Identification of Innovative Solutions to Decarbonise Transportation of People and Goods in Smart Cities

Clemens Schober, Susanne Roiser, Martin Eder

(Ing. Mag. Clemens Schober, Kapsch TrafficCom AG, Clemens.Schober@kapsch.net)
(Mag. Susanne Roiser, Vienna University of Economics and Business, susanne.roiser@wu.ac.at)
(Mag. Martin Eder, Kapsch TrafficCom AG, martin.eder@kapsch.net)

1 ABSTRACT

The two major challenges mankind has to face during the 21st century in the context of transportation are urbanization and CO_2 emissions. These two phenomena cause serious problems and bring along a strong need for the implementation of innovative and "smart" solutions in future cities. The substantial need for these solutions, however, can lead to interesting commercial opportunities for innovative companies.

In the light of this trend development an innovation project, which was based on the lead user approach, was conducted by the Institute for Entrepreneurship and Innovation (E&I Institute) at the Vienna University of Economics and Business (WU Wien) in cooperation with Kapsch TrafficCom AG (Kapsch). The latter is a member of the Kapsch Group, a worldwide renowned Austrian company. Kapsch operates in over 35 countries and is a leading international supplier of intelligent transportation systems (ITS). Its core business is the development and supply of electronic toll collection (ETC) systems, and the technical and commercial operation of the latter.

Finding radically new concepts and solutions is always a challenging task. However, the lead user method is an applicable tool to gain deeper insight into complex problems and to produce highly innovative ideas and solutions.

The main goal of this research project was to find innovative solutions to decarbonise transportation of people and goods in "Smart Cities". Several important constraints have to be considered in connection to the underlying problem. Firstly, solutions must be commercially realizable by the year 2025. Secondly, commercial business models should be marketed on a B2G or B2B basis. Thirdly, the focus lies on cities with more than two million inhabitants. In addition, solutions must be scalable. Finally, any solution ought to lead to a reduction of CO^2 emission.

A major difficulty for the conducted lead user method was the definition of the search field and the term "smart city". In general, there is no singular definition of what makes a city smart and there is also no clearly defined strategy which must be implemented in order to improve a city's smartness (Austrian Institute of Technology, 2011). Smart cities have several dimensions as outlined by the European Commission (2009): smart mobility, smart environment, smart governance, smart people, smart living and smart economy. While the interdependencies of these dimensions were only investigated in phase 1 of the lead user project, it was necessary to narrow down the search field so as to be able to find feasible concepts and solutions.

2 SMART MOBILITY

The current mobility trend can be characterized by the rapid exhaustion of fossil fuels combined with increasing environmental, health and safety problems (Grob, 2009). Especially in Asian cities the rapid urbanization and motorization, which is due to an increased income level, led to poor conditions of urban transportation (Morichi, 2005). Thus, smart mobility solutions would need to primarily solve problems of accessibility and availability of sustainable macro (for longer travel distances, e.g. trains) and micro mobility (for bridging the "last mile", e.g. flexible public individual transport), combined with efficient Intelligent Traffic Control (ITC) systems. Lenz (2011) pointed out that travel behaviour is ever more diversified nowadays, which leads to a shift from mono-modal to multimodal transport. This means that different transport modes in cities (trams, buses, metro, trains, cars etc.) will need to be interlinked and coordinated to ensure short travel times. Additionally, this requires an interconnectivity of all transportation modes and/or users so that shared information can be used to improve the prediction of traffic flows (Kambitsis, 2010).

In addition, transportation modes themselves can be improved in a smart way. By converting fuel-driven cars into electric cars, for instance, this approach has already been put into practice. Several countries have

already built large funds to facilitate this development with regards to their public transportation systems (Coune, 2011). However, the common "last mile" is still not covered–even if the public transport systems are

ISBN: 978-3-9503110-2-0 (CD-ROM); ISBN: 978-3-9503110-3-7 (Print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

very advanced (i.e. micro mobility). This is one reason why further solutions in the area of electric vehicles are still required (IET-Transport Forum, 2003).

Shared-vehicle concepts might also intelligently reduce the number of cars in cities (Winterhoff et al., 2009). A reduction of the number of cars used in cities is necessary as space (especially in connection with parking lots) becomes more and more limited. Furthermore, the abandonment of cars in cities would also tackle the problem of CO_2 emissions.

