PUBLIC BICYCLES: HOW THE CONCEPT OF HUMAN-ORIENTED "MOBILITY SHARING" TECHNOLOGY CAN INFLUENCE TRAVEL BEHAVIOUR NORMS AND RESHAPE DESIGN EDUCATION

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ABSTRACT

Although at the moment an excess of 500 public bicycle schemes of variable sizes operate in almost 50 countries worldwide, the impact of their use on travel behaviour and modal change have neither been studied extensively nor have been understood thoroughly as yet. This work negotiates the initial stages of an international research scheme that means to look into the attitudes and system user experiences (the latter only when it is applicable) that could define the design (or re-design) criteria for three public bicycle schemes in three cities of different size and culture. These systems are currently on three dissimilar operational phases spanning from bidding for funding to actually having a fairly successful system already in place. As a matter of fact, the choice of the three case study cities represent an effort to frame the dynamics of the bike-sharing phenomenon in a micro-scale (Drama, Greece, 50.000 residents), meso-scale (Gothenburg, Sweden, 500.000 residents) and mega-scale (Shanghai, China, 23 million residents) looking also into the attitude-shaping process before and after the implementation of a scheme. This project's didactic role is a twin one; it aims to reinforce education practice on sustainable mobilities design by using student projects as an apparatus for supporting research and promoting urban change in real societal terms and subsequently to integrate the findings of the research into future postgraduate and undergraduate course material. Thus, bike-sharing design, for the means of this paper, aims to serve as an academic platform for integrating and synchronising research and education by promoting a balanced and timely development of technological opportunities that capture the mobility needs of tomorrow.

Keywords: Public Bicycles, Bike-Sharing Schemes, Travel Behavioural Change, Sustainable Mobilities Planning and Design, Research-driven Design Education

1   URBAN TRANSPORTATION DESIGN AND DESIGN EDUCATION

Governments worldwide are committed to control the ever-rising levels of conventionally fuelled car use amongst their populations. This is due to a conscious attempt to secure that their societies may live in urban environments, which support development meeting the travel needs of the present without compromising the ability of future generations to enjoy the merits of liveable cities. In their armoury policy-makers have a variety of 'stick' and 'carrot' measures to tug and tempt people out of their cars, respectively. Of the former, demand-side measures could force people not to travel by car, or to travel by car less; of the latter, softer measures, which hope to persuade the car user to consider modification to their behaviour including improvement in alternatives [1].

Lately a rapid growth in the number, range and scale of voluntary travel behaviour change initiatives has challenged the assumption that modal shift is only possible through regulatory mechanisms [2]. This means that focusing on how to improve car alternatives is a key in any well-rounded urban strategy aiming to provide equitable transport. There is a need therefore, for design in general, and design education in particular, to be an integral part of reforming conventional transport regimes that have been based on the philosophy of "providing all necessary means of access to private automobiles". This could be achieved by introducing research-driven education, based on specific

real-life case study scenarios, that seek to expand the knowledge spectrum of young designers in terms of understanding alternative transport options; options that would serve the emerging reality for creating a more balanced modal share.

Such education should see design in a very distinctive way, which goes far and beyond its original role as a medium that guides product development to optimum levels of performance. Design needs to be re-defined in a way so that it becomes a shared responsibility process, where designers and the society as a whole, develop a sole agenda for user-centred technological innovation. This effectively means that design education would be utilised as a powerful medium to achieve this designers-society alignment, whereas design students could be a very important link bridging design with everyday life and people's specific urban requirements. Moreover, design should be associated not only with the delivery of a good transport mode in terms of producing a well-received product, but it should rather embrace a holistic approach for catering the needs of a road user-centred homogenous product-service system. This different orientation of approaching design could support a systemic educational approach to urban transportation that could progressively facilitate new knowledge generation. This "intellectual capital" will enable the transition from designing for an existing transport system, dictated by conventional car orientation, to designing for a transport system that prioritises alternative product system innovation [3].

More specifically, when design education negotiates urban transportation it should concentrate on studying, improving, expanding and delivering alternatives to car transport options that have the potential to support more sustainable mobility patterns. Public bicycles or bike-sharing could be the very definition of such a transport mode.

