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A European vision for more environmentally friendly buses

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ABSTRACT

This paper deals with *EBSF – European Bus System of the Future*, *3iBS – the Intelligent, Innovative Integrated Bus Systems* and *ZeEUS – Zero Emission bUs Systems*, three research projects funded by the European Commission, with the aim to develop a new generation of buses. The common task is to develop innovative solutions to increase the attractiveness of this mode and to operate more environmentally-friendly vehicles.

Key working areas are more comfortable layouts, advanced ITS-based solutions to improve operations, new engines designed to save fuel and the enhancement of the electric option. Concern for the environment lies behind the majority of these innovations. The innovations are tested in real urban environments and performance assessed through Key Performance Indicators. Within *EBSF* it was also possible to perform a Transferability Exercise (TE) to assess the theoretical exportability of the innovations to more urban contexts.

The research objective of this paper is to critically revise the projects' results and present them for further applications beyond the European projects field. Results thus far stressed contrasting aspects within a common vision for the development of a new generation of buses. Stakeholders are well aware of the need to comply with the European standards in the field of sustainable mobility. This is shown by the fact that the majority of them are becoming more environmentally aware about the need to renew their fleets. However, because of economical reasons they fail to consider any environmental concerns in the TE, even when these should be crucial in the transfer decisions.

Introduction

This paper deals with three projects funded by the European Commission within the 7th Framework Program and coordinated by UITP – Union Internationale des Transports Publics: *EBSF – European Bus System of the Future* (2008–2013), *3iBS – the Intelligent, Innovative Integrated Bus Systems* (2012–2015) and *ZeEUS – Zero Emission bUs Systems* (2013–2016). All are aimed at developing a new generation of urban bus systems adapted to the specificities of European cities. *EBSF* acted as a driver to increase the attractiveness and raise the image of bus systems in urban and suburban areas, by means of developing new technologies on vehicles and infrastructure in combination with operational best practices, and

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testing them in real operational scenarios within several European cities. *3iBS* is the natural follow-up of *EBSF*. By capitalizing on the results of *EBSF* and other bus system projects, *3iBS* is committed to stimulating research, exploiting bus system innovations, supporting deployment and implementation of key solutions, and exchanging knowledge on an international scale. Finally, *ZeEUS* aims at extending the fully-electric solution to a wider part of the urban bus network. The development of large capacity electric vehicles as well as the infrastructure able to provide the required charging energy is aimed at facilitating the market up-take of electric buses in Europe. Thus *ZeEUS* covers innovative electric bus solutions with different electric powertrain systems under demonstration in eight European cities. The related analyses and results will help develop guidelines and tools to support stakeholders in efficiently introducing electrified bus systems in European cities.

In an 8-year timespan, more than 70 main partners of international relevance are involved in the three projects (Table 1), covering all areas of expertise (from manufacturing, to operations, to research), geographical regions in Europe and size of cities. The work includes not only testing activities, but also standardization procedures, surveys involving experts and end-users (operators, passengers and drivers) and dissemination activities, as further detailed. Thus, the outcomes of all the three projects reflect the position of the main European stakeholders in this field and provide a vision on how to develop the bus of the future.

The contemporary situation

The need to fund three research projects to revamp buses in European urban areas is due to current mobility problems. Car dependency especially in terms of high motorization rates, space consumption and unsuitability to accommodate passenger flows in a sustainable way are behind this. On the other hand, buses, due to higher capacity, better environmental and safety performance can provide a more sustainable travel option, as will be further elaborated.

Towns and cities across Europe are facing growing mobility challenges due to a constant increase of passengers flows in densely populated urban areas. Urbanization has grown continuously over the past decades, counting for 74% of the European population residing in urban areas in 2011. This trend is expected to continue in the years to come, reaching a peak of around 82% of urban dwellers in 2050 (United Nations, 2012). Urban sprawl, re-location of activities to the outskirts and new mobility habits have resulted in chronic congestion throughout European cities. The average delay in minutes for one-hour journey driven in peak periods is 29 min (TomTom International, 2013).

Aggravating factors are the strong dependence on passenger cars also for covering small distances (Eurostat, 2013) and the still-too-high motorization rate (from 2006 to 2011, in the majority of the EU Member States such rates kept on increasing, and in 10 out of the 28 Member States one car per two inhabitants is available). It is not surprising then that passenger cars are dominant in the modal split across Europe, the average being, in the period 2003–2012, as follows: 7.0% rail, 83.8% passenger cars and 9.2% motor coaches, buses and trolley buses (Eurostat, 2014). At the same time, fuel combustion in transport accounted for 20.2% of the greenhouse gas emissions in the EU 28 Member States in 2011, since "*transport was the only source that presented an increase between 1990 and 2011 (+19%)*" (Eurostat, 2013:147). A last but not least aspect, usually less acknowledged, is represented by the space consumption due to the massive use of passenger cars. In urban areas, where space is scarcer and scarcer, an automobile consumes 285 m^2 min/pkm (including commuter parking), whereas a bus ranges from 17 m^2 min/pkm (if operating on a reserved lane) to 8 m^2 min/pkm (in mixed traffic), which makes the latter among the most space-efficient modes for travelling within cities (Bayliss, 2000).

Such few facts are sufficient to stress, once more, the unsuitability of car-dependent lifestyles. At the same time, public transport is accredited for being a smart solution to all of the above; since bus systems move around 50–60% of all transit passengers (30 billion per year) in the EU. This average pattern changes from a 50% share in large cities with multimodal networks up to 100% in smaller towns and medium-size cities. Buses have a major role to play: they are in the front line in competing with passenger cars for any travel and displacement of people within the city. Moreover, the newest generations of buses can be a very appropriate mode to meet needs in the field of environmental safeguards (in terms of energy efficiency, emissions and space occupancy) and operational effectiveness, for they can be more easily adapted to the different requirements of passengers and do not require heavy infrastructures (Tozzi et al., 2014). It is also worth remembering that buses are highly efficient passenger transport modes with low levels of fuel consumption even with modest levels of occupancy (Fig. 1), thus contributing to the reduction of CO_2 and other GHG emissions. Safety is one more point of strength for buses, as the related accident rates are very low if compared to other passenger transport modes.

Nevertheless, the level of satisfaction for public transport in European cities is very different, since it ranges from high percentages in many urban areas in Northern and Western Europe (Zurich 95%, Rostock 90%, Helsinki 89%, Vienna, Hamburg and Strasbourg 88%, Rotterdam and Rennes 87%, just to mention the top five positions) to very low ones in Central Eastern and Southern Europe (among these: Palermo, Naples, Ankara, Budapest), according to a study by the European Commission (2013). Dissatisfaction stems from poor performance such as regularity, punctuality, speed, comfort and design, which all contribute to the general modest attractiveness of this mode, if compared to other transit options. Moreover, although genuine innovations have taken place in the field of bus manufacturing over recent years, users are still far from perceiving them and therefore far from changing their perception about travelling by bus (Tozzi et al., 2014:2).

A paradigm shift is therefore needed. Underlying beliefs of expected discomfort, service irregularities, unattractive onboard travel experiences can be radically changed, provided an innovative transport system is supplied which combines passengers' desire for mobility, according to their own specific needs and expectations, the operators' economic requirements, and at the same time meeting general environmental needs.

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