3 DOOMSDAY SCENARIO FOR FUTURE CITIES

To get better insights into the problems inhabitants of megacities face today, Kapsch prepared a "doomsday scenario". In this presentation current trends and developments are projected into the future with the aim to show how cities would look like by the year of 2030 if no further actions were taken (see Figure).

Fig. 1: Excerpt of the doomsday scenario of Kapsch

In order to get to a common understanding of what goals we addressed, we envisioned a future smart city which they presented to all project participants (see Figure 2).

Fig. 2: "Beautyville" Vision of a Smart City by Kapsch

4 OBJECTIVE AND METHODOLOGICAL APPROACH: THE LEAD USER METHOD

The objective of the project was to find innovative solutions for megacities in order to lower their level of CO2 emissions and leverage their citizens' satisfaction by enhancing life quality by application of the lead user method. Involving lead users and experts from all over the world shall help to overcome functional fixedness which often occurs within a company and in turn hinders innovative progress. Involving people from analogous markets should further encourage this out-of-the box approach.

High competition, shorter product life cycles and rapid technological change made it crucial for companies to constantly innovate. Especially radical innovations are needed in order to remain competitive. In this respect traditional marketing research methods often fail to deliver valuable results.

Most marketing research methods work with random samples of customers in order to ensure that they represent the average typical customers (Lüthje & Herstatt, 2004, p. 554). They are often restricted to obtain only information about the users' needs and assign the task of generating ideas for solutions to manufacturers (Gary L. Lilien, 2002, p. 1043).

However, average users are strongly constrained by their real world experience, an effect called "functional fixedness". Studies showed, for example, that those who use an object or see it used in a familiar way are blocked from using it in a novel way (Gary L. Lilien, 2002, p. 1043). In order to forecast their needs in the future or assess a radically new product, the customers have to master the very difficult mental task of imaging a context of use, which does not yet exist. Therefore, average users are unlikely to contribute insights into new product needs and possible solutions (von Hippel, 1986, p. 791).

In contrast, so called "lead users" do not have to imagine themselves in a not yet existing situation because the "new" is already familiar to them. (Lüthje & Herstatt, 2004). According to von Hippel lead users have two distinguishing characteristics: "(1) They are at the leading edge of an important market trend, and so are currently experiencing needs that will later be experienced by many users in that market. (2) They anticipate relatively high benefits from obtaining a solution to their needs, and so may innovate." (von Hippel, 2005, p. 22). The first characteristic is based on the assumption that market needs evolve over time and are driven by important underlying trends. Therefore, solutions developed by lead users today will be attractive to many users tomorrow (see Figure 3). The second was derived from studies showing that the greater the expected benefit from a needed innovation is, the greater the investment in obtaining a solution will be (von Hippel, 2005, p. 22).

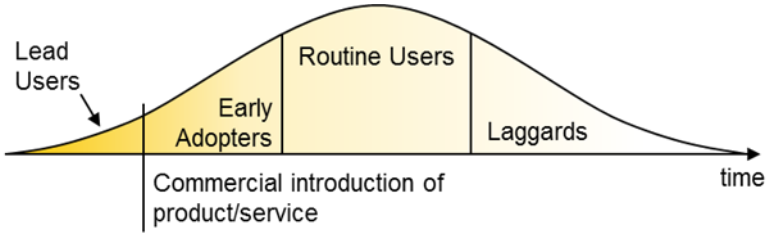

Fig. 3: Lead users' position in the adaption curve (Churchill, von Hippel, & Sonnack, Lead User Project Handbook, 2009)

The lead user research method exploits this fact by integrating lead users directly into the company's concept development process. Consequently, the project team can benefit from both the solutions and the information concerning the underlying need held by lead users (Churchill, von Hippel, & Sonnack, 2009, p. 6).

Products developed by lead users are often commercially attractive, have higher novelty and address newer customer needs (Gary L. Lilien, 2002, p. 1055). Furthermore, the method is not restricted to leading edge users in the target market, but also tries to make use of users from advanced analogous markets, which have similar needs in a more extreme form. This approach increases the likelihood of identifying radically new ideas for new products and services that will be "breakthroughs" for the target market (Gary L. Lilien, 2002, p. 1043).

In many cases lead users do not request financial compensation for their services. This phenomenon is called "free revealing" and means that all intellectual property rights to the information are voluntarily given up (von Hippel, 2005, p. 9). It mainly appears when lead users are part of other fields and industries and would not feel any negative competitive effects from revealing what they have done, or when they developed their

innovation just to solve their own specific need. In these cases lead users are generally happy to share their knowledge (von Hippel, 1999, p. 54).

