"MOBILFALT" – INTEGRATION OF RIDE-SHARING INTO PUBLIC TRANSPORT AS A NEW APPROACH FOR RURAL AREAS

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ABSTRACT

Due to demographic changes and rural exodus public transport in sparsely populated areas is getting more and more inefficient. On the other hand, user costs for both public and private transport will rise above average and may exclude some groups from mobility for economic reasons.
In order to provide sustainable mobility, the public transport authority of Northern Hesse (Nordhessischer Verkehrsverbund) is planning to integrate ride-sharing into its public transport system. The objective of our research is to evaluate under what conditions this highly innovative approach can be an appropriate and sustainable solution to providing mobility. This includes spatial dimensions, economic aspects as well as requirements and attitudes of the population.
In order to identify critical success factors and obstacles, focus groups in three pilot areas will be repeatedly interviewed in depth about their attitudes towards public transport and ride-sharing before and during the pilot phase. Furthermore, changes in traffic demand and social impacts will be investigated based on representative surveys. The mobility needs and the economic context will be monitored. Also the cost, revenues and new passengers will be estimated as well as the economic and social benefits in order to make feasible recommendations to improve public transport in rural areas.
As the service is supposed to start in April 2013, the first results will focus on the implementation process and on the focus groups. Short-term effects on the demand and interdependencies between remaining public transport and "Mobilfalt" will also be presented.
During the planning and implementation process it turned out that local political support is essential for acceptance from among the population. Furthermore taxi companies will take part in order to compensate unavailable lift offers. They therefore need to be involved at an early stage.

Keywords: Sustainable mobility, social cohesion, sparsely populated areas, rural areas, public transport, ride-sharing

CHALLENGES FOR PUBLIC TRANSPORT IN GERMANY

The German population has stagnated since 2003. In 2008 the population in Germany totalled 82.53 million and was down to 81.75 million in 2010. In 2011, the population rose by 0.1 % to 81.84 million, because the net immigration to Germany overcompensated the natural decrease, in contrast to the years before.[Statistisches Bundesamt 2011] According to predictions of the German Federal Statistical Office, only 65 to 70 million people will live in Germany in 2060. Until 2020 the most likely scenarios predict a population between 80.4 and 79.9 million (-1.9 % up to -2.5 % in 2020 compared to 2008).[Federal Statistical Office 2009]
In addition, the age structure of Germany's population will dramatically shift. In particular the number of the oldest seniors (over 80 years old) will rise from 4 million (a share of 5 % of the population) in 2008 up to 10 million in 2050 and then decrease to 9 million (about 14 %) in 2060.[Federal Statistical Office 2009]
The development varies strikingly in different regions: In some agglomerations such as the Cologne/Bonn region and the Rhine Main area around Frankfurt, as well as in the south and southwest of Germany (e.g. Mannheim, Stuttgart or Munich) the population will continue to grow by 2025. On the other hand, projections predict strong declines in the east of Germany, which has had to face a substantial exodus of people since the German reunification in 1990. This concerns also large parts in former West Germany. Agglomerations with a strongly decreasing population are the Ruhr area and the Saarland. Regions with a lower population density and decreasing population are for instance the northern parts of Bavaria and Hesse, the south of Lower Saxony and South and East Westphalia (see Figure 1).

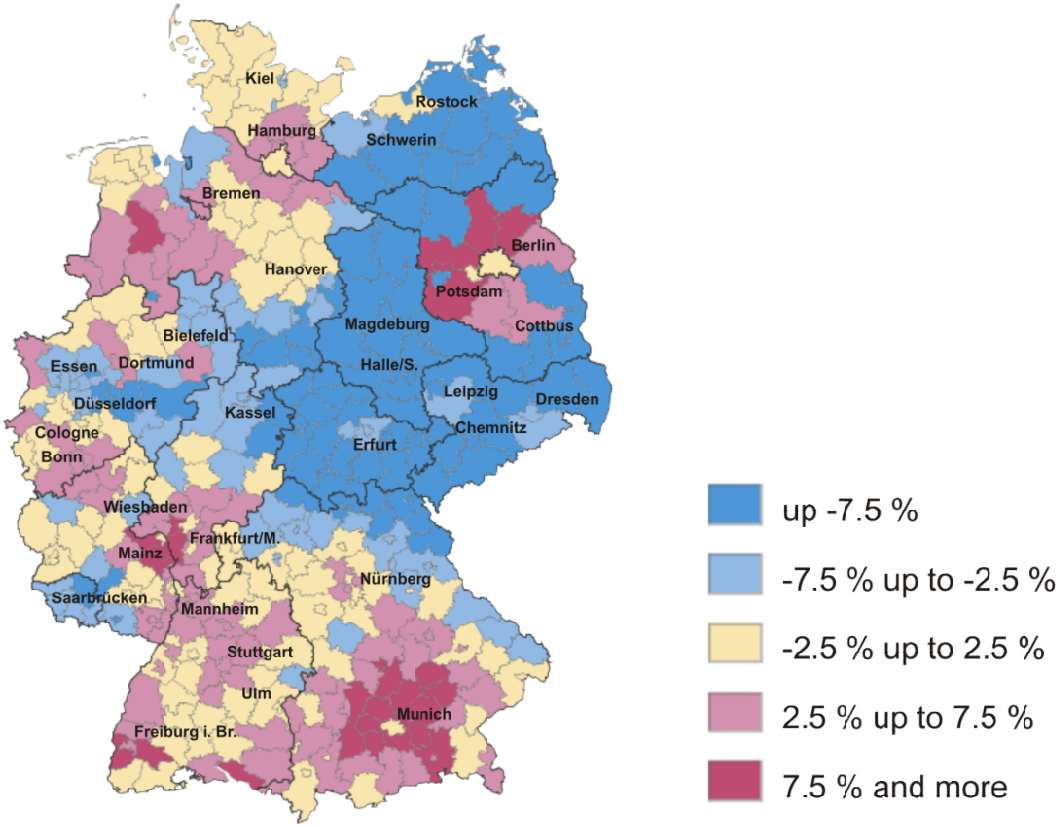

Figure 1 – Changes of Germany's population 2025 compared to 2009 in %. Source: The Federal Institute for Research on Building, Urban Affairs and Spatial Development [BBSR 2011], map source: [BBSR 2011]

Furthermore, demographic ageing strengthens the decline in population (see Figure 2). These developments challenge especially rural areas: A decreasing population leads to a shrinking number of potential customers and causes a decreasing demand for services and goods. As a result, businesses close down. Notable examples are consolidation processes of shopping possibilities - even for daily needs - or the decreasing number of doctors ("physicians' shortage") in rural areas. This leads to growing distances that need to be covered.[BMVBS 2010:22]

As a result, people who are not able to drive their own car for age or health reasons and do not have sufficient access to public transport, will be excluded from social life.

