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Anticipating transitions beyond the current mobility regimes: How acceptability matters

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ABSTRACT

Today's car-based transportation systems require a transition toward sustainability. This is particularly the case in suburban areas, where the costs for introducing a new transportation system are high due to the low population density. At the same time the negative externalities of the current mobility regime – such as health costs and congestions – are increasing rapidly. Based on expert interviews with car manufacturers, transportation authorities, environmental groups, and scientists we identify two visionary characteristics of future, more sustainable transportation systems: automated driving and sharing. Using these two characteristics, we apply the scenario-axes technique to develop four mobility scenarios for a suburban context that range from business-as-usual to a radical and more sustainable one. In an evaluation with ten criteria that measure a scenario's performance from a user perspective, the radical scenario performs worst since it does not meet current individualistic user requirements. Our findings suggest that lock-ins of users' expectations act as barriers for the diffusion of novel transportation systems. These barriers cannot be overcome by technological innovations and regulation alone. Hence, we call for innovative arenas, wherein technology and user acceptability could co-evolve.

1. Introduction

In the course of the 20th century, automobility has become the dominant mode of transportation (Urry, 2004). At the same time, car-based transportation systems are responsible for a variety of negative environmental impacts, both on a global and local level. These include noise, air pollution, the emission of greenhouse gases, or fragmentation of ecologically valuable land (Urry, 2004; Moriarty & Honnery, 2008; Meyer, Kaniovski, & Scheffran, 2012). Particularly in thriving, densely populated urban and suburban areas, the unwanted effects of these transportation systems, such as congestion, increased health costs, and opportunity costs for land use, are increasing steadily (Figliozzi, 2011; Yin & Lawphongpanich, 2006). Thus, further growth in the transportation sector threatens to lead to a cutback in life quality, particularly in these densely populated areas (Knoflacher, 2009; Newman & Kenworthy, 1999). In addition, the current mobility regimes' dependence on fossil fuels, along with the threat of possible resource shortages (Aftabuzzaman & Mazloumi, 2011), intensify the need for a radical transition of contemporary transportation systems toward more efficient and sustainable states. A transition can be

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defined as ‘‘a shift from one socio-technical system to another, i.e. a system innovation’’ (Geels, 2005, p. 682). This requires changes in the socio-technical regime, which includes both technical and non-technical elements, such as firms, the policy framework, and user behavior (Nykvist & Whitmarsh, 2008). In transition studies, *radical* refers to fundamental political or social reforms of current regimes. The need for a transition has not only been recognized by science (e.g., Kahn Ribeiro et al., 2012) but also by many governmental decision makers; for instance, in Switzerland (UVEK, 2011), the Netherlands (Kemp & Rotmans, 2004), and relevant corporations in the transportation and energy sectors (WBCSD, 2004).

In many large metropolitan areas, a stepwise shift from car-dominated transportation is already underway. The high population density in inner-city areas allows for a high capacity utilization, which increases the economic attractiveness of investments in public transportation infrastructure (Garcia-Palmorares, 2010). However, in suburban areas, the implementation of mass transit systems is more expensive (Travisi, Camagni, & Nijkamp, 2010), and a denser schedule is often only run during rush hours due to the lower population densities. But as these areas, which are often referred to as *urban sprawls* at the fringe of city regions, are constantly growing in size in many regions worldwide (ARE & SECO, 2011; Garcia-Palmorares, 2010; Jaeger, Bertiller, Schwick, & Kienast, 2010), they suffer more and more from the negative impacts of car-based transportation systems. Furthermore, the absence of a densely meshed public transport service often results in a last-mile problem (Chao, Gong, & Fahui, 2010), meaning that many citizens lack access to hubs for long-distance public transportation, such as train stations. Hence, people tend to rely on automobiles, both for commuting and for leisure transport, to access agglomeration centers. Thus, a transition of the suburban transportation system is a particularly challenging endeavor.

