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Understanding the diffusion of public bikesharing systems: evidence from Europe and North America

Stephen D. Parkes [a], Greg Marsden [a,*], Susan A. Shaheen [b], Adam P. Cohen [b]

[a] Institute for Transport Studies, University of Leeds, Leeds LS2 9JT, United Kingdom
[b] Transportation Sustainability Research Center, University of California, Berkeley, Berkeley, CA 94720, United States

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ABSTRACT

Since the mid-2000s, public bikesharing (also known as "bike hire") has developed and spread into a new form of mobility in cities across the globe. This paper presents an analysis of the recent increase in the number of public bikesharing systems. Bikesharing is the shared use of a bicycle fleet, which is accessible to the public and serves as a form of public transportation. The initial system designs were pioneered in Europe and, after a series of technological innovations, appear to have matured into a system experiencing widespread adoption. There are also signs that the policy of public bikesharing systems is transferable and is being adopted in other contexts outside Europe. In public policy, the technologies that are transferred can be policies, technologies, ideals or systems. This paper seeks to describe the nature of these systems, how they have spread in time and space, how they have matured in different contexts, and why they have been adopted.

Researchers provide an analysis from Europe and North America. The analysis draws on published data sources, a survey of 19 systems, and interviews with 12 decision-makers in Europe and 14 decision-makers in North America. The data are examined through the lens of diffusion theory, which allows for comparison of the adoption process in different contexts. A mixture of quantitative and qualitative analyses is used to explore the reasons for adoption decisions in different cities. The paper concludes that Europe is still in a major adoption process with new systems emerging and growth in some existing systems, although some geographic areas have adopted alternative solutions. Private sector operators have also been important entrepreneurs in a European context, which has accelerated the uptake of these systems. In North America, the adoption process is at an earlier stage and is gaining momentum, but signs also suggest the growing importance of entrepreneurs in North America with respect to technology and business models. There is evidence to suggest that the policy adoption processes have been inspired by successful systems in Paris, Lyon, Montreal, and Washington, DC, for instance, and that diffusion theory could be useful in understanding public bikesharing policy adoption in a global context.

1. Introduction

Public bikesharing systems as an innovation have become increasingly popular in recent years with a significant portion of this growth occurring over the past decade. These systems are open to the public and serve as a form of public transportation. Their origins can be traced to Europe, but they have since spread across the globe with systems deployed in Asia, Australia, and North and South America (DeMaio, 2009; Shaheen et al., 2010). This growth leads us to consider what role such services may play in future transport systems.

Diewald (2001) identifies an innovation as the development and application of something new. This can be the combination of a series of discrete pre-existing components into a new system. He suggests that two separate processes need to be considered. Research generates the new products, materials, and practices, while "technology transfer" is what enables implementation. In the context of this paper, the innovation is the combination of bicycles with secure storage and electronic reservation/payment systems in the form of information technology (IT)-based public bikesharing systems, the pathway to which is described further in Section 2.

Technology transfer is the movement of know-how among individuals with institutions or companies. In the field of public policy, the technologies that are transferred can be policies, technologies, ideals or systems; this is typically referred to as "policy transfer" (Dolowitz and Marsh, 2000; Marsden et al., 2011). Notions of policy transfer are of potential significance in understanding how bikesharing systems spread. While structural or formal institu-

* Corresponding author. Tel.: +44 (0)113 3435358; fax: +44 (0)113 3435334.
E-mail address: G.R.Marsden@its.leeds.ac.uk (G. Marsden).

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tional factors have been shown to be important in determining policy adoption in different contexts (Banister, 2003), it is argued that the movement of policies needs to be understood much better through studying the role of actors in the system (McCann, 2011; Peck, 2011).

Diffusion theory considers the way in which innovations spread through social systems and is important to the study of the spread of public bikesharing over different continents (Rogers, 2003). Almost 50 years of research in diffusion theory across many disciplines identifies some strong recurring themes. Within different policy or practitioner communities there are typically individuals (or organizations) that seek to adopt new policy ideas before they achieve widespread acclaim (e.g., in transport one could consider London's decision to adopt a congestion charging zone as one such decision). Some of these individuals or organizations are seen as "different" and therefore do not connect well to other practitioners or networks to spread their knowledge. Some well networked individuals or organizations that mix with both the innovators and the mainstream community exist; they are critical to demonstrating and disseminating new practices. The "mainstream" adopters can be further classified as "imitators" or "laggards" depending on the timescales over which they subsequently adopt an innovation, although it is a matter of empirical research to establish whether the "imitators" or "laggards" are losing out from later adoption or are making a pro-active choice to reject (perhaps less desirable) innovations. The theory puts social interactions to the fore in explaining knowledge transfer – consistent with organizational learning theory (Boonstra, 2004) and situated learning (learning that occurs in an applied environment) in facilitating the application of practices.