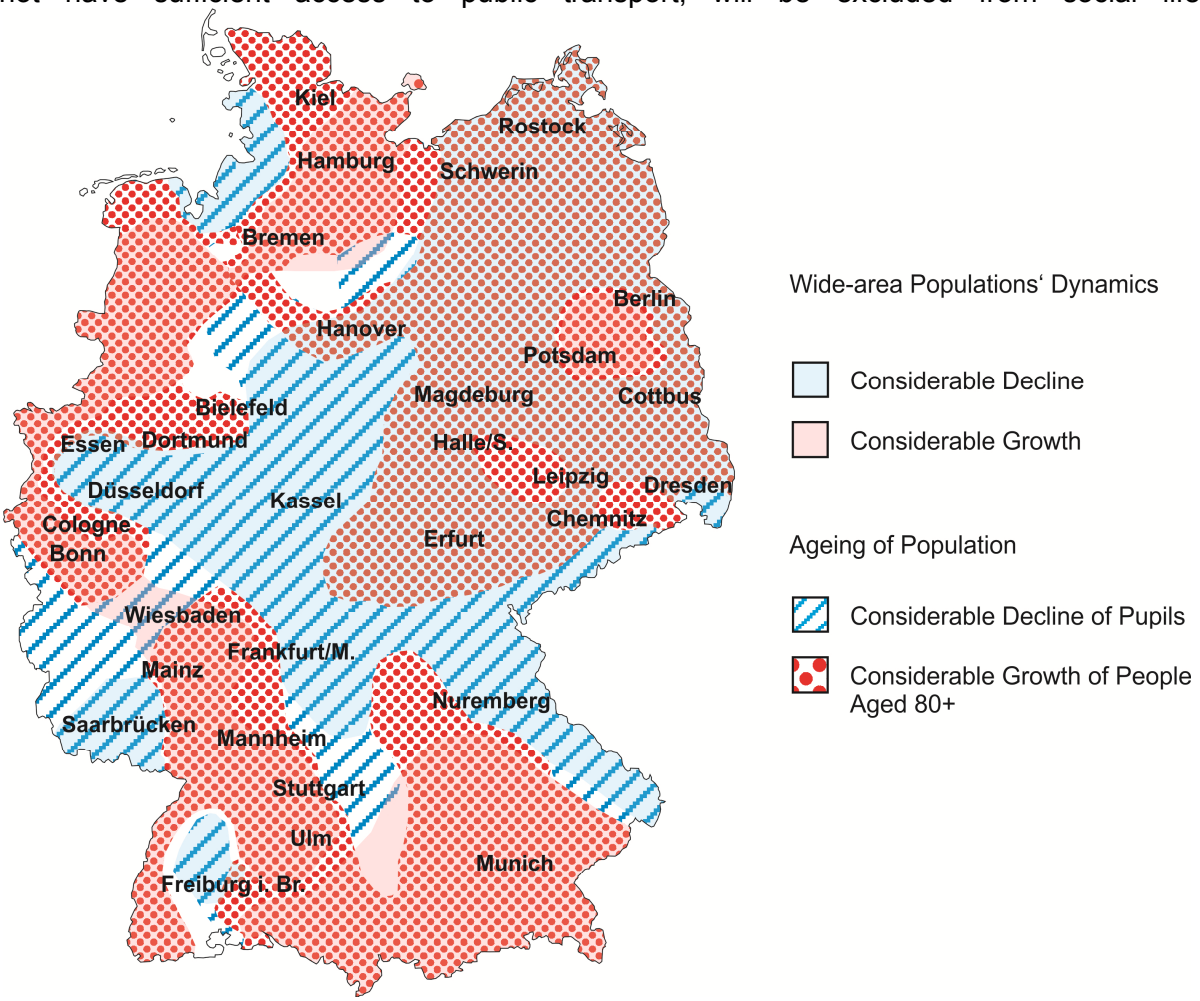

Figure 2 – Effects of demographic change in Germany 2025 compared to 2005, source: population projection by The Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), map source: [BBSR 2012])

Public transport in rural areas is facing multiple challenges. This concerns particularly the bus service in rural areas with a minor demand and low population density. Due to its immanent characteristics, the bus service in rural areas is mainly used by captive riders. In rural areas about 80 % of all bus passengers are pupils and the bus service is therefore mainly adapted to their needs. Demographic change and rural exodus have a serious impact on the demand for public transport. How the structure of bus services will develop in the future is consequently very closely linked to the remaining number of school locations. If schools are closed down, this will lead to growing distances between homes and schools. As a consequence of these structural changes and the declining demand, the cost for the

operation of buses will rise. At the same time, the revenues will decline and the service will become less attractive.
On the other hand, the number of elderly people will grow above average in rural areas, but private car ownership in this age group will be higher than in the corresponding group today. People who own a car, tend to use their car more frequently than people without a car, so more elderly people do not cause more customers of public transport. On the other hand, there are people who are not able to drive a car any more. There is therefore a risk of exclusion from social participation because in sparsely populated areas there are often no facilities for daily needs within walking distance. This explains why rural areas are affected more severely by these processes.

