trips during the week and longer leisure journeys on the weekends.

Fig. 27 Trips by number and duration per weekday



Source: INVERS n=374 (h > 0)

Fig. 28 Number of trips per start time



Source: INVERS n weekdays=295; n weekends=83; Trips h>0

Over the day, a certain usage pattern with peaks during rush hours can be seen. Most trips either started in the afternoon between 4 and 5 p.m. or in the morning between 8 and 11 a.m. Then there was another peak in the evening (going out time) between 7 and 8 p.m.

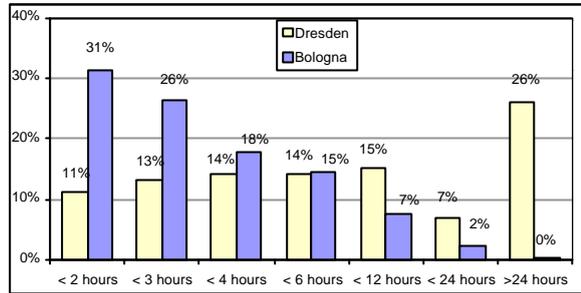
On weekends, the same peak demand periods could be seen, but here the "going out time" between 8 and 9 p.m. played a larger role than on weekdays.

Use of CarATC vehicles

On average, a CarATC vehicle in Bologna was booked for 1:09 hours per day. This indicates a very low usage level in comparison with current commercial car sharing operations in Europe; in Dresden for example, a vehicle is in use for an average of 8:45 hours every day. This is a clear indication that there is still a high potential of growth (as well as a substantial need of increased use in commercial terms) in the present car-sharing operation in Bologna. Especially for future business planning this is an issue of high importance.

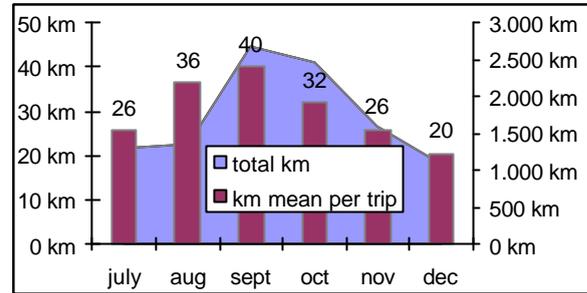
Usage profiles of CarATC users

Fig. 29 Number of trips per trip length



Source: INVERS n=374 trips(km/h>0); stadtmobil Dresden

Fig. 30 Trip length per months



Source: INVERS n=346 (0 km=32)

CarATC vehicles were mostly used for trips of two to three hours. Shorter trips of up to two hours accounted for almost a third (31%) of all trips. Few people used CarATC for trips of six or more hours.

Table 4 Bookings per month and car-sharing member

	trip length - Dresden	trip length - Bologna		bookings - Dresden	bookings - Bologna
minimum	100 km	11 km	minimum	0,6	0,6
maximum	320 km	34 km	maximum	1,1	1,0
mean	160 km	22 km	mean	0,9	0,8

Source: INVERS; stadtmobil Dresden

There was an arithmetical average of 0,8 bookings per user per month in Bologna, with a minimum of 0,6 bookings and a maximum of 1. These figures correspond to the bookings in Dresden.

The average trip length was rather short in Bologna as each CarATC member drove an average of 22 km per month. In Dresden on the contrary the average distance was 160 km.

The average mileage per car, member and month was 4 km in Bologna and 158 km in Dresden.

Per month, the average mileage of CarATC was 219 km and 1.292 km of the Swiss CarSharing organisation.

These findings on actual use of CarATC indicate the usage pattern characteristic of the specific trial situation in Bologna:

- Many trips were obviously made in order to experience this new service, rather than to primarily satisfy a mobility need.
- The urban structure of Bologna, with its access restrictions for private cars and severe parking problems makes it more likely that car sharing is used for inner-city trips, i.e. trips of shorter distance and duration.
- The Smart cars are typical city cars, therefore they are mainly used for trips of short duration.

While fewer users will use CarATC out of curiosity (in relative terms) once the service has been established, trip time will naturally increase. Equally, a wider choice of cars, which is recommended also for other reasons, will lead to more peri-urban and interurban/ regional trips, and thereby increase average mileage and booking time.

However it can be expected that the proportion of short-term use will continue to be comparatively high due to the specific urban structure and traffic scheme in Bologna. This factor will continue to influence the use pattern and will need to be addressed in the business case for commercial operation.

Swiss results indicate that the average mileage per month increases as the car-sharing company gets more vehicles and customers. (Private cars in Switzerland have an average mileage of 13.000 km per year, tendency shrinking since more and more people own second and third cars.)

Indicator 3.2: Income during the pilot application

This indicator aimed to measure the income attained during the car-sharing pilot application.

ATC personnel costs, as well as the call-centre costs (for CarATC booking) were covered by the TOSCA project. Investment costs related to the Smart cars did not have to be considered in the cost calculation since the car dealer provided the vehicles for the whole project at no charge.