Diffusion theory, however, is better at explaining how an innovation diffuses rather than why it was selected and successful in the first place. Indeed, successful examples populate the evidence base rather than failures or those that achieved only small-scale application (Rogers, 2003). The reasons for adoption are complex and depend on local circumstances. It is likely that innovations will not be equally relevant to different circumstances, and Rogers (2003) highlights the "matching" stage as being important in organizational adoption decisions. Multiple solutions might also be applicable to a particular problem, in which case diffusion will be affected by the extent to which local preferences steer the selection of one system or policy over another (for example light rail versus heavy rail or bus rapid transit). The literature suggests that policy innovations are most likely to be adjusted and tailored more specifically to local needs by early adopters who take a more pro-active role in the policy learning process (Westphall et al., 1997). By contrast, later adopters tend to adopt policies as a response to pressure to do so and are more likely to accept the most common practices (Westphall et al., 1997; DiMaggio and Powell, 1983).

Diffusion theory has been used for a limited number of explorations of planning and transportation policy. Kern et al. (2007), for example, examined the extent to which cities belonging to different regions of Germany had adopted the United Nation's sustainable development policies by adopting a Local Agenda 21 agreement in one of the few organizational diffusion studies with a strong transportation connection. As of June 2006, 2610 local authorities (around 20%) had initiated Local Agenda 21 policies, and the numbers seem to have reached a plateau, perhaps related to a post-Kyoto decline in climate change support. The Local Agenda 21 case study found the S-shaped adoption curve typical of innovation diffusion. Kern et al. found that "the local authorities' capacities (size, wealth, political institutions, and social capital) and location appear to be crucial for Local Agenda 21 diffusion. Local Agenda 21 pioneers tend to be middle-sized or large cities" (p. 610). State capitals and university towns were often pioneers. Thus, it is important to study what types of cities choose to adopt public bikesharing and in what way.

To explore the adoption patterns of bikesharing systems, this paper begins with a description of public bikesharing and discusses how they have evolved over the past few decades. Please note that community-based bikesharing systems, such as those deployed on college campuses, employments sites, and hotels, are not covered in this paper. There has been a significant increase in uptake of IT-based public bikesharing systems in Europe, North America, and Asia. Next, the methodology employed in this research is presented. The study draws upon written reports, questionnaires, and telephone interviews to maximize the understanding of the systems' location, their evolution, and their adoption. To explore the potential of bikesharing as a possible broader global policy innovation, the paper reports data from Europe and North America. The results establish an analysis of the speed and extent of the spread of the systems, which bring together data from a variety of published sources and feedback from system operators and/or cities that have such systems. Next, we describe factors that appear to impact the decision to adopt such a system before discussing the extent to which public bikesharing has the potential to grow beyond a niche market (a more narrowly defined group of end users than the mass market).

2. Public bikesharing system evolution

The principle of bikesharing systems is simple: bikesharing users access bicycles on an as-needed basis. Public bikesharing stations are typically unattended and concentrated in urban settings. They provide a variety of pickup and drop-off locations, enabling an on-demand, very low emission form of mobility. The majority of bikesharing programs cover the costs of bicycle maintenance, storage, and parking (similar to carsharing or short-term auto access). Trips can be point-to-point, round-trip, or both, allowing the bikes to be used for one-way transport and for multi-modal connectivity (first-and-last mile trips, many-mile trips, or both) (Shaheen et al., forthcoming; Shaheen et al., 2012a). The last mile refers to the distance between workplaces or homes and the public transport stops where users have disembarked (Shaheen et al., 2010). If these distances are too great to walk in a reasonable time, bikesharing offers users an option to help them complete their journey.

Generally, trips of less than 30 min are covered through a daily, monthly, and annual pass at no extra charge. They can pick up a bike at any dock by using their credit or debit card, membership card, or key, and/or a mobile phone. When they finish using the bike, they can return it to any dock (or the same dock in a round-trip service) where there is a spot and end their session. By addressing the storage, maintenance, and parking aspects of bicycle ownership, public bikesharing encourages cycling among users who may not otherwise ride bikes. Additionally, the availability of a large number of bicycles in multiple dense, nearby locations frequently creates a "network-effect," further encouraging cycling and, more specifically, the use of public bikesharing for regular trips (e.g., commuting and errands) (Shaheen et al., 2012a).

Bikesharing systems emerged in the mid-1960s with the introduction of the 'white bikes' of Amsterdam in the Netherlands (DeMaio, 2009; Shaheen et al., 2010). This first-generation system consisted of a number of bicycles that were painted white and distributed around the city to be used by anyone, free of charge. Only a limited number of first-generation systems existed, and their success was restricted by the lack of security for the bikes, which meant that they were frequently stolen.

The general failure of first-generation systems was eventually met with the emergence of a second-generation that began to