

## **Bus Stop 3.0 – Bus Stop of the Future – Multifunctional Centers for Regional Development**

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### **1 ABSTRACT**

“Bus Stop 3.0 – Bus Stop of the Future” represents the future of public transport stops and bus stops in particular serving as multi-functional centres for innovative urban and regional development. This project examines the demands and challenges related to the expansion of functions and comfort of a bus stop and integrates it as a meeting place for social interaction in its environment and thereby improves the usage and usability of public transport. “Bus Stop 3.0 - Bus Stop of the Future” is analysing technical specifications and wishes to upgrade normal bus stops to local and regional communication centres. The research is conducted within the framework of a Living Lab in the city of Schwechat where various scenarios of future bus stops were developed.

To prepare and look at the current “State of the Art”, a Geographic Information System (GIS) was used to collect, analyse and visualize the state of the art on public transport with respect to socio-demographic attributes and location information. Wishes and needs for public transport and the wanted specific user requirements on bus stops of public transport users as well as of non-public transport users have been evaluated by an online questionnaire and focus groups and are presented in the final documentation. Within the project, a Best Practice Database (BPD) has been developed. About 110 national and international examples show implementations on bus stops for innovative meeting and communication places as well as the needed technical infrastructure or as connection points and charging stations for e-mobility. Numerous practices provide interactive features, allowing riders to explore routing maps, browse community message boards and given the internet connectivity by wifi. Independent electrical power for these features can be gathered, for example via photovoltaic cells embedded within the bus station or by vertical or horizontal wind generators. Any number of other information services (from local supply companies, tourism, public authorities, transportation authorities, on demand taxi services) can be offered as well at the “Bus Stop of the Future”. Last but not least, a modular concept of a “Bus Stop 3.0 - Bus Stop of the Future” has been designed.

The `Living Lab Schwechat` served in the development of scenarios from the theoretical and real introduction of possible prototypes for an intelligent bus stop.

### **2 STATE OF THE ART**

Most attempts to design intelligent bus stops are concerned with customary electronic passenger`s information systems, which announce the departure of the next means of transportation and indicate, perhaps, a little additional information or advertisement. Nowadays the real classical bus stop exists of a stand with a time table, a sign of identification and a bus shelter with seats. Often lighted advertising is part of the bus shelter (for example the “Citylights” at the bus stops in Vienna and its surroundings).



Figure 1: Current Bus Stop in Schwechat, Main Square (Source: own illustration, CEIT Alanova, 2009)

Features of a well designed bus stop should include:

- Safe and direct ways to all areas of access at a bus stop

- Enough waiting area with the possibilities of sitting and/or leaning and/or take shelter
- A wide range of information serving
- Enough lighting
- Comfortable and accessible possibilities of entrance
- Guidance system for visually impaired people

In cities you can find on frequently used bus stops time table displays, which show the passengers the waiting time of the next bus (so called dynamical passenger information system). More statically or dynamically services are usually not available, just the opposite occurs: Many bus stops don't have any bus shelter and/or lighting and/or seats.

All of this is basically a static part of the bus stop with no ability for users to interact with the surrounding environment e.g. other customers, local business or communities.

### 3 THEMATIC MAPS TO ANALYSE AND VISUALIZE INFORMATION AT “BUS STOP 3.0”

Geographic Information Systems (GIS) serve many purposes, among them are to collect and store data, to analyse and visualize information. The use of GIS in “Bus Stop 3.0” focuses on the analysis of the bus stop itself by (geo)locating bus stops and bus line frequencies as well as on visualizing the sociodemographic environment. Furthermore, a combination of qualitative (questionnaire) and quantitative (demographics) data has been employed to set the stage for future spatialization processes and their visualizations. For example, the questionnaire's result on well perceived stops and not so nice ones is available for querying in an IMS environment as in the Figure 2 for Schwechat is shown below.



Figure 2: Well perceived (green) and not well perceived (red) Bus Stops (Size indicating the numbers mentioned); Results from questionnaire (Source: own illustration, Geologic Dr Benedikt, 2009)

A main advantage of using a spatial information system, like a GIS in the context of “Bus Stop 3.0”, is to collaboratively design and allow to research the living environment where these bus stops lie in.