The project was targeted to yield a turnover of about 50.000 € at the end of the experimentation phase.

The data for assessing and evaluating this indicator were delivered by ATC in Deliverable 3.1 'Operation and result measurement report.' A plausibility check was carried out that revealed a number of inconsistencies¹⁹ which could not be resolved. The following has to be stated:

- The data provided by ATC referred to the time from 1 June to 31 December²⁰ and not to the exact evaluation period, which did not cover June.
- The data lacks detail and consistency in order to enable the planned level of detail in calculations. Therefore, the evaluation with respect to indicator 3.2 was limited.

It is therefore recommended to ATC to undertake a detailed business case calculation to enable them to calculate essential financial data (e.g. 'break-even-time'; minimum number of users, cars, locations). Strategic benefits for the public transport operator achieved by the new service should be considered, such as improved relationship with existing customers, acquisition of new customers as well as improved image.

Income during the pilot application

ATC generated a turnover of 5.413,05 € during the total pilot phase from 1 June to 31 December 2001 (see Table 5).

For the same period, ATC reported costs of 13.872,16 € for the car-sharing pilot application (see Table 6)²¹. Subtraction of these costs from the ATC revenues, results in a deficit of -8.459,11 € for the seven month period from 1 June to 31 December.

The calculation shows that CarATC has not covered its costs during the pilot application phase. Therefore, only about 10% of the declared success criterion (turnover of about 50.000 € at the end of the experimentation phase) was realised.

Experience in other cities has shown that "car-sharing is profitable as volume business that needs to have encompassed the critical mass of vehicles and customers."²² Car-sharing can be cost covering provided that it starts with a large fleet, with different vehicle types and several locations. Since the pilot application in Bologna started with few cars and locations, the success criterion was obviously too ambitious.

The results show the need for (at least initial) financial support to realise this new transport option, which contributes to sustainability in the city. On the other hand, there are mid- and long-term benefits for ATC such as the acquisition of new customers, improved customer relationships with

¹⁹ For example questions regarding the price of a Smart car and the length of the depreciation period.

²⁰ According to ATC, June data could not be excluded, as CarATC invoices were issued on a quarterly basis. Since the pilot started on 18 June, ATC data includes 2 weeks more than covered by the evaluation phase.

²¹ Vehicle costs, hard- and software cost were not included as these were covered by the TOSCA project.

²² B. Holm in Perner et al. p.6

existing customers as well as an improved image. The Swiss experience has shown that the longer people are car-sharing customers, the less they use the car-sharing vehicles. This leads to economic car use and to finding the best cost-benefit alternatives. Customers make more use of public transport, cycle more or try to combine different destinations in one trip by car.

Table 5 ATC revenue based on CarATC use from 1 June to 31 Dec 2001

Revenue	€
ATC invoices to users *	5.826,22 €
Missing vehicles refund	+25,82 €
Refuel refund	+154,94 €
Incidents	- 154,94 €
Towing services	- 361,52 €
Cancelled trips	- 77,47 €
Total revenue based on CarATC use	5.413,05 €

Source: ATC data

* ATC invoiced 5.826,22 € to CarATC users. Different figures had to be subtracted as shown in Table 5. The two which are not self explanatory are listed hereafter:

- Missing vehicles refund (a reservation had been paid for, but the car was not at the expected location).
- Refuel refund (users paid at a gas station not listed with ATC and were then refunded).

Table 6 ATC declared costs for car-sharing from 1 June to 31 Dec 2001

	Costs	€
1)	Personnel*	4.519,00
2)	Marketing campaign (portion)**	1.329,36
3)	Car insurance	5.828,73
4)	Fuel costs	480,00
5)	Maintenance costs	672,24
6)	Vehicle cleaning costs	182,83
7)	Smart cards	550,00
8)	Parking places (signs)	310,00
	Total costs	13.872,16

* In the calculation it was assumed that these costs (partly) were for the call-centre.

** Portion considered as a part of the total amount depreciated along 5 years.

Source: ATC data

Table 7 Cost-revenues car-sharing pilot from 1 June to 31 Dec 2001

Reveue-costs	€
Total charges to users	5.413,05
Costs	-13.872,16
Revenue-costs	-8.459,11

Source: ATC data

Indicator 3.3: Future interest of pilot customers in car-sharing service

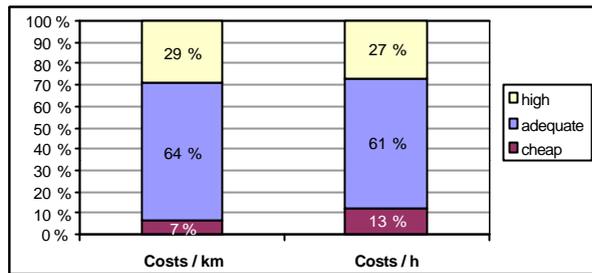
The interest of pilot customers in using the car-sharing service in the future and under which conditions they would do so was assessed as well as whether they were recommending car-sharing to others. This indicator generates basic information on the growth potential and overall customer satisfaction of Bologna car-sharing.