There are a number of visions for alternative transportation systems that address some of the problems of conventional, car-based transportation in suburban areas. These include technical solutions, such as automated vehicles (e.g., like the *Cybercar* showcase in La Rochelle, France; see Nashashibi, 2011), and organizational innovations, such as denser and smarter schedules for public transportation, or paratransit systems, i.e., public transportation without fixed routes and schedules (Vuchic, 2007). For a potential implementation of any of these novel transportation alternatives, technical and legal challenges (e.g., questions of liability in case of an accident) need to be overcome. In addition, cost constraints as well as the expectations and acceptance of potential users must be considered. Furthermore, there is uncertainty with respect to the future development of all these factors. Against this backdrop, tangible descriptions of plausible development pathways for a transportation system may provide guidance for the characterization and assessment of its different future states (Costanza, 2000). This is why *visions* may play crucial roles in transition processes (Kemp, Schot, & Hoogma, 1998). Such visions are often articulated in an intuitive way, drawing from individuals' subjective experiences and emotional reactions (Dane & Pratt, 2007; Trutnevyte, Stauffacher, & Scholz, 2011). They can be seen as possible and desired states of the system's future that are neither developed through a well-defined methodology, nor based on a specific scientific theory (Van der Helm, 2009). Yet, when developed and shared among a group of stakeholders, these visions can support the development of a common understanding of complex issues and stimulate goal-formation processes. They may also foster consensus among a range of key stakeholders, such as scientists, politicians, and technology developers (Dierkes, Hoffmann, & Marz, 1996; Eames, McDowall, Hodson, & Marvin, 2006; Williams & Edge, 1996). In particular, integrating the expertise and perspectives of different transportation system stakeholders ensures that a vision does not focus narrowly on a single technology; rather, a broader system perspective is taken. Stakeholder engagement also provides an initial validation of the plausibility of the vision. Otherwise, a more structured procedure would be required, where desirable visions are first developed in an intuitive process, and then assessed analytically based on their feasibility (as, e.g., done by Trutnevyte et al., 2011).

Current research on the promotion of more sustainable transportation systems follows two main lines. One is technology-centered (e.g., Farla, Alkemade, & Suurs, 2010; Baggen & Aben, 2006), while the other focuses on policy-based approaches for fostering innovation and the diffusion of new technologies (e.g., Shiftan, Kaplan, & Hakkert, 2003; Kemp & Rotmans, 2004; De Greene, 1994; Schot, Hoogma, & Elzen, 1994; Rotmans & Loorbach, 2009; Loorbach, 2007; Van Geenhuizen & Nijkamp, 2001). Some scholars have also considered a combination of both (Nykvist & Whitmarsh, 2008; Pel & Boons, 2010; Geels, 2007). In addition to technology- and policy-focused approaches, a central factor of sustainability transitions of urban transportation systems is the social dimension (Boschmann & Kwan, 2008). The bi-directional relationship between users and technology is particularly relevant (Kline & Pinch, 1996; Nye, 1999; Schot & de la Bruheze, 2003): on the one hand, user expectations are an important guide for the development of technological innovations to ensure their acceptance by customers and, subsequently, their successful implementation on a large scale. On the other hand, technological innovations may also bring about a shift in the functional requirements of users. With respect to mobility, these not only include quantitative factors, such as the speed or price of a certain mode of transportation, but also qualitative ones, such as availability, cleanliness, and convenience (Vuchic, 2007). Lie and Sørensen (1996) describe the process of adapting consumer expectations as the *domestication* of new technologies and artifacts in existing user environments. This two-way interaction between technology and users is often referred to as co-evolution, ‘‘a process of mutual articulation and alignment of product characteristics and user requirements,’’ which can be crucial for successful diffusion of innovations (Schot & de la Bruheze, 2003, p. 231). But while the social dimension and technology-user interplay is often implied in the literature on sustainable urban transportation systems, few studies explicitly address these issues (Boschmann & Kwan, 2008).

The present study approaches the complex issue of sustainability transitions in suburban transportation systems. In particular, the research focuses on the following two research questions: (i) *What are the visionary characteristics of more sustainable future transportation systems in a suburban area*? and (ii) *What are major challenges to the acceptability of these systems from a current user perspective*? In this study, we approached these research questions in a stepwise manner. Visionary characteristics of a more sustainable future transportation system for suburban areas were developed using the