In the future GIS will be developed as a Spatial Monitoring System on the effects of technological innovation on the sociodemographic environment. It will focus on tasks, like keeping track on how many families are attracted by bus stop innovations, how many companies are additionally established, what kind of technological usage is appropriate for students and etc. It is designed to allow the city's planning institutions to closely follow the usage and development of a bus stop and its surroundings and eventually move bus stop locations as well as to enhance the quality of citizen participation through technologically enabled interaction at “Bus Stop 3.0”.

## 4 WISHES AND NEEDS ABOUT A “BUS STOP OF THE FUTURE”

### 4.1 Online Questionnaire

To interact with bus stops using state of the art technology in general and mobile devices in particular is essential for a “Bus Stop 3.0”. In 2009, an online questionnaire was started in spring with the duration of two months, where users and potential customers were invited to participate. Issues were set for the general use of a bus stop as well as the possible use of new technologies. 504 people answered the online questionnaire (in total 549 questionnaires including the paper questionnaire). Different web pages provided the online-link to the questionnaire (for example the webpages of BMVIT/ways2go, VOR - Verkehrsverbund Ostregion, City of Schwechat, Verein CORP – Competence Center of Urban and Regional Planning and the research institute CEIT Alanova).

The poll ratings reflect the discontent with the state of the art (60% feel unpleasant waiting at a bus stop). Reasons for the discontent for example are the timeliness of the busses, less cleanliness and safety. Only 6% supported the need of technology at a bus stop. Obviously those polled could hardly imagine, that a bus stop could be more than a waiting area, where you are usually only a few minutes waiting for the bus.

The questionnaire focused on different subjects to be evaluated:

- Attitudes to the bus system respectively to the public transport
- The usage of a bus and its needs
- The usage of a bus stop and its needs
- Current intensity of using Information and Communication Technology (ICT)
- Attitudes of possible developments

In addition to the wishes of “more seating accommodations” and “dynamical passenger information system”, also “ban of smoking”, “better weather protection” and “better lightning system” had been addressed. Also creative ideas, like the possibility of heating in the wintertime or cooling in the summer, were called.

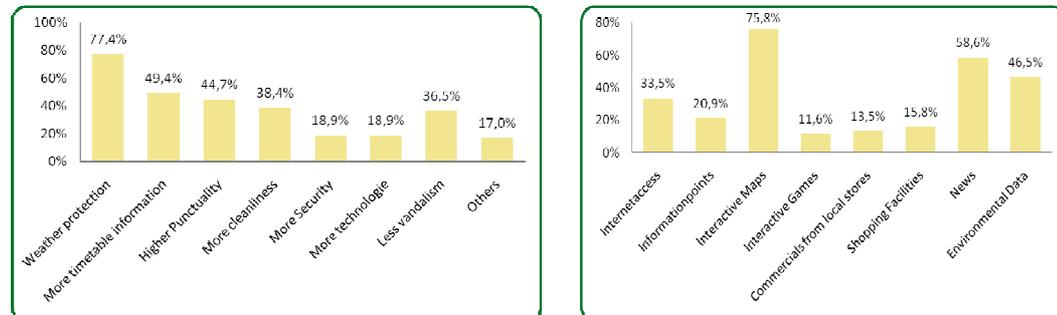


Figure 3: Improvement suggestions of wishes and needs at a bus stop (in %) (Source: own illustration, CEIT Alanova, 2009)

The called demands are the same through the different age classes, which means the wishes are align with the improvement suggestions.

### 4.2 Focus Groups

The focus groups increased the understanding of the user requirements for the online questionnaire. The target groups and the result of their needs and wishes for a “Bus Stop of the Future” are:

- Students: Mostly called were “seating accommodation”, “food supply”, “passenger information system”, “infoscreen” and the “availability of free internet (handy)”.
- Senior citizen: Their wishes for a future bus stop were “infoscreen”, “weather protection” and the “current dates of events in the community”.
- Entrepreneurs showed a great interest in new services at bus stops, since their target groups can be probably reached with appropriate advertisement. At a bus stop an advertisement can be pleasant and the acceptance is higher, when waiting for the bus.

The people of the focus groups were citizens or companies in the `Living Lab Schwechat`. Such a `Living Lab` allows to correspond to the knowledge of the `research citizens` as well as their personal wishes, images and ideas. This was very helpful for designing a customer-friendly, future product like “Bus Stop 3.0”.