Freely revealing users may benefit from enhancement of reputation, from positive network effects due to increased diffusion of their innovation, and from other factors like being able to buy a well-produced solution to their need (von Hippel, 2005, p. 9).

As shown in Table 1, lead users can be found in both low and high technology fields (Churchill, von Hippel, & Sonnack, 2009, p. 11). The percentage of users who improve prototypes or develop new solutions is significant. The numbers range from 10% to nearly 40% depending on the industry (Lüthje & Herstatt, 2004, p. 556).

Study	Field of innovation	Users sampled (n)	% of users who developed solution for own use
Lüthje (2004)	Equipment for outdoor sports (Germany)	153	10%
Lüthje (2003)	Medical surgery equipment (Germany)	261	22%
Franke and Shah, (2002)	"Extreme" sporting equipment (Germany)	197	38%
Tietz, Morrison, Lüthje and Herstatt (2002)	Kite surfing equipment (Australia)	157	26%
Lüthje, Herstatt and von Hippel, 2002	Mountainbike equipment (USA)	287	19%
Morrison Roberts and von Hippel, 2000	Library information search system OPAC (Australia)	102	18%
Herstatt and von Hippel, 1992	Pipe hangers hardware (Switzerland)	74	36%
Urban and von Hippel, 1988	PC-CAD for the design of printed circuit boards (USA)	136	24%

Table 1: Fraction of users who build solution for own use (Churchill, von Hippel, & Sonnack, Lead User Project Handbook, 2009)

In recent years there has been an increasing interest in applying the lead user method to the development of products and services (Nikolaus Franke, 2006, p. 302). It was successfully used by numerous world leading companies like 3M, Johnson&Johnson Medical and HILTI (Lüthje & Herstatt, 2004, p. 553).

5 PROJECT DEFINITION AND GOALS

After Kapsch had decided to conduct an innovation project in cooperation with the E&I Institute, which is among the leading departments all around the world regarding the implementation of lead user projects, they nominated a group of people who worked out a more detailed area of focus within the search field of smart cities together with the E&I Institute. Out of two remaining subfields, namely "decarbonising urban transport" and "smart energy solutions", the former was chosen as it seemed to be related to the more urgent need for solutions, especially from a user`s perspective, and in turn to a higher chance of commercial success.

The next task was to find a precise description of the search field and the overriding goals of the project. The following constraints were thus set: The main focus of the project should be to identify innovative solutions, with commercial potential, that decarbonise individual and/or public transportation of people or goods while increasing the users' convenience.

Furthermore, some specifications were made to narrow down the focus and to provide the project team with a better understanding of the expected outcome of the lead user project:

- The underlying concepts to the solutions should be highly innovative, but must be commercially realisable by the year 2025 or 2030 at the latest.
- All existing and future technologies, systems and products may be used to draw concepts. Creativity should only be limited by realistic technology forecasts.
- Development phases of three to five years are expected.
- Commercial business models should be marketed on a B2G or B2B basis.

An expansion to the B2C market will only be considered if there turns out is a major business opportunity that requires this step to be taken.

- The main focus should lie on cities with more than 2 million inhabitants. Solutions have to be scalable.
- Smart cities are defined as to be systemic, human, anticipatory, resource-efficient and technologically innovative.

Concerning the regional focus of the project, it was agreed that both, cities in developed and in developing countries were of interest to the project partner and that a better regional focus could be developed during a later phase of the project.

6 DATA COLLECTION AND ANALYSIS

In a first step, the search field was narrowed down to the most accurate needs and trends. In order to do so, the students involved in the project systematically skimmed through the relevant literature, browsed the World Wide Web and conducted more than 500 interviews with experts and megacities' citizens who were affected of the problems described above.

We thereby identified 18 needs which were then ranked according to their importance. After having presented the outcome of the need and trend analysis to the project partner, the latter agreed to the recommendation of focusing on the four suggested needs, namely:

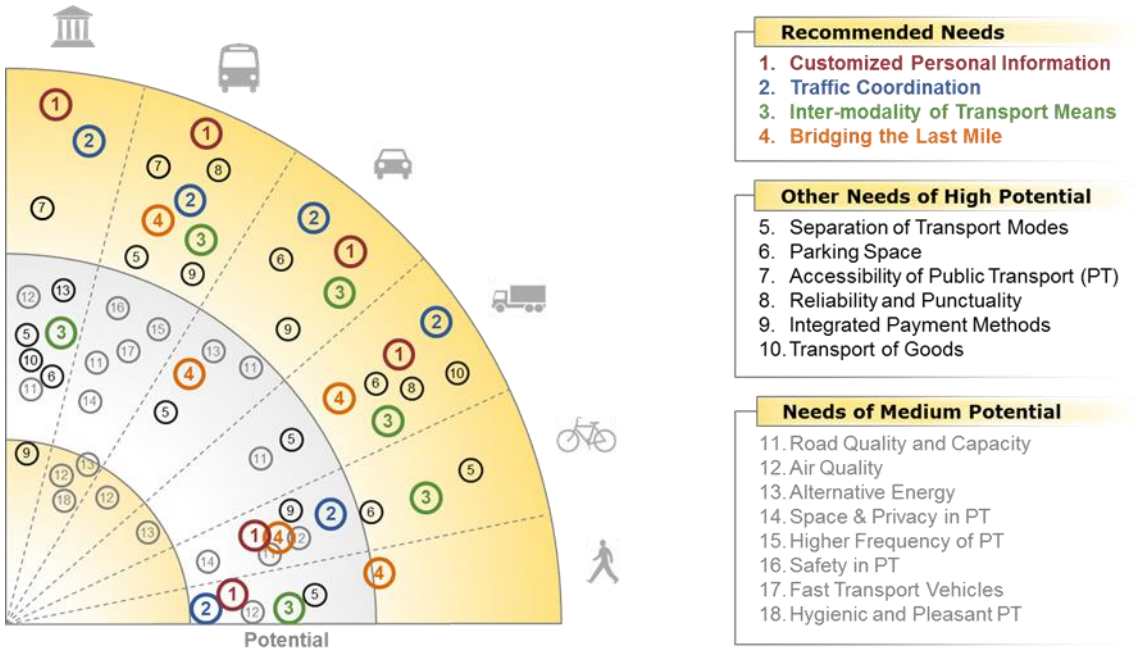

Fig. 4: Trend matrix (own contribution)

6.1 Need for Customized Personal Information

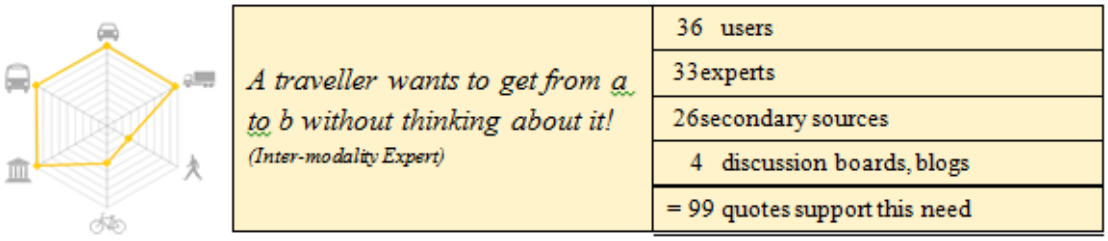

Fig. 5: Need for Customized Personal Information (own contribution)

Both users and system operators strive for information that would be real-time, accurate and relevant and simultaneously presented in a user- friendly fashion. This need turned out to be extremely relevant with a full score of five out of five and is relevant for all participants of public transport. This is not as surprising when considering the fact that information sharing can influence a passenger's comfort, might enhance

ISBN: 978-3-9503110-2-0 (CD-ROM); ISBN: 978-3-9503110-3-7 (Print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

accessibility to divergent destinations as well as improved itineraries and, last but not least, can lead to time efficiencies.

In the first instance it should be emphasised that users want an easy access to relevant information that would provide details concerning all modes of transport. It should help every traffic participant, from a cyclist to a driver to a metro operator, in a seamless transition from point A to B. It is imperative that information is reliable and 'up-to-minute', because otherwise it would not fulfil its task of assisting travellers in trouble and enabling a stress-free journey. A few examples of the nature of information needed would include schedules for different transport modes, envisaged delays, accessibility information, traffic congestion and availability of cycling paths. Providing such information would definitely solve the general confusion with currently often incomplete, lagged and unreliable information. Furthermore, it would also reinforce the image of stability and security of the transport system.