RECENT DEVELOPMENTS

Innovations in public transport

Besides reducing the supply of transport services, a common approach to raising the cost effectiveness of public transport in view of lower demand in sparsely populated areas is the introduction of demand-responsive transport (DRT) and express bus services.

- DRT is mainly provided at times of low demand (in the evenings and at weekends), however sometimes school buses are the only conventional bus service that is still available. DRT is normally operated by a taxi company on behalf of the transport authority. A ride needs to be booked in advance (30 to 60 minutes before the estimated departure time). DRT is in service not only in rural areas but also in cities, particularly at night.

- Express bus services are characterised by short travel times and direct routes between starting point and destination, regular interval timetables as well as operation that is independent of demand. In rural areas, express bus services are often operated in combination with a demand responsive service: To avoid indirect routes, interchange points have been introduced where DRT and express buses are connected with each other.[Bertocchi 2009]

An alternative to improving the cost effectiveness of conventional bus services in rural areas are bus-call systems. They work on the call principle, which means that the bus will only stop after receiving a call from bus stops that are equipped with a call button. Unnecessary drives and detours can thus be avoided. More than 50 on-call bus stops are in service in Germany and Austria.[SCHNEIDER et al. 2011]
But from the point of view of public transport authorities, demand responsive services are relatively expensive and have a negligible impact. This applies especially to a DRT with a frequent service and a high rate of utilisation while the occupancy rate of the single rides is low. In the worst case, the public transport authority needs to commission a taxi company for a long journey for only one passenger. As a result, the cost per passenger may be high, while the fare revenues remain low. Furthermore, a sufficient number of taxis is required which may be difficult in some regions.

Other possibilities to ensure mobility are bus services offered by volunteer bus drivers (German: Bürgerbus, Dutch: Buurtbus). In most cases, the service is run by a non-profit association, the major part of the volunteer drivers are retired persons. This kind of service was implemented for the first time in the Netherlands. In Germany, the first "Bürgerbus" was implemented in 1985, today there are more than 150 "Bürgerbus" buses in service. These services are offered mostly in rural areas, but sometimes also in big cities.[PRO BÜRGERBUS NRW 2012] In contrast to Social Car Schemes that are common for instance in England, no membership is necessary for using the system.

Ride-sharing in Germany

Ride-sharing became popular in Germany as safer and and more reliable alternative to hitchhiking in the 1980s. At that time, ride-sharing agencies existed in bigger cities. In the last decade they were replaced by websites providing ride-sharing services. In Europe, carpooling.com, which was launched in Germany in 2001 with the name mitfahrgelegenheit.de, holds the biggest market share.[Carpooling 2012]
State of the art are websites which provide real-time ride-sharing; "flinc" [Flinc 2012] and "PocketTaxi" [Pockettaxi 2012] should be mentioned here. Unlike common ride-sharing websites, real-time ride-sharing does not only aim at large-distance rides, but also at inner-city rides. It is possible to connect offers and requests with social networks in order to create a "network of confidence".
Whereas "flinc" and "PocketTaxi" are university start-ups, car companies are also entering the segment of ride-sharing: Daimler has started the website "moovel" that provides information about different means of transport in the Stuttgart area, including ride-sharing, public transport and car-sharing. Partners are the transport authority of Stuttgart, the public transport operator Stuttgarter Straßenbahnen and the ride-sharing website carpooling.com.[Moovel 2012] Furthermore Daimler holds a minority stake in carpooling.com, including technical collaboration [Carpooling 2012] after having run a ride-sharing service in the cities of Aachen and Ulm in Germany.
Another pilot project for improving information about different travel possibilities is the "immer mobil" project (translation: "always mobile") which included real-time information about public transport, demand-responsive services and ride-sharing on a local scale. At present, the results of a field test are being evaluated. [Immermobil 2012]
However, ride-sharing is not set-up as part of public transport. The possibility to use this service depends on the rides that are offered, while public transport is operated at times that are published in timetables. There have been attempts to establish ride-sharing as part of public transport, notably a pilot project run in Lower Saxony by the University of Wuppertal in the 1980s. In this project, stops for ride-sharing – similar to bus stops - were set up and ID cards for participants including an insurance were sold. Another approach was tested in Switzerland (Burgdorf, Canton of Bern) in 2005: A system called "Carlos", based on display columns, offered the opportunity to request a destination-oriented ride-sharing service. The passing drivers could read the requested destination on an LED display. However, the occupancy rate of the columns was far too low to cover the costs.[VDV 2009]

THE "MOBILFALT" PROJECT

Basic information

In order to tackle these challenges, the new approach of the "Mobilfalt" project is to improve public transport by integrating ride-sharing into public transport. In practice, the service would run as follows:

- There will be common timetables with an hourly service, but passengers will have to book in advance via Internet or telephone, as they need to use common demand-responsive transport. In contrast to DRT, the rides in the timetable are provided not by a taxi but by lifts in private cars.

- To ensure reliability and safety, participants need to register and identify themselves beforehand. The membership is free of charge.

- "Mobilfalt" addresses both providers of lifts and passengers to link small villages and the nearest town in order to go shopping, to the doctor or to get to a train station. Providers of lifts will receive a financial compensation per kilometre. Passengers pay the fare electronically in advance at the moment of booking.

- Lifts can also be offered in commercial cars and vans running light. Thus, enterprises will have the possibility to offer lifts and so receive compensation. Commercial traffic becomes more efficient and doing business in rural areas pays off also under conditions of rising petrol prices.

- If no lift is offered although there is a request, transport will be ensured with a taxi such as in an ordinary demand-responsive service, so there will be "guaranteed mobility". The fare to be paid would be the same in both cases.

- The payment and the linking of persons to be picked up and providers of lifts would be arranged automatically by an IT system.

- In order to promote "Mobilfalt" in the pilot region, cooperation projects with volunteers and local businesses have been set up. Volunteers have been instructed to be able to give information about "Mobilfalt" and to canvass participants among their private contacts. They are also able to assist people to register for "Mobilfalt". Moreover, selected local businesses cooperate with "Mobilfalt" in order to promote their own products and services in the pilot regions.