Acceptance of car-sharing fares...

As special incentive no admittance or monthly fees were claimed during the pilot application phase. Users were charged by time of use and mileage: 1,29 € per reserved hour and 0,26 € per driven kilometre.

Almost three quarters of CarATC users rated the CarATC pilot fares as being either cheap or adequate. There was little difference in the estimation of costs per km or per hour.

Fig. 31 "What do you think about Car-Sharing fares?"



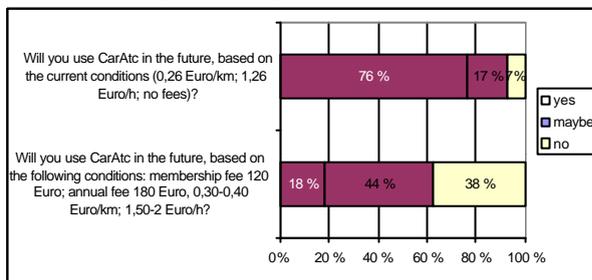
Source: Q-TOSCA q.10 n-km=72; n-h=71

... and future use

Three quarters of CarATC users would remain car-sharing customers under the current conditions. 17% were undecided, only 7% considered quitting.

ATC plans to implement new tariffs: 120 € one-time admittance fee, 180 € annual fee, 1,75 €/h, 0,35 €/km. Under these conditions, 18% indicated to go on, whereas 44% were still thinking about it and 38% considered quitting²³.

Fig. 32 "Will you use CarATC in the future?"



Source: Q-TOSCA q.11 n-current=71; n-future=72

Four in five users did either not agree to the new tariffs or were indecisive. If CarATC really decides to implement the new prices they would need to convince especially the indecisive pilot users (44%). More details on the higher quality and improvement of the service as well as the gains for the customers (causing the higher prices) might encourage more pilot customers to make up their mind in favour of CarATC.

17 of the 36 comments given in the open question (no. 19), were concerned with costs and/or admission of new users. Suggestions included for example a combination of the price/ticket for public transport and car-sharing or a larger differentiation within the pricing system (e.g. according to type of vehicle).

ATC might follow these suggestions and implement a more elaborated tariff system, offering e.g. also students tariffs and a combination with public transport season tickets. Bremen has already introduced a combined offer of public transport and car-sharing in 1998 and has achieved very positive results with it. 16 % of the clients of the "Bremer Karte plus AutoCard" are new clients for public transport

²³ This plain fact is not surprising: Who would volunteer to pay more with no apparent gain or improvement of the service?

season tickets. Additionally, a remarkable shift has taken place from monthly season tickets (used preferably for the bad weather season only) to annual season tickets (12 months validity)²⁴ - giving public transport a major role as basic means of transport.

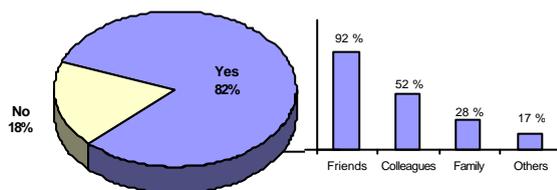
Users recommending CarATC

82% of CarATC users have recommended car-sharing Bologna to other persons or would do so in the future, mainly to friends (92%) and colleagues (52%) (see Fig. 33).

These numbers reveal again the overall satisfaction with the CarATC service and form a good basis for the future. Customer surveys from cambio Bremen have shown that first-hand information from satisfied car-sharing customers was the main reason for newcomers to join car-sharing. As car-sharing is not yet very well known in Bologna, an effective 'marketing' by the pilot users is indeed very important to stimulate the overall demand.

For CarATC this implies that improving the service is not only an investment in customer relationships, but also the most important way to attract *new* car-sharing users.

Fig. 33 "Have you recommended CarATC to others or would you do so in the future?"



Source: Q-TOSCA q.18 n=73

²⁴ Whereas before only 54% of the new clients had annual season tickets, this number has risen to 78%.

3.5 Contribution to sustainability

With car-sharing “fewer cars are needed to meet the mobility needs of a given number of people and so the city becomes a more attractive place to live in.”²⁵ Therefore, the TOSCA project was expected to contribute to sustainability with the car-sharing take-up in Bologna.