6.2 Need for Traffic Coordination

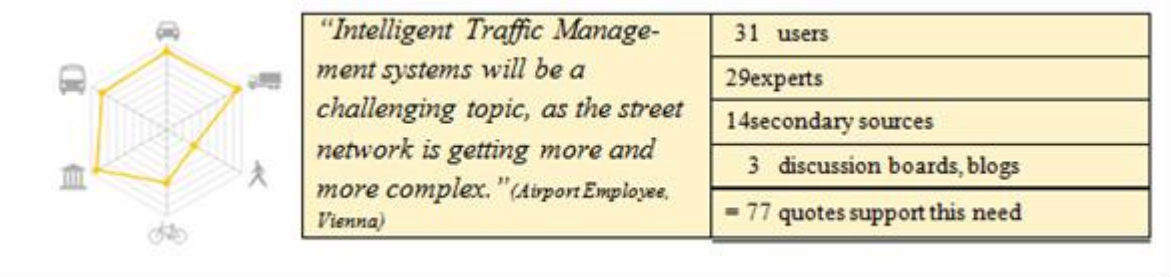

Fig. 6: Need for Traffic Coordination (own contribution)

Due to rapidly changing traffic conditions it is getting important to communicate on-site information as quickly as possible. Improved traffic management is essential for a better coordination of traffic participants. A reason for this is the constantly rising number of cars. Furthermore, the local situation in different cities should be taken into account when thinking about the management of traffic. The importance of this need is reflected by the fact that it affects all inhabitants of cities, such as pedestrians, cyclists, car drivers, logistic companies as well as public transport and the government. Therefore the need for better traffic management received the highest relevance.

Drivers are frustrated by a discontinuous traffic flow since time is getting more and more important in today's world. Also, logistic and service companies providing cities with goods and fulfilling important tasks lose time and money if the traffic management is poor. Especially emergency and breakdown services need to move fast from one place to another. Pedestrians and cyclists are also affected, as red traffic lights and traffic congestions slow them down as well. Thus, all traffic participants ask for coordination mechanisms which immediately adapt to changes. Therefore, also the government is interested in solutions to this need. A good and adoptive infrastructure for everyone is essential in order to assure a high quality of life in big cities.

Besides, parking is another important issue influenced by traffic management. Drivers looking for a parking space reduce speed and block other traffic participants. Therefore, better information on the availability of parking is also required.

6.3 Need for Inter-modality of Transport Means

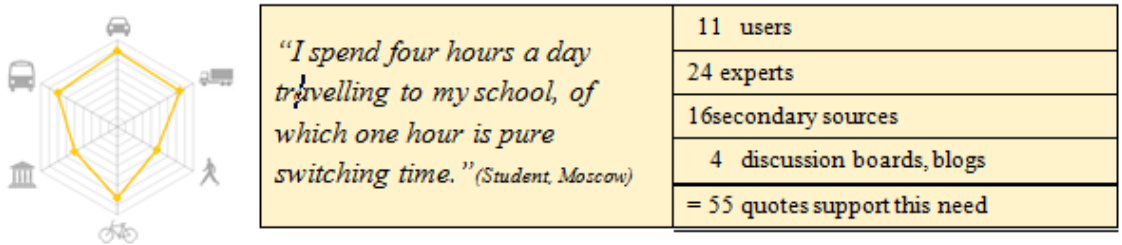

Fig. 7: Need for Inter-modality of Transport Means (own contribution)

Integrating various–public and private–transport modes and in turn minimizing the time spent both on travelling and changing means of transport was the idea behind intermodality. This need received the highest relevance of five out of five points and is relevant to all participants. However, we considered governments, public transport, private drivers and logistics service providers to be most affected.

As road networks become more congested, other various modes of transport will need to take an increasing role. It is important to help people to switch between private and public transport; therefore, a better link between these two is necessary.

Since travel distances are increasing in megacities, it is not possible to get to the destination using only one mode of public transport. However, those different modes are often not synchronized or not well planned - this can prevent people from getting where they want as fast as they could if everything worked smoothly. As several users expressed during the research, people are "... not going to use public transport instead of ... [their] car unless it is as convenient." Hence, an optimal integration of various transport modes should provide a complete door-to-door service for customer, because people do not like changing transport modes. They want to minimize time they spend on that and do not want to lose a single minute waiting for transport.

Intermodality can basically split up into four main demands: Firstly, traffic systems should be comprehensive. In concrete terms, travellers require a complete door-to-door service in form of one integrated system for all modes of transport. Secondly, schedules should be integrated, more flexible and aligned to allow reducing time. Thirdly, simplicity is important: people do not want to spend time thinking about which combination of transport to use, but rather demand a predefined solution. Finally, seamless switching options are important in order to provide barrier-free and time-efficient movement between transport modes.