Partners

The leading partner for this project is the transport association of Northern Hesse (Nordhessischer Verkehrsverbund). The project is funded by the state of Hesse as part of its strategy of sustainability. A pilot project will start in 2013 in the Werra-Meißner county and

the Schwalm-Eder county in the north of Hesse. Two consulting engineers have been commissioned to plan the "Mobilfalt" service (traffic concept, timetables).
The role of the Chair of Transportation Planning and Traffic Systems of the University of Kassel is process consultancy and scientific evaluation.
The overall aim is to establish a sustainable solution for public transport in rural areas, to improve social cohesion by mutual aid in villages and to develop feasible recommendations for rural areas. To ensure this, the project is linked to a project with a similar approach in the Odenwald county in the south of Hesse.
As a result, this additional service may improve the reliability and flexibility of, and the accessibility to, public transport and strengthen rural areas.

Pilot regions

The three pilot regions are located in the centre of Germany, in the north of the federal state of Hesse (see Figure 3). The closest major city is Kassel (about 195,000 inhabitants).

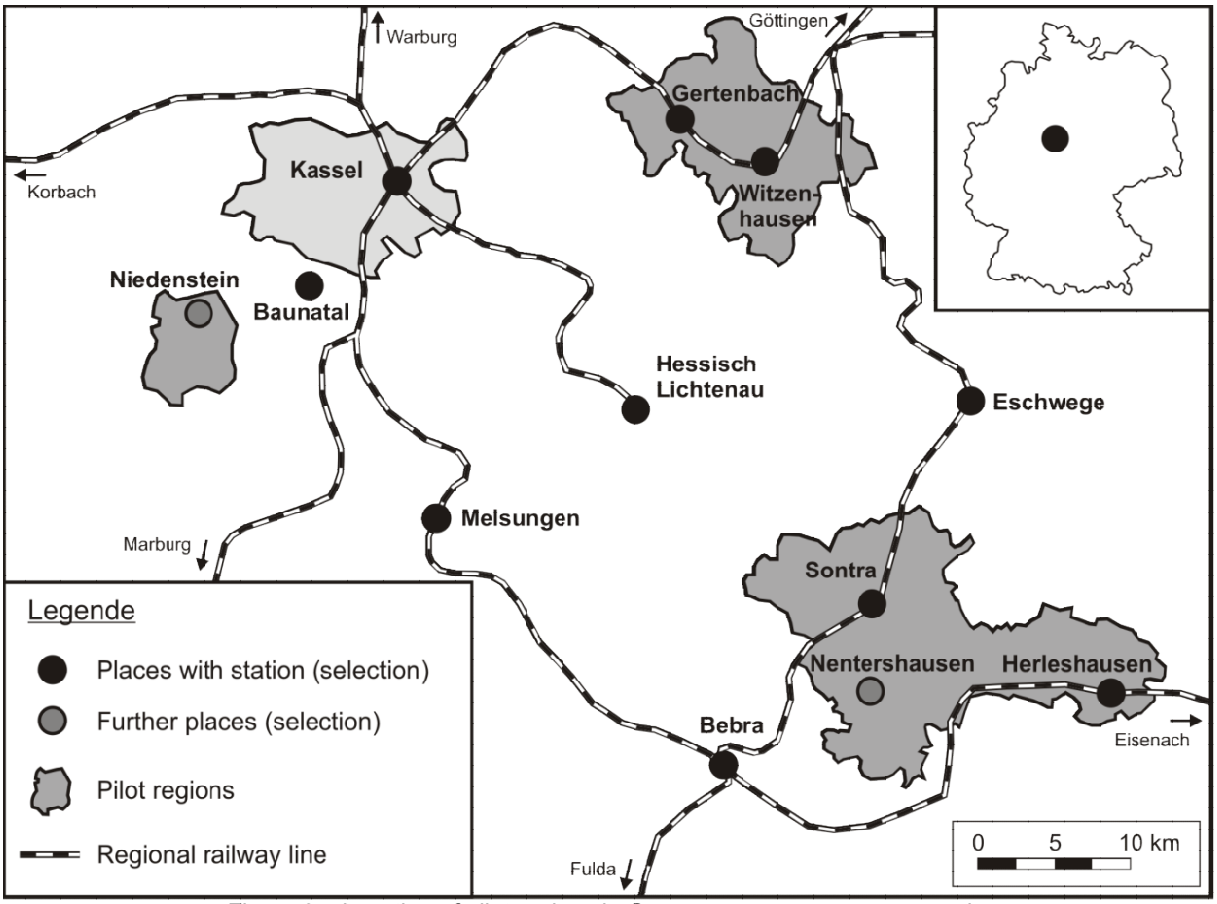

Figure 3 – Location of pilot regions in Germany. map source: own work

North Hesse is an example of demographic change processes that are underway in large parts of Germany. Similar conditions of a declining and ageing population can be observed in many parts of Germany as described before.
The latest forecast of Hessen Agentur of the year 2010 predicts for the Werra-Meißner county a decline of the population by 16.2 % in 2025 compared to 2009, and thus an even

stronger decline than the Federal Statistical Office predicted in 2008. The decline in the Schwalm-Eder county will be 10.8 %.[Hessen Agentur 2010]
The selected pilot areas are:

- The town of Niedenstein (about 5,300 inhabitants) is located about 24 km from the centre of Kassel and near the town of Baunatal (about 28,000 inhabitants). Baunatal hosts a large Volkswagen plant with more than 13,000 employees. At a later stage, offers for commuters to Baunatal will play an important role in this pilot region, although Baunatal is located outside the pilot region.

- The second pilot region consists of the municipalities Herleshausen, Nentershausen and the town of Sontra, which cooperate in an inter-communal association.