## 5 NATIONAL AND INTERNATIONAL BEST PRACTICES

In addition to the validation of the results of the survey and of course to discuss possible future features of “Bus Stop 3.0”, so called national and international Best Practices were collected and analysed and documented in a database. In that way it was possible to design a modular concept of a “Bus Stop of the Future” and to create visual examples of a “Bus Stop 3.0” prototype.

About 110 examples of Best Practices have been collected and classified into seven different categories (design, shopping, energy supply, ICT, routing, games and accessibility). The Best Practices range from designing a concept to implement a project/prototype. Furthermore some features, which are not implemented at a bus stop yet, were put in the database because of relevance of “Bus Stop 3.0”.

With about 50 examples of Best Practices of information and communication technology (ICT) applications, ICT tools are an integral element of “Bus Stop 3.0”. Because of that, such ICT applications are discussed in this paper.

A variety of software and hardware solutions are currently available for functions ranging from real time passenger information, internet access and digital signage to location and context based information and guidance systems for visually impaired passengers. These various applications need only be integrated to provide the functionality identified for the „Bus Stop 3.0” prototype. Today’s ICT solutions are largely driven by the Internet. With this in mind, both wired and wireless solutions can be considered for delivering connectivity to “Bus Stop 3.0”. However, in terms of cost and flexibility, the most promising solutions are wireless technologies including WiFi Mesh, WiMAX and LTE. These solutions can be applied in an ad hoc fashion to deliver connectivity to specific bus stops or “Bus Stop 3.0” itself can become an element of broader wireless initiatives including citywide wireless projects.

### 5.1 The Bus Stop as an information point

A number of cities offer public transportation information including route planners, timetables, disruption information, real-time tracking, ticketing, etc. This information is made available at displays mounted at public transportation stops. Services such as „Quando” for Vienna, Lower Austria and Burgenland and “Scotty” bring public transportation to the Web and to the smart phones of travellers. Travel information services are also becoming available to the visually impaired. The „RAMPE Project”, for example, is an interactive, acoustic Information System for a better mobility of blind people. A number of Austrian cities (Salzburg, St. Pölten and Graz) offer audio departure information to visually impaired by pressing a button.



Figure 4: An interactive touch screen on the “Opera” bus stop in Paris offers a digital map to the passengers. (Source: [http://www.lepost.fr/article/2010/01/30/1915197\\_abri-bus-multimedia-a-l-opera-2-plus-de-details.html](http://www.lepost.fr/article/2010/01/30/1915197_abri-bus-multimedia-a-l-opera-2-plus-de-details.html), 2010)

Regardless of the technology, advertising can play a key role in funding the delivery of ICT services to “Bus Stop 3.0”. Digital signage is a fast growing medium that allows the delivery of targeted (by location, context and even demographics) ads to consumers. The signs are becoming increasingly sophisticated and interactive (e.g. games, information queries, e-coupons, etc.). Beyond digital signage, the explosion in the smart phone market has led companies such as Google, Nokia, etc. to develop GPS-backed applications that can deliver advertisements, sale information, and coupons based on users’ travel history and shopping habits.

## 5.2 The Bus Stop as a meeting point

Location-based services and the increasing number of smart phones are being combined with Web 2.0 applications to create new services. Location-based social networks are arising. They allow users to share information on places, social gatherings, music, street art and much more. Through services like Sociallight, FIND IT, Qype, Yelp, Whrrl and many more, users are leaving digital graffiti, digital sticky notes, georeferenced photos, reviews and a variety of other digital „crumbs” in their paths for their friends or the general public to retrieve.

In addition to supplying information and entertainment to passengers, ICT can help their experience waiting for buses to be more pleasant. CCTV monitoring can ensure their safety while sensors automatically manage lighting and weather protection at “Bus Stop 3.0”.

The reduction of barriers at bus stops is mostly realised through ICT and increased modern conveniences. Bus terminals, bus rapid systems (BRT) and rendez-vous bus stops are encouraging such developments. Bus stops for demand (“Bedarfshaltestellen”) encourage the usage of bus stops in rural areas.