People want convenient (parking) solutions in case they have to use their cars or bicycles to get to remote public transport stations that are not in walking distance from their homes. All of the above should be managed in order to increase public network attractiveness.

6.4 Need for Bridging the Last Mile

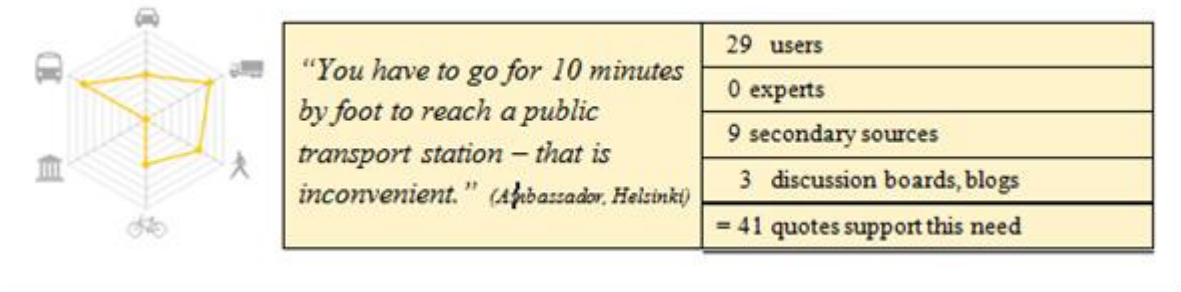

Fig. 8: Need for Bridging the Last Mile (own contribution)

The "last mile" need describes the need for more convenient and more efficient movement of people from a transport hub to their final destination. The need received a relevance of four out of five. Especially inhabitants of suburban areas and people facing physical difficulties are affected.

People are unwilling to walk long distances between transport stations and targeted final destinations, primarily due to personal safety and time issues. These issues are important for people who experience health issues or face the physical difficulty to carry different goods on their own. Also, the question of covering the last mile is especially acute where land-use patterns have moved more jobs and people to suburbs with a lower population density. These regions are often not within walking distance to existing public transportation options. Transit use in these areas is often less practical which in turn promotes either a reliance on cars resulting in more traffic congestion and pollution, or forces people to change their place of residence and move to a convenient, but more expensive area.

Traditional issues connected to the "last mile" need in public transit include the lack of feeder buses, of improved bicycling infrastructure as well as of an urban planning reform:

- Lack of biking infrastructure and bike-sharing solutions

ISBN: 978-3-9503110-2-0 (CD-ROM); ISBN: 978-3-9503110-3-7 (Print)
Editors: Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI

Biking is increasingly being looked at as an important mean to connect people to the network of transit systems. Efforts should include improving bike infrastructure such as creating dedicated bike lanes and building bike stations at transit hubs, encouraging employers to provide shower facilities and other bike friendly amenities, as well as effective highly adaptable bike sharing programs.

- Lack of adequate planning-based solutions

"Last-mile-barriers" could be eliminated by locating housing close to transit and providing other transit incentives.

- Lack of shuttles and feeder buses

Shuttle services that connect transit with commercial centres and/or places of employment could help overcome the "last mile" barrier.

During the next phase (=identification of suitable problem solvers within the trend fields) more than 600 people were directly contacted in order to find the most suitable lead users and experts. The communication media ranged from phone and Skype calls (approximately 700) to emails (roughly 300) and forum entries (about 100). Out of a total of 617 people as many as 110 people were interviewed at least twice, 39 lead users and experts were regarded as "perfect fits", and in the end 27 of them were invited for innovation workshops.

7 CONCLUSION

In the course of three workshops with nine lead users and experts participating at a time, nine innovative concepts were finally presented:

7.1 The Hive

The HIVE system (Humans use Information to choose Vehicles to travel in an Environmentally friendly way) allows traffic participants to adapt to special needs of the various traffic situations on the basis of information gathered via car2car communication.

7.2 JA–the Journey Assistant

JA is a software-program which allows its user to personalize his/her journey. Offering various journey opportunities to the latter, it does not only combine the different modes of transport, but also integrates the opportunities of the whole city into one system. Due to its self-learning intelligence it is able to adapt to the user's preferences.

7.3 E-chair

The e-chair, a small electric vehicle, serves its user to cover the last mile and longer walking distances within the city. Due to its shape and an integrated system which communicates with the environment, it allows the user to drive on walkways or crowded areas.