- The third pilot region is the town of Witzenhausen (15,400 inhabitants). Witzenhausen hosts a faculty of the University of Kassel with more than 800 students and is one of the smallest towns in Germany that hosts a university.[Universität Kassel 2011]

See Table I for statistical information.

In Herleshausen, Sontra and Gertenbach (which belongs to the municipality of Witzenhausen) there are train stations with an hourly railway service, in Witzenhausen there is a station with train service twice an hour.
The bus service is mainly adapted to the needs of pupils which means that there are rides in the morning between 06:00 a.m. and 08:00 a.m. and from 12:00 noon until about 6:00 p.m. during the week. There is no service on Saturdays and Sundays. Exceptions are only few trunk lines that have rides also at weekends and an hourly service from Monday to Friday.
For the pilot regions Herleshausen/Nentershausen/Sontra and Witzenhausen, public transport has been investigated with regard to accessibility of important destinations. It turned out that the best travel possibilities are in the mornings. In the afternoons and evenings, boroughs without a train station do not have any public transport.
For the Sontra region, the lack of accessibility is even insufficient throughout the whole day, because travel times to middle-order and high-order centres is much too long.[VfR Werra-Meißner 2011] Although Niedenstein is located near Baunatal and Kassel, the accessibility is relatively poor due to twisting roads in the hilly surroundings even for private traffic.

Table I – Population and surface area of the pilot regions (30th June 2011), data source: [Hessisches Statistisches Landesamt 2011]

Pilot region	Inhabitants	Area [sq km]	Pop. density [inh./sq km]	Number of boroughs
Niedenstein	5,273	30.41	173	5
Witzenhausen	15,378	126.69	121	17
Herleshausen	2,925	59.52	49	10
Nentershausen	2,887	57.06	51	6
Sontra	7,953	111.29	71	16

EVALUATION OF THE "MOBILFALT" PROJECT

The Chair of Transportation Planning and Traffic Systems of the University of Kassel contributes the scientific evaluation of the project. The evaluation includes all stages of this new approach, starting with the conceptual design up to the testing and the assessment and monitoring of effects in various respects, e. g. traffic or social issues.
The evaluation consists of two parts, process evaluation and impact evaluation:

- The process evaluation focuses on the measures und sequence of implementation of the various steps during the planning process. This includes all steps during the conceptional planning and implementation of the measures.

- The impact evaluation identifies and assesses the impacts of the single measures with regard to a system of objectives. This system of objectives consists of superior and subordinate objectives which are structured into approval aims, economic aims, traffic aims, social and cultural aims and ecological aims.

Figure 4 shows the linkage between both parts of the evaluation and different steps of a planning process, starting from pre-orientation to testing phase. The impact evaluation follows, but uses also data gained during the process evaluation.

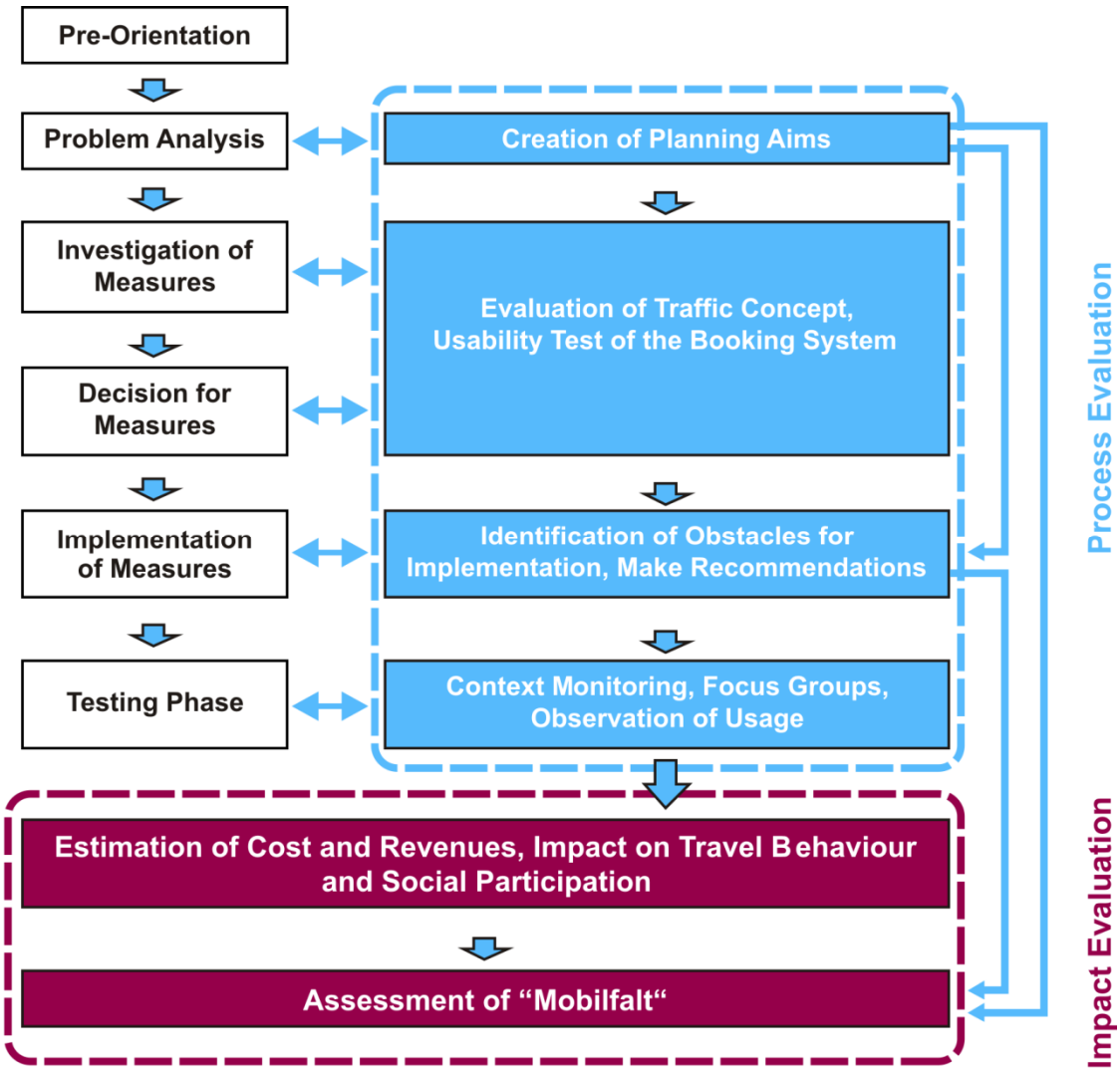

Figure 4 – Process evaluation, impact evaluation and the linkage to the planning process. Source: [FGSV 2001], own work