To evaluate the ‘contribution to sustainability’ the following indicators were used:

- Reduction of car use
- Reduction of parking space
- Reduction of CO₂ emission

Indicator 4.1: Reduction of car use

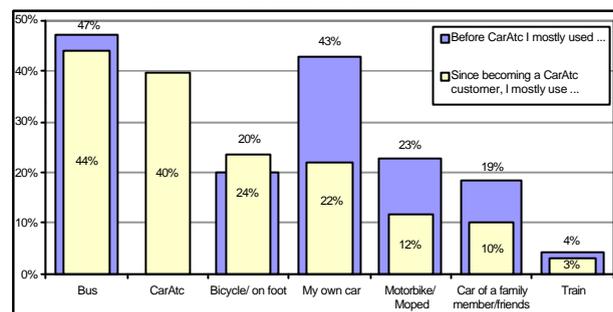
Previous research has revealed that every car-sharing vehicle has the potential to replace between 4 and 10 private cars²⁶. Due to the pilot character of the Bologna car-sharing application, an actual reduction of cars could not be expected within the lifetime of the project. For this reason, the indicator measured both the present decision and future intention to reduce car use.

Mobility patterns

Before the start of CarATC, buses were the number one means of transport for the TOSCA survey respondents, bus use even exceeding use of one’s own car.

After joining CarATC, buses did not lose their importance, but the other “motorised solutions” private car, motorcycle/moped and loaned car did. Half of the respondents did not list these any longer among the two most frequently chosen means of transport.

Fig. 34 “Have your habits changed since you became a CAR ATC user ?”



Source: Q-TOSCA q.5a n-before=70; n-since=68

The importance of cycling and walking has increased as well.

In line with previous experience, e.g. in Switzerland, car-sharers mainly become public transport users and cyclists. After having become car-sharing customers, people use public transport by far more frequently than before. Customers who did not own a car before have a personal record of little more car use afterwards. Commercial car-sharing cars simply replace car loan among friends and family practiced earlier.

A similar situation can be proven in Bologna: Already after 6 months of pilot application, a change in modes of transport could be noticed that favours the environmentally friendly modes. The CarATC slogan “just use a car when you need one” seems to have been fruitful. The results reveal that car-sharing is not a competition to public transport. CarATC challenge for the future is to build on this start and establish car-sharing as a real complementary service to public transport and an environmentally friendly alternative mode of transport in Bologna.

²⁵ Source: ZEUS Project (2000), p. 74

²⁶ Source: ZEUS Project (2000), p. 74

Driven mileage

Based on users' self-assessment, about one quarter of the CarATC users drove less kilometres than before joining CarATC, 62% did not see a difference, 12% drove more than before.

In addition to the general question, a specific question requested the exact reduction/ increase in mileage. Only 8 persons answered this question (8 of 26 who had marked 'more' or 'less' in the question before). These users indicated to have saved 125km net (they drove 105km more than before, but 230 less than before). Because of the small sample these results have not been interpreted further.

In Switzerland, people giving up their own car as a result of car-sharing reduced their mileage considerably by 6.700 km or 72% per year and user. In part, this was compensated by additional use of motorcycles/mopeds (+1.300 person km per year), bicycles (+ 800 km per year) and, most of all, public transport (+ 2.000 km/per year). Calculated over all means of transport, annual mileage decreased by 2.700 km by those who gave up their private car. Those not owning a private car before becoming car-sharers, as well as those using car-sharing vehicles as second car, changed their behaviour only marginally.

As indicated with the Swiss reference, reduction in mileage is mainly achieved by reduction in the use of owned cars. As indicated before an empirical proof of this fact cannot be expected on the basis of a pilot application, but rather in the future (see below.)

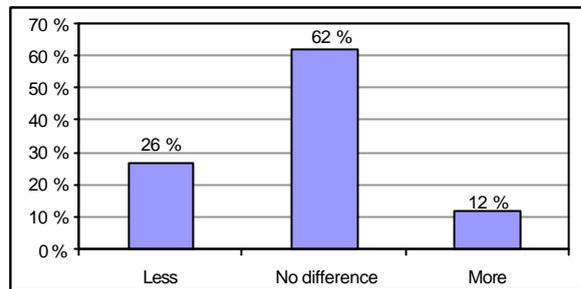
Reduction of cars

4% of the survey respondents planned to sell their cars, 11% were contemplating whether or not to sell. 7% planned to get rid of their second car, 8% were not sure yet. 18% of the CarATC users who did not own a private car were not planning to buy one in the future.

Numerically the success criterion of 25% car-sharing customers expressing the intention to give up a car or not to buy one due to car-sharing in the future has most likely not been met (based on the stated intentions of current users).

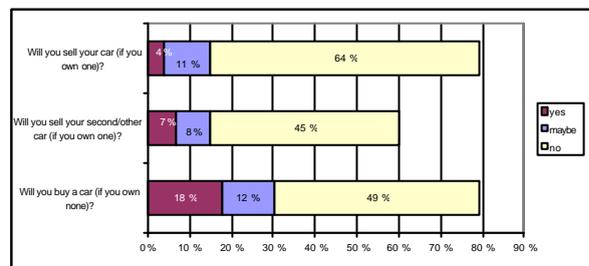
In addition, it is neither clear how much these preferences were due to the CarATC mobility offer (or other reasons), nor whether cars would eventually be given up in reality. At the same time there was also a quite significant potential of "maybe"s.