7.4 The HUG

Several interchange points, big hubs, will be implemented in each city. Each passenger will be connected to a traffic system which allows the passenger to opt–depending on the purpose of the journey and other important facts as the weather–for a personalized vehicle which brings him/her to the interchange point closest to his/her final destination. This hub station provides for further individualized vehicles to cover the last mile.

7.5 Why not Number One

"Park Now" or "Why Not Park Number One" is utilizing existing Kapsh ITS technology for optimizing the parking situation in a city. A central system is aware of space available in parking lots as well as the parking costs and will automatically lead the cars to the free parking lot closest to the driver's final destination.

7.6 Star egg vision

Traffic participants can become members of a traffic community. A Smart-phone app allows them to enter their upcoming journey. A dynamic system matches the needs of all members and suggests the most efficient journey and possible collaborations with others for each user.

7.7 S³

The goal of the S³ system is to provide open, reliable real-time traffic information for users and systems. S3 helps to better coordinate traffic in a city and will make transportation more convenient and time-efficient.

7.8 Move your Black Box Information System

Move your Black Box Information System is a system that helps optimizing an individual's route and the traffic flow at the same time by merging information on public and private transportation which can be gathered by implementing sensors on the road. Intermodal transportation solutions, time-efficient locomotion and the reduction of congestion shall form the positive output of the system.

7.9 Free Move–Move Free

This concept addresses the problem of inefficiently used road space resulting from rigid traffic management. Rather than offering an innovation to an existing infrastructure frame and rules, FreeMove innovates the frame itself. Traffic rules should be adapted to the needs of a user.

8 REFERENCES

AUSTRIAN INSTITUTE OF TECHNOLOGY. (2011). Inputs for a Roadmap towards Smart Cities in Austria.

BANISTER, D. (2005). Unsustainable transport: city transport in the new century. Routledge.

CARAGLIU, A., DEL BO, C., & NIJKAMP, P. (2009). Smart Cities in Europe. Serie Research Memoranda 0048, VU University of Amsterdam, Facult of Economics and Faculty of Business Administration and Econometric.

CHURCHILL, J., VON HIPPEL, E., & SONNACK, M. (2009). Lead User Project Handbook.

CHURCHILL, J., VON HIPPEL, E., & SONNACK, M. (2009, October). Lead User Project Handbook - A Practical Guide for Lead User Project Teams. Retrieved October 29, 2011, from http://mit.edu/evhippel/www/index.html: http://mit.edu/evhippel/www/Lead%20User%20Project%20Handbook%20(Full%20Version).pdf

COUNE, C. (2011). Environmentally Responsible Development. Retrieved 10 28, 2011, from Speech at the XXIV World Road Congress in Mexico City, 26 September 2011: http://www.internationaltransportforum.org/docs/pdf/CCmexico2011.pdf

DROGE, C., STANKO, M. A., & POLLITTE, W. A. (2010). Lead Users and Early Adopters on the Web: The Role of New Technology Product Blogs. Journal Of Product Innovation Management, 27(1), pp. 66-82.

LILIEN, Gary L., P. D. (2002). Performance Assessment of the Lead User Idea-Generation Process for New Product Development. Management Science(8).

GROB, G. R. (2009). Future Transportation with Smart Grids & Sustainable Energy. Retrieved 10 29, 2011, from http://www.iiisci.org/journal/CV$/sci/pdfs/XF463SC.pdf

HOUGHTON, J., REINERS, J., & LIM, C. (2009). Intelligent Transport–How cities can improve mobility. IBM Institute for Business Value.

IET-TRANSPORT FORUM. (2003). theiet.org. Retrieved 10 28, 2011, from http://www.theiet.org/forums/forum/messageview.cfm?catid=227&threadid=27934&enterthread=y

JEPSON Jr., E., & EDWARDS, M. (2010). How Possible is Sustainable Urban Development? An Analysis of Planners' Perceptions about New Urbanism, Smart Growth and the Ecological City. Planning Practice & Research, 25, 4, pp. 417-437.

KAMBITSIS, J. (2010). Glimpse the Wireless Future of Transportation. Retrieved 10 29, 2011, from Wired.com: http://www.wired.com/autopia/2010/02/intelligent-transportation-systems/

LAKHANI, K. (2006). Broadcast Search in Problem Solving: Attracting solution from periphery.

LAKHANI, K., & JEPPESEN, L. B. (2010). Marginality and Problem Solving Effectiveness in Broadcast Search. Organization Science, pp. 1016-1033.