The purpose of evaluation is to make recommendations and raise the probability of successful implementation by examining the essential determining factors. Another aim is to derive recommendations for the implementation of a ride-sharing system as part of public transport in similarly structured regions.
The project period of the evaluation by the University of Kassel is shown in Figure 5.

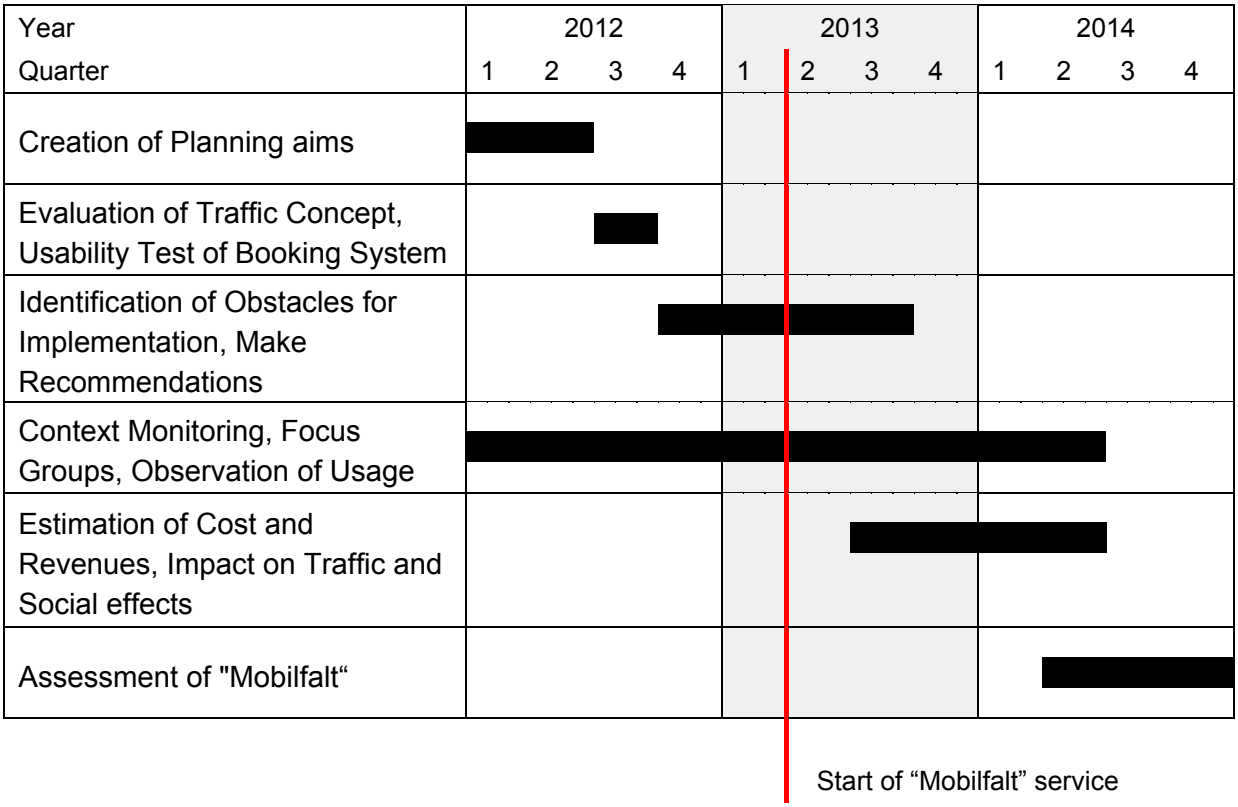

Figure 5 – Project period of evaluation

Process evaluation

The first step of process evaluation consisted of the development of a system of planning aims by the University of Kassel.
As every planning is done in order to achieve an aim, evaluation is to assess the extent to which planning aims have been achieved. Planning aims need to be defined at an early stage during project planning. If feasible recommendations are to be made also for other, similar projects, it becomes even more important to evaluate a project because it is essential to know the reasons under which planning leads to a successful result. Unfortunately planning is very often not accompanied by evaluation, so it is difficult to tell in retrospect what elements of the planning process were essential.
Usually there are several planning aims, and planning has an impact in various respects. Since planning aims can be fairly general in nature so that it is difficult to directly measure in how far an aim has been achieved, a system of planning aims should be created. In this system, single superior aims are composed of several subordinate ones, which together form a hierarchy of aims. The deeper an aim in a hierarchy, the more palpable it is.
To measure the degree of achievement, every (subordinate) aim needs an indicator with a measurable target value. The single aims need to be disjunct and need to cover the complete range of impacts to be evaluated. It is also possible to accord a weighting for different aims.

For "Mobilfalt", the University of Kassel proposed the system of planning aims. The target values and the weighting were defined by the transport association of Northern Hesse (Nordhessischer Verkehrsverbund) as the leading partner.
In Figure 6 the hierarchy chart of the planning aims for "Mobilfalt" is shown.