Fig. 35 "Do you drive more or less km since you joined CarATC"



Source: Q-TOSCA q.6 n=68

Fig. 36 "Will you sell or buy a car?"



Source: Q-TOSCA q.11 n-sell car=58; n-sell second=44; n-buy=58

Table 8 Potential reduction of cars due to CarATC

		Minimum	Maximum
	Dresden	Bologna* (sell/not buy= yes)	Bologna* (sell/not buy= yes+maybe)
Assuming (optimistically) that the reason for selling or not buying a car respectively, was users' participation in CarATC, a potential for the reduction of 36 to 59 cars could be argued. Each of the eight CarATC cars would thus replace 6-8 cars. ²⁷	A. Number of car-sharing members	635	97
	B. Number of Car-sharing cars	38	8
	C. Potential of given up cars	60	22
	D. Cars not bought	181	45
In the Dresden reference case a similar ratio can be seen. There, one car-sharing vehicle replaces approximately six other cars.	E. Reduction of vehicles [C+D-B]	203	36
	F. Substitution ratio c-s car [(C+D):B]	6,3	5,5
		8,4	

Source: Q-TOSCA q.11; *stadtmobil* Dresden, p. 36-38

* The Bologna data of course has to be treated with caution as the selling or not buying was not explicitly linked to CarATC.

In Switzerland it was proven that the actual reduction of car ownership is a mid- to long-term effect. The positive effects on the users' total cost for personal mobility when at the same time the car-sharing member could remain as mobile as before, strengthened users' trust in car-sharing with increasing duration of membership. This has especially been proven by those customers who used the *Mobility cars* most of all as second car upon their joining the car-sharing organisation.

The longer they were members, the higher was their willingness to give up their car. 60 % of former car owners sold their car after a couple of years. Car-sharing vehicles were then used as first car, the privately owned car became superfluous.

Those having given up their cars are particularly interesting for combined mobility services since their mobility behaviour changed very strongly in favour of environmentally friendly modes of transport (public transport, cycling, walking). This group comprises about 15-20% of all Swiss customers today.

The share of those giving up their private cars was much larger during the pioneering phase of Swiss car-sharing than it is now. With the co-operations with public transport, today mostly regular customers of public transport are attracted who quite often do not own a car. In the future, Mobility CarSharing plans to convince more 'regular' car users of the benefits of car-sharing.

Due to the pilot character of the Bologna car-sharing application and the relatively short period of evaluation no substantial and empirically proven number of absolute reduction of car use could be expected in Bologna after only 6 months. The (Swiss) car-sharing experience has shown that these are mid- and long-term goals. The national car-sharing initiative in Italy favours such a long-term perspective for CarATC and its contribution to sustainability.

²⁷ The "minimum" column shows the number of respondents answering "yes - they would sell their car or not buy a car". The "maximum" column refers to those saying "yes" plus those saying "maybe". Then, the number of car-sharing cars used by the respondents was deducted from the number of cars they would potentially give up or not buy.

Indicator 4.2: Reduction of parking space

Car-sharing has the potential to win back public space by making car-use more rational. Research in ZEUS revealed that every car-sharing vehicle "saves at least five parking spaces."²⁸ Consequently, it could be assumed that car-sharing in Bologna has the potential to reduce parking space in the future. Space that is now "blocked" by cars could be opened up for social and ecological functions, for walking, get-togethers, playing or new vegetation.

In Bologna in the year 2000, 30.000 parking spaces were registered in the city centre and its immediate periphery. Especially in the densely populated and build up area of Bologna's city centre any space gained from parking use is precious.

As outlined in the previous section, the evaluation results reveal a potential reduction of 36 to 59 cars in total in Bologna. As one car parking place in Bologna is calculated with 10 m² space, a total of 360-590 m² urban space could thus be "won back" from parking use due to car-sharing - potentially.

Whether the targeted success criterion of 360 m² has been met could not be empirically proven, but evaluation data suggests that this might well be achieved in the future. Once Bologna car-sharing will have overcome the pilot character, customers will have a service they can rely on when selling or not buying a private car.

Indicator 4.3: Reduction of CO₂ emissions

The aim of the indicator was to estimate the reduction of CO₂ emissions due to less driven kilometres and reduced car ownership (life-cycle calculation). The indicator refers to changes due to the reduction of vehicle mileage and car ownership.²⁹

In TOSCA, the GEMIS³⁰ model was used for life-cycle calculation³¹ per replaced vehicle. The GEMIS model of the Ökoinstitut in Darmstadt is a tool for the comparative assessment of environmental effects of energy consumption. It is based on a life-cycle analysis program and a database for energy, material, and transport systems. Apart from the direct CO₂ emissions, the model also includes the energy consumption for the production of raw materials, the necessary transport and the vehicle production itself.

Only an indication of the estimated reduction per mileage of CO₂ emissions could be calculated as it depends on factors, which are outside the capabilities of a modelling approach, like:

- Vehicle type and performance,
- Duty cycle,
- Traffic conditions.