2 INTRODUCING PUBLIC BICYCLES

A bike-sharing system is a combination of bicycles that can be picked up and dropped off at numerous points across an urban area with an appropriate transport infrastructure built to accommodate their use. [4]. Bike-sharing systems have been introduced as a means to extend the accessibility of public transit services to final destinations in a way that promotes the development of sustainable and aesthetically pleasing urban environments that prioritise people over cars. By providing free or affordable short-term access to bicycles, these systems offer transportation that could eventually substitute short car trips with bicycle rides. This likely mobility scenario could help societies to alleviate road traffic congestion and moderate problems linked with unnecessary car usage like climate change, air and noise pollution, pedestrian injuries and deaths, declines in physical activity and obesity [5]. The most important function of such a scheme is the concept of "sharing" since individuals use bicycles on an "as-needed" basis without the costs and responsibilities of bicycle ownership [6]. This could initiate or reinforce the process of building a culture of shared responsibility for the "well-being" of the scheme and the city's transport system in general.

Recent experiences suggest that bike-sharing systems can act as a door opener for increased bicycle use [7] by being a "living" reminder that bicycle belongs to a city's streets. More specifically, public bicycles have the potential to increase the acceptance of cycling as a legitimate urban transport mode in cities that still lack a good level of bicycle use by introducing a new and attractive system experience. In cities that a good cycling mentality is already in place, a competent bike-sharing scheme could add a valuable element to existing mobility services; something that enhances the transport system's overall potential in terms of providing option value. A public bicycle scheme could work as an initial investment that could help cycling become part of a city's urban identity something that will progressively create the need for more investments aimed to improve bicycle-related infrastructure and services. A public bicycle scheme could also practically facilitate intermodal travelling.

3 AN INTERNATIONAL PLATFORM FOR BIKE-SHARING

This work means to describe an international research scheme examining the attitudes and system user experiences (the latter only in cases when this is a viable scenario) regarding public bicycles in three cities of different size. As a matter of fact, the choice of the three case study cities represent an effort to frame the dynamics of the bike-sharing phenomenon in a micro-scale (Drama, Greece, 50.000 residents), meso-scale (Gothenburg, Sweden, 500.000 residents) and mega-scale (Shanghai, China, 23 million residents) looking also into the attitude-shaping process before and after the implementation of a scheme. These systems are currently on three dissimilar operational phases. In Drama they still plan

the scheme and are actively bidding for funding it, in Gothenburg a successful scheme is already in place that has been massively expanded over the last three years, whereas in Shanghai public bicycles are still tried out on a smaller scale only in specific areas not centrally located and perhaps are more inclined towards tourist audiences. The analysis that follows purposely focuses on the issues referring primarily to the links of this public bicycle research with design-oriented transport education.

3.1 Case Study Gothenburg: Identifying and Eventually Replicating Success

Gothenburg is the second largest city in Sweden by population and the fifth largest in the Nordic countries with a city-based population of 519,400 residents. Gothenburg is situated on the Southwestern coast of Sweden and has a strategic geographical position in Scandinavia, being approximately half way between Copenhagen and Oslo. In terms of climate conditions, because of the moderating influence of the warm Gulf Stream, Gothenburg enjoys milder weather than other cities with similar high northern latitude. Gothenburg is a city with a relatively good level of public services in place, providing a wide range of transport options to its commuters. With over 80 km of double tracks, the blue iconic tram of the city is the largest light rail network in Scandinavia and together with the bus network form the basis of the public transport system. There are also daily boat and ferry services catering the needs of a city that is defined (even in terms of its own name) by river Göta. In early 2013, a road pricing scheme was introduced in the city centre to regulatory enforce in some respect modal change, while parking pricing is another measure that has been spread to all central and residential areas of Gothenburg for many years now [8].

With over 600 km cycling routes, Gothenburg provides an extensive bike road network that makes cycling a valid transport option for the city's commuters. Gothenburg has already in place Styr & Ställ, which is a self-service bike rental system, spread across 57 stations throughout the city centre with approximately 600 bicycles. The system can be accessed 24 hours a day and seven days a week. It is available between 1st of March to 31st of October. Technical support is open at working hours every weekday. In order to access the system, customers have to subscribe to a 3-day pass (10 SEK), a season pass (250 SEK) or special business subscription. As a matter of fact the season pass for year 2014 will cost even less (starting from 75 SEK). The usage price is free for the first 30 minutes to allow for people to experiment without any cost the system. The scheme is financed by the revenue generated from its users and from the commercial billboards placed throughout the city. Approximately 50,000 annual users signed up in 2012 for using this service; this number includes a large number of tourists and is not restrained only to daily commuters. Around 70,000 movements took place on a weekly basis at that time; movement is any case a bike is rented, returned or moved by the service staff from one station to another [9].