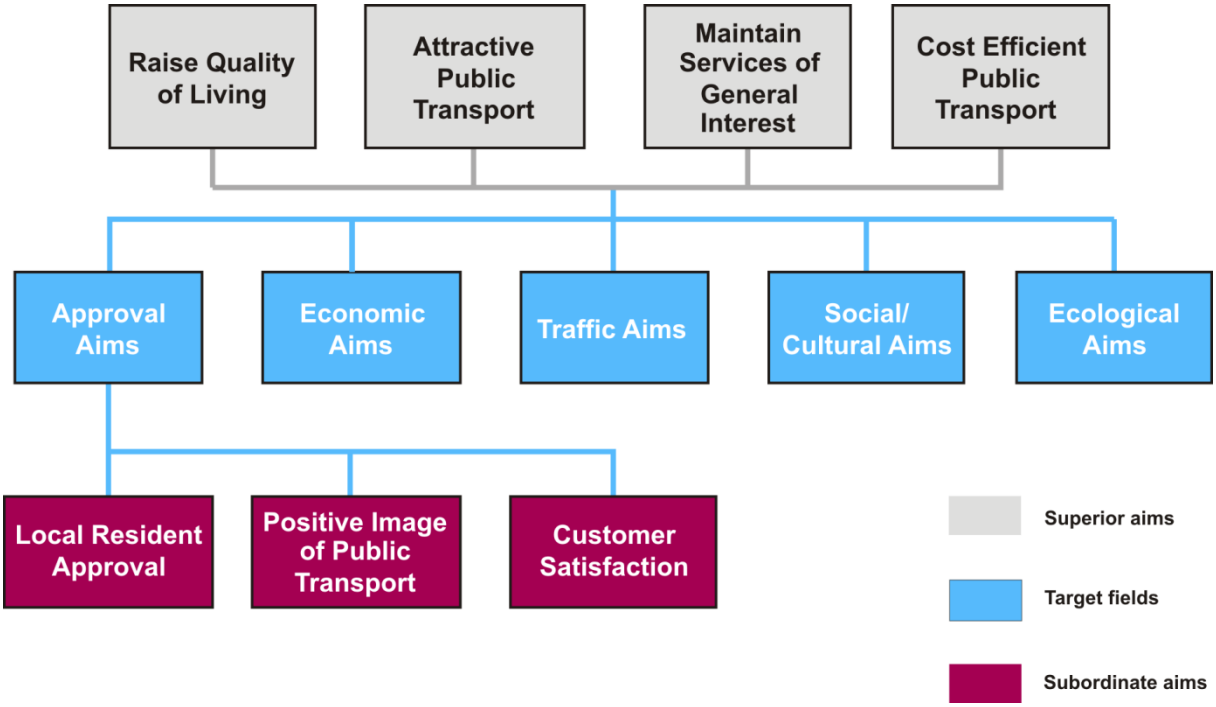

Figure 6 – Part of the system of planning aims. Source: own work

On the highest level, there are the following superior aims of "Mobilfalt":

- The quality of life should be raised.
- Public transport should be more attractive.
- Public transport should be more cost efficient.
- Services of general interest (market and non-market services which the public authorities class as being of general interest and subject to specific public service obligations) should be maintained.

In order to measure the achievements with regard to these superior aims, subordinate aims classified in five different respects (target fields) were defined (Figure 6). Altogether, there are 13 subordinate aims on the lowest level with 25 indicators. The target values of each indicator have been set on the basis of investigations from other DRT systems in Germany and on university expertises for similar projects. The indicators will be checked one year and three years after beginning the "Mobilfalt" service.
Figure 7 serves as an example for the approval aims and their indicators.

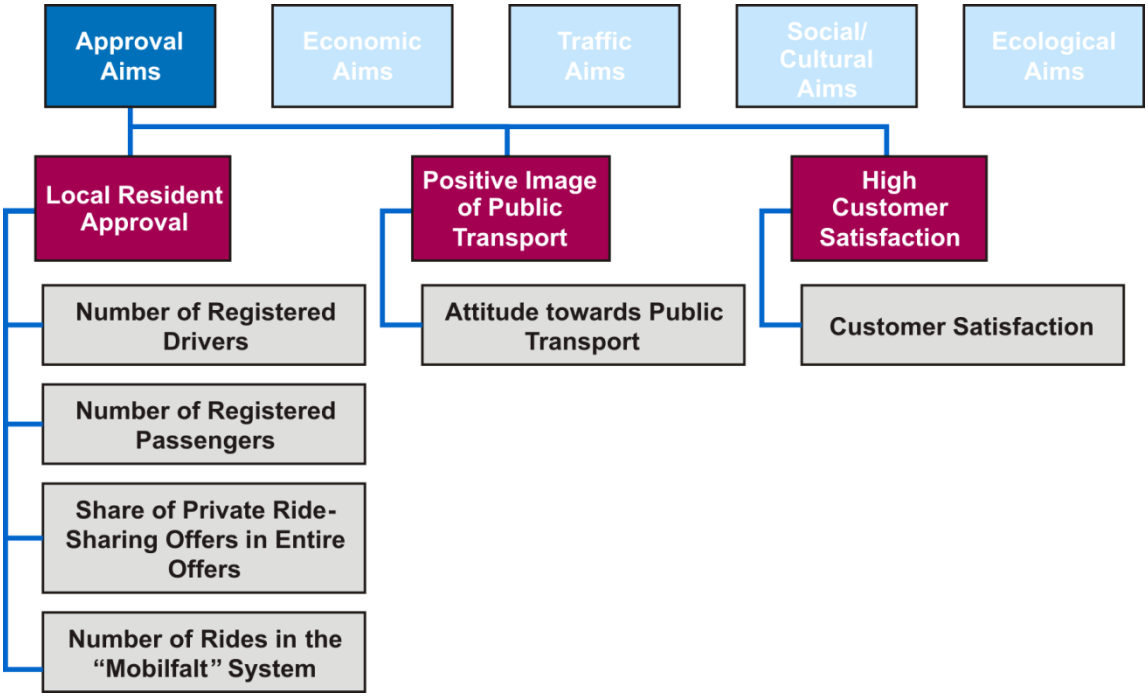

Figure 7 – Approval aims and their indicators. Source: own work

The aim "Local Resident Approval" is evaluated by the indicators shown in Table II, the data can be gained from the booking system:

- For the "*Number of Registered Drivers"* and the *"Number of Registered Passengers"*, the target value is a certain share of all potential participants, depending on the number of car owners and population aged over 14 years in each pilot region except in the main township.