CO₂ calculation

The aim of the indicator was to estimate the reduction of CO₂ emissions due to less driven kilometres, an effect of reduced mileage and car ownership. As indicator 4.1 revealed, no cars have actually been given up so far and no valid data on reduced mileage is available.

²⁸ ZEUS project (2000), p.74

²⁹ The fact that car-sharing vehicles often replace old cars with higher pollution is not included in the calculation.

³⁰ GEMIS was developed in 1987-89 by Öko-Institut and Gesamthochschule Kassel and is continuously upgraded and updated. GEMIS is available for free as public domain software at: www.oeko.de/service/gemis

³¹ Life cycle assessment: Assessment of emissions produced throughout a vehicle's life cycle, includes the entire chain from vehicle and fuel production to the use and ultimate disposal or recycling of the vehicle. The analysis does not include emissions associated with servicing vehicles or disposing/recycling at the end of their use.

The targeted success criterion of an estimated reduction of up to 4 tons of CO₂ (due to +/- 20.000 Km saving, during pilot) has surely not been met.

However, to get an impression of the potential CO₂ reduction, a tentative estimation has been calculated. It is based on the assumption that one CarATC could replace 6 to 8 cars in the future. Further it was assumed that a CarATC vehicle would replace cars of the same type, that is to say Smart cars. Based on the below mentioned data (which is based on pilot data) the CO₂ emissions were calculated with the following model inputs:

- Vehicle type: Smart car
- Type of fuel: diesel
- Total number of driven kilometres per year: 2.627,75 km/a³²
- Average consumption of fuel per 100 km: 4 litres per 100 km
- Exhaust emission standard: EURO3
- Main use: inner-city journeys

The life-cycle calculation calculated an emission of 341,9 kg of CO₂ for one car per year if driven by one person 2600 km per year. Taking into account that 1 CarATC car could replace 6 to 8 cars this would mean a reduction of 2.051 kg to 2.735 kg CO₂.

In Bremen, the ZEUS project³³ evaluation has shown that car-sharing has replaced about 500-700 private cars. More than 2.200 participants (Jan. 2001) have reduced their car mileage by a total of about 5.500.000 kilometres annually. In a GEMIS life-cycle study this equals a CO₂-reduction of about 1.250 tons per year in total due to car sharing.

The Swiss car-sharing customers active in 1998 saved 4.200 tons of the greenhouse gas CO₂. Since the founding of modern car-sharing in 1987, already 4,5 Mio litres of fuel have been saved in Switzerland, equalling approx. 10.000 tons CO₂.

More generally, the environmentally relevant effects and overall economic benefits of a well deployed car-sharing operation are very substantial: With the reduction of motorised travel and its partial shift to public transportation, car sharing contributes considerably to the reduction of CO₂ emission, air and noise pollution, traffic accidents and surface utilisation. In addition, the decrease in the overall number of cars contributes to less space 'blocked' by cars and brings about the reduction of pollution caused by the production, maintenance and disposal of cars.

³² Equivalent to 10.511 km driven by 8 cars in 6 months during the pilot phase.

³³ See Reference Cases in chapter 2.2.

4 Conclusions and Recommendations

The overall results of the evaluation reveal that the transfer of IT-based car-sharing from Bremen to the public transport operator ATC Bologna has been successful, even if real use was comparatively low and the economic criteria were not met during the evaluation period. With the pilot application of the TOSCA project, CarATC has been established as a new mobility service in Bologna. Pilot customers were satisfied. Due to the Iniziativa Car-Sharing Italia (ICS) the continuation of car-sharing in Bologna is almost guaranteed.

As the overview in Table 9 documents, the majority of the success criteria has been met. Yet, besides the assessment of the results obtained, the evaluation also allows to derive recommendations for the future improvement of the car-sharing service in Bologna as summarised below.

Vehicle fleet & locations

On the basis of lessons learnt from previous car-sharing implementations (c.f. 'TOSCA Car-Sharing Take-Up Guide'³⁴) it is recommended that car-sharing should be implemented on a large scale with attractive offers ("start big, grow quick") – then demand will grow quickly in short time.

As CarATC started with 8 car-sharing cars of one vehicle type at four pick-up points, the growth in the absolute number of users as well as the use of the capacity of the cars is accordingly small.

Yet, the focus of the TOSCA project was not to achieve economic sustainability already at the end of the pilot phase, but the transfer of proven IT-tools for car-sharing and the take-up of a modern service as an additional mode of transport in Bologna – and this goal has been achieved.

Since good availability of cars is a major success criterion for car-sharing, ATC needs to extend the number of cars in order to reach a higher degree of availability.

Considering the importance of a diverse vehicle fleet, the Bologna results indicate that the type of vehicle, Smart, with its special size and image (small and "trendy" city car) seems to have attracted a clientele with a certain user profile. By offering a wider variety of vehicle types, CarATC could increase its overall attractiveness for a wider public. In the future, more vehicle types would enable potential customers to make their choice according to their specific transportation and travel needs at a given moment.