The work package referring to Gothenburg's potential for providing an advanced bike-sharing experience reflect a two-step process consisting of a postgraduate student research design exercise and a primarily quantitative online survey targeting the residents of the city in order to frame existing challenges within the first years of the Styr & Ställ's usage. In late 2012 seven teams of four to five young designers, all of whom participated in the Masters course Visual Brand Identity and Product Design being closely guided by the authors, were affiliated with designing an innovative hypothetical bike-sharing scheme for the city of Gothenburg, Sweden, that would have been an upgrade over the existing one. The goal of this course exercise was a dual one. It was designed to provide students with a learning experience that would allow them to develop a theoretical and empirical understanding of: a) how aesthetic and symbolic qualities of products can be used to support and develop the visual identity of brands and b) how human-centred design innovation could provide viable but the same time attractive answers to current (and future) needs for sustainable transport. The second goal of this project exercise was the collection of primary data, through the means of ethnographic studies and interviews with Styr & Ställ representatives and users, and with Gothenburg commuters in general, that would enable the authors to identify the advantages and disadvantages of the current system. On top of that the students designed visual upgrade scenarios for bike-sharing in Gothenburg discussing a lot of innovative ideas like: a) employing intelligent technology applications for improving the pre-service, on-board and post-journey experience, b) introducing fully electrical or pedal-assisting bicycles and c) integrating bike-sharing not only with a city's public transit or landscape but with its very own urban identity. Identifying the problems and opportunities that have been missed thus far, which restrain the scheme's potential to achieve wider societal acceptance, is the basis for producing an improved design approach that could lead to a bike-sharing system capable of attracting more users.

This process allowed this work's primary research tool (which is the online survey) to be timely informed and adequately centred around the real challenges reflecting the use of Styr & Ställ. This subsequent study is goaled towards identifying in a scientifically sound way the attitudes of people towards bike-sharing in general and towards Styr & Ställ in particular, whereas it also means to record the system user experiences of the people that have tried at least once the scheme. This would pragmatically enable the development of advanced human factors design concepts meaning to support the development of the Styr & Ställ system into a more user-friendly and thus societally acceptable means of transportation. The online survey has similar format and contains questions and sections easily comparable with the surveys delivered in Drama and Shanghai. This is a conscious research strategy choice so that the overall study could be cohesive and homogeneous. Another function of the Gothenburg study utilises students as an effective data collection medium but at the same time engages them actively in real research by having them circulating the online survey through their social media applications.

3.2 Case Study Shanghai: Learning from Past Mistakes

Shanghai is considered as one of the most rapidly transforming metropolitan environments in the world, with over 23 million inhabitants. In terms of population, it is the largest city in China and has been one of the fastest developing economies globally being the commercial and financial centre of mainland China with the busiest container port in the world. Despite a boosting local economy, the rapid urbanisation has created huge challenges for Shanghai. Environmental degradation, social sustainability and the urban growth itself are issues that need to be taken care of. High density is one of the main features of the city, with more than 3,600 people per km^2. The population has doubled during the last three decades and it is still increasing at a rapid pace. Diversity is another exceptional local characteristic. Shanghai is a global city with many different cultures and life-styles, which leads to consequences such as poor material supply, huge need for environment protection requirements, rising issues of public security and disrupted social equality. Increasing population also brings an increasing number of private vehicles and growing conventional fuel consumption. Since Shanghai is a city that looks to be in the frontiers of sustainable and inclusive urban development, it needs to continuously revisit its policies, its urban infrastructure and its built environment service provision that could produce social inclusion problems and have feasible design solutions in place to overcome any city-induced mobility related barriers [10].

Bike-sharing is among the transport interventions that actually are being prioritised by the Chinese Government in an attempt to revive the iconic image of China in terms of being "the kingdom of bicycle" [11, 12]. For example, Hangzhou Public Bicycle, located in a metropolitan area populated by nine million residents, is the largest bike-sharing system in the world already, with 66,500 bicycles operating from 2,700 stations (early 2013 figures). For the means of the 2010 World Expo, Shanghai launched a limited public bicycle programme that failed to transform to a citywide bike-sharing mode. Nowadays public bicycle schemes of much lesser scale than the size of Shanghai could dictate are running independent from each other in the districts of Minhang (the bigger one), Pudong, Baoshan and most lately in Shanghai's former French Concession targeting only tourists (initiated by Xuhui District's Tourism Bureau) [13]. Therefore, there are grounds to believe that there is a lot of yet unrealised potential for bike-sharing in Shanghai and a research study trying to indicate drivers and barriers to its acceptability could be a key for a more citywide user-centred public bicycle plan.

The Shanghai study aims, through the use of a primarily quantitative online survey targeting people commuting within the city's premises, to capture the public acceptance that a citywide bike-sharing programme could have. In a secondary stage the work could be also attempting to record the system user experiences of the people that have tried at least once the district-based schemes. Masters and Bachelor students of Tongji University's College of Design and Innovation will be distributing the questionnaire across the city being utilised as an effective data collection mechanism for the means of this work package. The students' involvement also has to do with assisting in the translation of the questionnaire and of the results that have a more qualitative nature. This research exercise will be linked potentially with a postgraduate design education module and could be assessed by their educational tutors so that it would contribute in the module's final mark for the students.