LENZ, B. (2011). The Future of Mobility. Smart Cities 2011.

LITMAN, T. (2011). The Future Isn't What It Used To Be. Victoria: Victoria Transport Policy Institute.

LOFTHOUSE, G. (2004). Megacity Challenges–A Stakeholder Perspective. A research project conducted by GlobeScan and MRC McLean Hazel and sponsored by Siemens.

LÜTHJE, C., & HERSTATT, C. (2004). The Lead User method: an outline of empirical findings and issues for future research. R&D Management(5).

MILLARD, J. (2009). Government 1.5 - is the bottle half full or half empty? Retrieved 10 8, 2011, from European Journal of ePractice: http://www.epractice.eu/files/European%20Journal%20epractice%20Volume%209.3_1.pdf

MILLARD-BALL, A., & SCHIPPER, L. (2011). Are We Reaching Peak Travel? Trends in Passenger Transport in Eight Industrialized Countries. Transport Reviews, Issue 3 (31), 357-378.

MORICHI, S. (2005). Long-Term Strategy for Transport System in Asian Megacities. Retrieved 10 30, 2011, from Journal of the Eastern Asia Society for Transportation Studies, Vol. 6, p. 1-22: http://www.easts.info/on-line/journal_06/1.pdf

NICHOLAS, T. (2010). The Role of Independent Invention in U.S. Technological Development, 1880–1930. The Journal of Economic History, Vol. 70, No. 1.

FRANKE, N., E. v. (2006). Finding Commercially Attractive User Innovations:. The Journal of Product Innovation Management.
NZIOKA, R. (2011). Road accidents now a top agenda on world business. The Standard Media.
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT. (2011). Transport Outlook 2011: Meeting the Needs of 9 Billion People. Retrieved 10 17, 2011, from International Transport Forum: http://www.internationaltransportforum.org/Pub/pdf/11Outlook.pdf
OZMENT, J., & KELLER, S. (2011). The Future of Logistics Education. Transportation Journal, Issue 1 (50): 65-83.
PUCHER et al. (2005). Urban transport crisis in India. Transport Policy 12.
TAKEMOTO, N. (2009). Carbon-free green city planned near Shanghai. Retrieved 10 7, 2011, from http://www.cooltownstudios.com/2008/06/30/carbon-free-green-city-planned-near-shanghai
THE EUROPEAN COMMISSION. (2009). Smart Cities Workshop, 16–17 November 2009. Retrieved 10 30, 2011, from ec.europa.eu: http://ec.europa.eu/information_society/activities/livinglabs/docs/smartcities_workshop_report_v1_13l.pdf
THE EUROPEAN COMMISSION. (2011). European Initiative on Smart Cities. Retrieved 10 6, 2011, from http://setis.ec.europa.eu/about-setis/technology-roadmap/european-initiative-on-smart-cities
THE UNITED NATIONS UNIVERSITY AND WHO KOBE CENTRE. (2011). Aging Societies. Retrieved 10 22, 2011, from The Wisdom Years: http://wisdom.unu.edu/en/ageing-societies/
THE WORLD BANK. (2011). Global Economic Prospects. Washington: The World Bank.
THE WORLD BANK. (2011). Urbanization. Youthink! Retrieved 10 27, 2011, from http://youthink.worldbank.org/issues/urbanization
THUZAR, M. (2011). Urbanization in Southeast Asia: Developing Smart Cities for the Future? Regional Outlook, 2011/2012 Southeast, pp. 96-100.
UNITED NATIONS. (2007). World Urbanization Prospects. New York.
URBAN TRANSPORTATION TASK FORCE. (2005). Urban Transportation in Canada. Vancouver.
VON HIPPEL, E. (1986). Lead Users: A Source of Novel Product Concepts. Management Science, 32(7).
VON HIPPEL, E., S. T. (1999). Creating Breakthroughs at 3M. Harvard Business Review(September-October).
VON HIPPEL, E. (2005). Democratizing Innovation. Cambridge, Massachusetts: The MIT Press.
VON HIPPEL, E. A., Franke, N., & Prügl, R. (2008). 'Pyramiding': Efficient Identification of Rare Subjects. MIT Sloan Research Paper(4720-08).
WATSON, V. (2009). The planned city sweeps the poor away: Urban planning and 21st century urbanisation. Progress in planning 72: 51-193.
WINTERHOFF et al. (2009). Future of Mobility 2020. Arthur D. Little.