The results support ATC's plans to open more locations to reach a wider distribution over the Bologna area. This will not only improve access of current users, but will also attract new customers.

Customers

Until now, the CarATC core user group is dominated by male, young adults of high education, full-time or self-employment and living as singles or in small households. Subsequently, CarATC could increase and better balance its customer base by attracting specifically women, middle age and older people, especially families, as well as students.

IT-tools

The analysis revealed that the customers were satisfied with the IT-tools (smart card and onboard computer) and the billing technology and appreciated the transparency created through them. This is not only a positive, but also very important result as the success of IT-based car-sharing greatly depends on high levels of convenience and reliability of technological tools perceived by customers.

The limited number of online bookings (due to its delayed implementation) and consequently the lack of valid statements is a drawback for the evaluation of an IST project like TOSCA. It is strongly recommended that ATC carries out an analysis of online booking at a later stage.

³⁴ TOSCA Take-Up Guide, p. 11

Technical and usage problems

Of all the problems reported during the evaluation period, only very few were caused by the TOSCA IT-tools. IT-related errors were specific to the start-up phase and are not expected to have any significance during full operation.

The more users get accustomed to the service, the more these errors will diminish. It is recommended that ATC supports this process by good customer information at the beginning and continued communication with customers during their early CarATC membership. Concerning the internal accounting problems, there is no doubt that these problems need to be overcome before implementing commercially viable car-sharing operation in the future.

Cost/Revenues

CarATC has not covered its costs during the pilot application phase. Only about 10% of the declared success criterion (income of about 50.000 € at the end of the experimentation phase) were realised. Experience has shown that car-sharing can be cost covering providing that it starts with a large fleet, with different vehicle types and several locations. Since the pilot application in Bologna started with few cars and locations the success criterion was obviously too ambitious.

The results show the need for financial support to realise car sharing as a new mobility option that contributes to sustainability in the city. When considering the cost of this new service, the mid and long term benefits for ATC in acquiring new customers, furthering customer relationship with existing public transport users as well as a general image benefit have to be taken into account as well.

A win situation for public transport

The CarATC slogan "just use a car when you need one" seems to have been fruitful. Already after 6 months of pilot application, a change in modes of transport can be noticed that favours the environmentally friendly modes. The results reveal that car-sharing is not a competition to public transport, but rather a new complementary mobility service. The CarATC challenge for the future is to build on this positive start and establish car-sharing as a real additional mainstream mobility service to public transport in Bologna.

Sustainability

The main sustainability effect is achieved by the reduction in mileage, which is mainly achieved by a reduction of privately owned cars. General experience has shown that the longer car-sharing members use the service, the higher is their willingness to give up their car. Of course, this effect could not be empirically proven by a limited pilot application. But the results of the evaluation allow the assumption that a real effect on sustainability will be achieved in the future.

Customers service, marketing and tariffs

ATC should take up their customers' suggestions and implement a more differentiated tariff system, offering e.g. also students tariffs and a combination with public transport season tickets.

The overall satisfaction of the pilot users with the CarATC service forms a good basis for the future, as first hand information from satisfied car-sharing customers has a high 'pull-factor' for newcomers to join car-sharing. As car-sharing is not yet very well known in Bologna, an effective "personal marketing" by the pilot users is indeed very important to stimulate the overall demand. For CarATC this implies that improving the service is not only an investment in customer relationships, but also the most important way to attract *new* car-sharing users.

Table 9 Were the objectives met?

Impact 1: User friendly car-sharing system	Success criterion	Criterion achieved?
1.1 Perceived customer satisfaction with car-sharing service in terms of geographical location of car-sharing pickup points and variety of vehicle types	Positive balance of "good" marks	Yes
1.2 Perceived customer satisfaction with booking in terms of vehicle availability and	Positive balance of "good" marks	Yes
- Successful booking via call-centre	Positive balance of "good" marks	Yes
- Successful booking online booking	Positive balance of "good" marks	*
1.3 Perceived customer satisfaction with IT tools in terms of convenience of use of smart card and onboard computer and	Positive balance of "good" marks	Yes
- Reliability of smart card for access to vehicle	Positive balance of "good" marks	Yes
- Reliability of smart card for online booking	Positive balance of "good" marks	*
- Invoicing	Positive balance of "good" marks	Yes
Impact 2: Ease of operation	Success criterion	
2.1 Number of technical defects	Overall, errors comparable to other IT-based car-sharing operations	No
2.2 Number of errors in use	Overall, errors comparable to other IT-based car-sharing operations	Yes / No
2.3 Number of accounting defaults	Overall, errors comparable to other IT-based car-sharing operations	Yes / No
Impact 3 'Economic viability of car-sharing'	Success criterion	
3.1 Number of users and use patterns	100 regular car-sharing customers	Yes / No
3.2 Income during the pilot application	Income of about 100.000.000 Lira at the end of the pilot application.	No
3.3 Future interest of pilot customers in car-sharing service	Majority of pilot car-sharing customers indicate that they will to use service in the future - under the current conditions - under the new conditions Majority of pilot car-sharing customers is willing to recommend the service to others.	Yes No Yes
Impact 4 'Contribution to sustainability'	Success criterion	
4.1 Reduction of car use	Expressed intention of 25% customers to give up a car or <u>not</u> to buy one due to car-sharing in the future under the premises that the service will continue.	No
4.2 Reduction of parking space	360 m ² surface of urban space freed from car parking use.	No
4.3 Reduction of CO ₂ emission	Reduction up to 4 tons of CO ₂ (due to +/- 20.000 Km saving, during pilot).	No