- The indicator *"Share of private ride-sharing offers in entire offers"* measures the willingness of the driver to take part in the "Mobilfalt" service. The higher the value of this indicator, the higher the driver acceptance of the system.

- The indicator *"Number of rides in the ´Mobilfalt´ system"* characterises the passenger demand and is one of most important quantities for evaluation. The new service needs a sufficient demand to transform "Mobilfalt" into a normal operation after the testing phase.

Table II – Examples for indicators, target values and instruments for the evaluation of the aim "local resident approval"

Indicator	Target value (one year after beginning)	Instrument for evaluation
Number of Registered Drivers	> 2.5% of car owners in each pilot region except in the main township	booking system
Number of Registered Passengers	> 5% of theoretical potential of passengers (population aged over 14 years in each pilot region except in the main borough)	booking system
Share of private ride-shares in the entire scheduled service in the pilot regions	> 12.5%	booking system
Number of rides in the "Mobilfalt" system	> 0.5 rides a year per theoretical potential of passengers (population over 14 years except main borough)	booking system

The image of public transport and the customers' satisfaction in the pilot regions is evaluated by regular customer surveys conducted by the public transport authority of Northern Hesse. Randomly selected customers are interviewed about their attitudes towards public transport every year in the same period. This survey will be adapted for the purpose of the "Mobilfalt" evaluation in order to get information about knowledge and attitude towards "Mobilfalt". The University of Kassel will in addition conduct a focus group survey in the pilot regions.
Another step of process evaluation during the planning and implementation phases was the assessment of the transportation planning work performed by consulting engineers. So it was possible to contribute the university's own expertise and knowledge from evaluated DRT and public transport projects in Germany.
Furthermore, the IT-based tools were subjected to a pretest, in order to improve their usability and to make recommendations. Intuitive user guidance and usability is an important aspect in developing the system software to avoid barriers for people with little Internet experience.
While the steps described above cover the time span of planning and implementation, the development of important framework conditions will be continuously tracked and evaluated during the whole project, to be able to identify critical success factors and obstacles (context monitoring). All relevant changes of factors that are decisive for the project will be identified and their relevance for successful completion of the project will be investigated. These determining factors are subdivided as follows:

- Economic context (e.g. the price of petrol, development of GNP, changes in travel time), changes regarding the possible providers as for example taxi companies, and the implementation at the different stages will be monitored.

- The political context means the political backing in the pilot region and local support.

- The actor's context covers the cooperation with the taxi businesses and other actors that possibly offer rides as well as the cooperation with volunteers

During the testing phase, application of the system is monitored: The IT system for booking and billing allows the utilisation of the system to be tracked in detail. This data will be used to widen the knowledge about the application of "Mobilfalt" and for statistical projection and weighting of the surveys (see below). Important system characteristics and characteristics of travel demand in rural areas will be determined. This information is essential for quantifying the overall benefit of "Mobilfalt". It is used as input for process evaluation and for impact evaluation.
Furthermore, participants and dropouts will be interviewed, among other things to learn about the reasons for quitting, so weaknesses can be identified and systems and processes can be revised.

Impact evaluation

Impact evaluation forms an essential part of the overall evaluation process. This includes evaluating the business model, estimating the costs, revenues and new passengers, and quantifying the benefits in economic and social respects:

- Estimation of economic impacts: This includes mainly the cost of developing and implementing the IT system, payment for drivers who offer "Mobilfalt" rides and of advertising activities. Furthermore, the revenues gained through "Mobilfalt" and impacts (or interactions) on the remaining public transport are to be estimated. Likely effects may be a rising number of passengers in public transport due to improved access to interchanges of the public transport network, but the services offered by "Mobilfalt" may also lead to a cannibalisation of the remaining public transport services.

- Estimation of impacts on travel behaviour: These estimations are also used to assess the ecological aims (reduction of emissions) that are influenced by the modal choice and changes in behaviour

- Estimation of social and other non-monetary impacts: A very important item is the estimation of benefits including non-monetary criteria. These benefits are mainly the possibilities for social participation created by improved service, access to public transport and, consequently, access to important destinations. These benefits will be identified and evaluated.

While the economic impacts can be evaluated by business and demand data from the IT system, a survey has to be conducted to evaluate the impacts on behaviour and on social and other non-momentary aspects. To assess the impact of "Mobilfalt", representative groups of participating passengers and a comparison group not participating in "Mobilfalt" will be interviewed in depth during the pilot phase in 2013, in order to learn more about reasons

for decisions and for changes in behaviour. Furthermore, a representative survey will be conducted about one year after the start of the pilot project: Firstly with an online questionnaire and, as a second step, with an mail questionnaire in order to deepen the investigation. In this survey, the actual travel behaviour is to be investigated, but also the knowledge of and attitudes towards "Mobilfalt" and public transport in general. By this, changes of behaviour (modal choice, destination choice, activity patterns) should be measured. Another aim is to learn about possible improvements in order to implement a public transport system similar to "Mobilfalt" in other regions.
The results will lead to recommendations and guidelines for planning, implementation and estimation impacts of ride-sharing systems in addition to public transport in regions with a similar structure.

OUTLOOK

The "Mobilfalt" service will start in April 2013. From then on, the University of Kassel will start tracking the information about the utilisation and the development of the system, while context monitoring has started in 2012 and will be conducted continuously.
During the implementation process it turned out that local backing is essential for successful implementation. Before the system started, the project had been presented on a number of occasions, while also trying to learn more about specific traffic needs in the pilot regions and to find volunteers who may act as multipliers for promoting "Mobilfalt" in their communities. In addition the project was made public by the usual marketing activities. As the pilot phase will last until the end of 2014, the first evaluation results of the University of Kassel will be published in 2014.

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