Figure 5: Example for a Bus Rapid System in Bogota, Colombia (Source: <http://www.globalurban.org/Issue1PIMag05/MagHome.htm>, 2010)

## 5.3 The Bus Stop as a sustainable model

“Bus Stop 3.0” should incorporate energy saving technologies such as LED lighting and low power ICT solutions. Moreover, the addition of renewable energy technology cannot only reduce the overall carbon footprint of the bus stop, but can also allow it to be sited in locations with limited or no external power sources. The main renewable energy sources that can be incorporated into “Bus Stop 3.0’s” design are wind and solar, with the latter more suitable to most locations. However, location will be a major factor in the effectiveness of such solutions in generating energy for the bus stop. The renewable energy supplying “Bus Stop 3.0” could be integrated into e.g. local or regional concepts of climate protection.

Where conditions are favorable for renewable energy, in addition to power lighting and ICT solutions, the energy can be used to allow travellers to charge their mobile devices while they wait. „Bus Stop 3.0” could also incorporate a charging station for an electro-scooter or -bicycle.



Figure 6: The „Solar Bus Stop in Freiburg, Germany, produces 1.700 kWh/year and its electricity is fed into the grid. (Source: <http://www.vag-freiburg.de/wir-ueber-uns/klimaschutz-bei-der-vag.html>, 2010)

Remarkable for all Best Practices is, that in urban areas there are the most innovations at bus stops and a further development in rural areas is still neglected. But in these rural areas the project team sees a great potential for converting a bus stop into a multifunctional center (legal discussions about the needed area of additional features of a bus stop could be excluded).

## 6 THE CONCEPT OF A “BUS STOP OF THE FUTURE”

Because of the evaluated needs of the user (analysis of the focus groups and questionnaire) and the analysis of the collected best practices a modular concept was developed. To this, different types of a “Bus Stop of the Future” were designed.

Basically all technologies used within the project are already available, technically possible and socially accepted. The pioneering innovation of “Bus Stop 3.0” is based upon a special linking of these technologies to support the interactivity and communication at a public transport stops to enhance social interaction in a local and regional community.

From the research results of the surveys and the analysis of the Best Practices following characteristics for a “Bus Stop for the Future” this can be appointed:

- Feature for orientation for the public transport
- Feature for orientation for urban and rural areas
- Place of information, communication and local supply
- Meeting point
- A protected, saved and convenient waiting area

Based on the research results a list of technical and non-technical features of a “Bus Stop of the Future” could be drawn. The “Bus Stop 3.0” prototype can be put together of six modules, which are:

- 1.Comfort
- 2.Information
- 3.Accessibility
- 4.Energy
- 5.Safety
- 6.Service

Because of the modular and flexible structure of the “Bus Stop” prototype, modifications for user-friendly and specific applications are possible. The modules and respective the components can be easily upgraded to the actual state of the art. Such an example of a “Bus Stop of the Future” is shown in the figures below:



Figure 7: „Bus Stop 3.0 - Bus Stop of the Future“ by day, night and bad weather, Schwechat, Main Square (Source: own illustration, CEIT Alanova, 2009)

Based on the state of the art (see Figure 1), the bus stop in Schwechat were visually converted to a prototype of “Bus Stop 3.0” with combining five of the six modules: 1. Comfort, 2. Information, 3. Accessibility, 4. Energy and 5. Safety. Additional features range from “more seats”, “video surveillance”, “weather protection” and “better lightning system” to modernizations such as “dynamical passenger information service” and “digital black board”, etc.

## 7 CONCLUSION

“Bus Stop 3.0” is a project aiming at the development of a bus stop as an interactive place to communicate as well as a location for advertising of local service providers. The concepts worked within this project were focused on both: the bus stop and its integration within the surrounding living places. The use of a bus stop is not limited to exiting or entering a bus but to interact with technology, services, information and, well, other customers. “Bus Stop 3.0” tried to escape the infinite loop of well known facts and well known resulting conclusions with regards to demographic development and technological usability. The project was supported by local politicians, decision makers, commercial institutions, public transportation authorities and the local community and schools in the City of Schwechat. An important part was played by the citizens, who participate in the project within the framework of a “Living Lab”.

All results of this project-study are presented in the final documentation, that will be offered by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT). A mid-term aim will be the involvement of the results of “Bus Stop 3.0” into existing traffic concepts and to be a sustainable contribution when using public transport.

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