* No valid result, due to lack of data.

5 Literature

ANIMATE Guidelines for the Preparation of Validation Plans. See Maltby et al. (1996).

CONVERGE Checklist for Preparing a Validation Plan. See Maltby et al. (1998).

CONVERGE Guidebook for Assessment of Transport Telematics Applications. See Zhang et al. (1998)

TOSCA Take-Up Guide: Car-sharing in Practice. TOSCA project (2002)

ZEUS: Reducing Barriers to Zero and Low Emission Mobility. See: Glotz-Richter, M. et al. (2000a)

ZEUS: Vehicle Monitoring and Evaluation. See: Sunnerstedt, E. (2000b)

Baum, H. - S. Pesch (1994): Untersuchung der Eignung von Car-Sharing im Hinblick auf Reduzierung von Stadtverkehrproblemen. Institut für Verkehrswissenschaft an der Universität zu Köln (On behalf of the Bundesministeriums für Verkehr) Köln

CarFreeCities Network (1997): CityCarClub CarSharing Carfree but Carefree. (Brochure) 2nd print

European Commission (1999): Guidelines for Contract Preparation Co-ordinators of IST projects. European Commission, Fifth Framework Programme, DGXIII/132/99-EN.

Glotz-Richter, M. (ed.) (2000): INTERCEPT – INTERmodal Concepts in European Passenger Transport. Bremen neu erleben. Bremen

INVERS: Innovative Verkehrstelematiksysteme. (General information)

Krietermeyer, H. (1997): Auswirkungen von Car-Sharing auf die Nachfrage von ÖPNV Leistungen. Eine Repräsentativ-Untersuchung in München. In: Der Nahverkehr 9, pp. 14-20

Maltby, D. et al. (1998): Checklist for Preparing a Validation Plan: Updated Version (Issue 3). Fourth Framework Telematics Application Programme, Transport Sector, **CONVERGE** Project TR 1101, Deliverable 2.4.1.

Maltby, D. et al. (1996): Guidelines for the Preparation of Validation Plans (Version 2.0-Final). European Commission – DGXII, Fourth Framework Telematics Application Programme, Environment Sector, First **ANIMATE** Validation Quality Support Contract.

Muheim, P. - E. Reinhardt (2000): Das Auto kommt zum Zug. Kombinierte Mobilität auch im Personenverkehr. In: Internationales Verkehrswesen, 1+2, pp.27-30

Muheim, P. (1998): Mobilität wählen. CarSharing – der Schlüssel zur kombinierten Mobilität. Energie 2000 (ed.) (On behalf of the Bundesamt für Energie) Bern

Ökoinstitut Sudtirol/Alto Adige (1998): La mobilità del 21°secolo-Verso il Car-sharing anche in Italia. Roma

Olsson, A.R. et al. (2000): Reducing Barriers to Zero and Low Emission Mobility. A Guide for Cities. **ZEUS** Project Final Report. Stockholm

Perner, T. et al. (2000): Car-sharing und ÖPNV. Das Dresdner Modell. Ergebnisse einer Umfrage. Dresdner Verkehrsbetriebe (ed.), Dresden

Petersen, M. (1994): Autos teilen - Car-Sharing Projekt STATTAUTO. In: Behrendt S., Kreibich, R. (Hg.): Die Mobilität von morgen - Umwelt- und Verkehrsentslastung in den Städten, Weinheim/Basel, pp. 241-252

Petersen, M. (no year): Ökonomische Analyse des Car-sharing. Berlin

Sunnerstedt, E. (2000): Vehicle Monitoring and Evaluation. A **ZEUS** project report summary. Stockholm

Verkehrsclub Deutschland (VCD) (1993): Fördermöglichkeiten des Car-sharing. Bonn

Zhang, X., Kompfner, P., White, C. – B. Sexton (1998): Guidebook for Assessment of Transport Telematics Applications: Updated Version. Fourth Framework Telematics Application Programme, Transport Sector, **CONVERGE** Project TR 1101, Deliverable 2.3.1.

GEMIS Model information under: <http://www.oeko.de/service/gemis>