3.3 Case Study Drama: Starting Something New and Exciting

Drama is a city situated in the North East part of Greece next to the Greek borders with Bulgaria. It is the capital and the economic centre of the regional unit of Drama, which is part of the East Macedonia and Thrace region. Drama is distant from the Greek capital Athens (670 km) but relatively close to Greece's second largest metropolitan center Thessaloniki (158 km), whereas the closest airport and sea port are located in Kavala and Chrisoupolis 37 km and 68 km away from Drama respectively. Drama has a city-based population of 45,828 residents but the overall municipality population, which includes 14 suburban communities in close vicinity from the main city, is 58,944 inhabitants [14]. Until recently, the economy of Drama relied heavily on the local paper and textile-clothing production industries. However, these industrial production entities have either ceased their operations being victims of the Greek financial crisis and the steep competition from antagonists from abroad or moved across the border to Bulgaria in order to minimise personnel costs. This is something that has affected adversely the local economy drastically reducing employment provision. Recently, there have been efforts to exploit the rich local natural environment and to develop eco-tourism something emphasising the need for commitment to a more sustainable resource management strategy with mobility being one of those resources [14]. Drama despite its manageable size has some traffic congestion problems in its city centre due to their citizens' over-dependence on private vehicles. Public transport is only offered by the relatively unpopular bus services mainly used by students and older people and taxis.

Planning and subsequently implementing a small-scale public bicycle scheme, referring to a system of 50 to 60 bicycles in five stations spread in the most defining destinations of the city, is one of the newest additions to Drama's urban transportation strategic initiatives. Identifying the possible barriers that could reduce the public acceptability of a bike-sharing scheme and understanding thoroughly its potential for generating modal shift would enable the city to prioritise and customise the scheme's design requirements. Examining the attitudes of Drama's road users and tax-payers on cycling, bike-sharing and its suitability for Drama was therefore a timely and pragmatic need for producing user-oriented transport innovation.

The work package dedicated to Drama meant to fulfil this very need. It was founded on a primarily quantitative survey formed by 20 questions the majority of them employing 5-point Likert scales. The questionnaire was available in an online form and via one-page hard copies. The online survey was accessible through the official webpage of the Municipality of Drama, while paper-based questionnaires were distributed together with the water and sewage bill letters to many households in Drama and via the local organising team consisting among others by the first author, the president of the civil servants of the regional unit of Drama, a future Doctorate student in the field of transportation engineering and a number of undergraduate students. This engagement was a characteristic example of linking research with research-driven education since a student preparing to pursuit PhD studies had the opportunity to experience, at first-hand, a wide range of research design and data collection challenges and learn how to tackle them in real terms. The high-school, college and the local technical University's students that were actively involved in the distribution of the survey and also the student population that could be interested in pursuing research in the future have been invited to participate in a series of workshops/visualisation clinics that are planned for the dissemination of the work (reflecting the statistical analysis of 640 fully completed questionnaires) to the people of Drama. An event for presenting the initial findings of this work in the City of Drama and the local schools was delivered on May 2014 where the pre-Doctorate research student had a considerable engagement.

4   CONCLUSIONS

Bike-sharing is an inner-city travelling mechanism that provides a man-powered, and in some cases an electrically-motored mode, which means to replace conventionally fuelled car trips with bike rides. This is a modal change aiming to create less polluting and congestion-free road user experiences. In addition, this urban mobility system is based on the concept of "sharing" that is about disengaging private ownership from the actual usage of a vehicle, something that in principal could be providing flexibility and an equitable means of access to cycling. Nonetheless, this "sharing" notion also creates the need for the users to co-exist and co-function harmoniously in a system that they can see as "their own local system". Thus, a bike-sharing scheme is also an apparatus for promoting a philosophy of shared responsibility for catering the transport related needs of urban societies. Alternative to car

mobility in general, and vehicle-sharing schemes in particular, have a central role to play in the future of sustainable cities, but it is only through the understanding and acceptance by the people that these will succeed [15]. By engaging students in this process of co-creating an "understanding" framework (or in this case even a "sharing responsibility" one) this work influences a new generation of designers to be part of a timely and meaningful educational platform for dealing with urban transportation challenges. Crafting more transparent sustainable urban development pathways is more achievable if education becomes, in pragmatic terms, the intermediate step between research and design practice and students become the link that relates the design process to the society.

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