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Flying high in urban ropeways? A socio-technical analysis of drivers and obstacles for urban ropeway systems in Germany

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ABSTRACT

Urban ropeways are a novel option in public transport, using established technology known from the mountains to deliver public transport in urban areas. Generally seen as environmentally friendly with a small ecological footprint, the potential of urban ropeways has not yet been demonstrated in Germany. Applying the 'multi-level perspective' established in transition research, we analyse challenges in the diffusion process. Results are based on 14 interviews with transport planning experts, ropeway manufacturers and actors from cities with urban ropeway projects. The following major obstacles are identified: (1) restricted route layout and interferences with urban landscapes inherently narrowing the niche for urban ropeways, (2) frequent lack of a clear concept of how the urban ropeway will connect with the existing public transport system, (3) established actor constellations and planning routines in the public transport regime blocking off the take-up of urban ropeways, and (4) increasing public opposition against infrastructure investment projects in general. At the same time, a number of drivers stimulate the diffusion process: (1) flagship projects and events can showcase urban ropeways, (2) the public transport regime generally experiences a pressure to become more innovative, leading to (3) regime actors themselves discovering urban ropeways as an interesting option, and (4) a stimulating effect is expected from the first urban ropeways to be actually implemented in Germany. Overall, the diffusion process is still at an early stage, but our results illustrate a widespread expectation that urban ropeways will become part of the German public transport repertoire in the future.

1. Introduction

In recent years, the way transport is organised, particularly in cities, is changing. Ideas for reorganisation range from rather technological innovations like battery-electric vehicles to organizational innovations like car-sharing and community-based approaches such as free cargo-bike sharing. Within the more conventional sector of public transport, new approaches are tested to make the sector more efficient in economic terms as well as to increase public transport modal shares, thereby reducing the environmental footprint of the transport sector.

In this paper, we take a look at one specific innovation in this area: urban ropeways,[1] particularly considering the German public transport sector. This innovation is less of a technological kind, as ropeway systems of various types are common in mountainous regions, most frequently at skiing destinations (Puhe and Reichenbach, 2014). Generally, the technical characteristics of ropeways

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[1] Terminology for ropeway systems varies. Common terms used alternatively include 'aerial ropeways', 'aerial tramways', 'aerial lifts', 'cable cars', or 'gondolas', partially referring to specific technical sub-categories. See for example Alshalalfah et al. (2012) for a more detailed introduction.

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are well-known from existing installations (cf. Liedl, 1999; Sedivy, 2012). Layouts include different possibilities regarding operative characteristics like the number of cabins and the frequency of departures (continuous operation vs. fixed timetable). Meanwhile, the suitability of ropeways for urban transport purposes has been explained in a number of studies and reports (e.g. Alshalalfah et al., 2012; Clément-Werny and Schneider, 2012; Monheim et al., 2010; Weidmann, 2013). Ropeways are generally seen as an environmentally friendly means of transport, mainly because the motors in the stations use electric power which can easily be supplied from renewable sources, thereby reducing carbon dioxide emissions. Moreover, other emissions are equally low, with literally no impact on air quality and very little noise emissions from the moving cabins and the stations (Rudolph, 2009). Ropeways also require little land consumption (Pajares and Priester, 2015). Urban ropeways could therefore be a part of more sustainable urban transport futures. However, urban ropeways are clearly not a transport solution that fits every purpose: Ropeways provide direct point-to-point links with only limited possibilities for intermediate stations, they cannot extensively serve a whole area. Detailed route alignment is another critical issue, as curves are limited and require expensive engineering. Therefore, urban ropeways can only be one element in a wider public transport system, for example crossing topographical barriers, linking institutions with high passenger demand to the existing public transport network, closing public transport gaps, or relieving overloaded transport links.

Despite the potential illustrated above, the use of ropeways in urban contexts, fit into public transport networks and tariff schemes just like any other means of public transport, is a rather new and still very scarce phenomenon. Most prominently, a growing number of urban ropeway installations in Latin America has attracted publicity as well as scientific coverage, including for example the 'Metrocable Medellín' in Colombia (cf. Bocarejo et al., 2014; Heinrichs and Bernet, 2014), or a set of urban ropeway lines in La Paz, Bolivia (Doppelmayr, 2015). These installations have greatly increased the accessibility of existing informal settlements (favelas), which had not been served by public transport before, or build a more efficient alternative to former queues of busses stuck in traffic. However, those cases are not necessarily comparable with European cities, particularly regarding the existing public transport offer and the transport planning context. Therefore, the present paper will not examine these cases and focus on the context of the German public transport sector instead, where none of the urban ropeway projects proposed until today have been actually implemented, and proposed projects have been restricted to very specific contexts in a limited number of cases. This leads to the main question addressed in this article: Why have urban ropeways not been established as a relevant option in public transport in Germany until today?

Given the technical maturity of ropeway systems and the existing experience with possible layouts and technical limits, we do only marginally touch technical aspects of urban ropeways. Instead of delivering a technical analysis, we extend our perspective to the socio-technical context of urban ropeways, considering a wider range of potential obstacles and drivers affecting the diffusion process of urban ropeways. This means putting our analytical focus on constellations of actors involved in organising and operating public transport in Germany as well as the respective regulatory frameworks. In doing so, we take into account the importance of specific actors in the innovation process (Bratzel, 2000) as well as structural barriers within the organisation of the German public transport sector that are a probable cause for slowing down the diffusion of innovations (Karl, 2014). Issues range from individual actors' opinions, for example of bus operators, to the particularities of the legal framework for ropeways in Germany (cf. Stennecken and Neumann, 2016). For the analysis of the socio-technical context of technological innovations, various approaches have been developed in transition research, including the 'multi-level perspective' (MLP) on socio-technical transitions (Geels, 2002, 2011; Geels and Schot, 2007) or the 'technological innovation systems' (TIS) approach (Bergek et al., 2008; Hekkert and Negro, 2009; Hekkert et al., 2007) as prominent examples. Considering the rareness of even proposed urban ropeway projects in Germany until today, we chose the MLP as a tool dealing with technological niches which is well suited to address our research question (detailed introduction in Section 2).

In this article, our understanding of 'urban ropeways' is as follows: As urban ropeways, we consider ropeways that are geographically located in an urban area and that serve public transport needs. These ropeways are specific in the sense that the integration into the urban landscape as well as the operating conditions of public transport (transport volumes, operating hours) constitute specific challenges – which are combined neither for ropeways in urban areas serving tourist purposes nor for public transport ropeways outside urban areas. This definition is also in line with previous work (cf. Nejez, 2009; Pajares and Priester, 2015).

2. The multi-level perspective on socio-technical transitions

The MLP was introduced by Geels (2002) and has since been frequently used in analysing innovation processes and socio-technical transitions in various contexts. At its core, the MLP presents the three concepts of (socio-technical) niches, regimes, and the landscape. These build a hierarchy (Fig. 1): Niches are part of regimes and regimes are part of the landscape (Geels, 2002).

Within the MLP, niches are understood as places with room for experimentation, where innovation can happen. Niches provide a protected environment, allowing for learning processes during early stages of an innovation, leaving room to formulate expectations and visions, and building up networks of relevant actors (Geels, 2012). Inside niches, new approaches which deviate from established technologies and routines can be demonstrated, gaining momentum over time.

The socio-technical regime consists of a structuring set of deeply rooted rules and routines, coordinating and aligning technologies, companies, institutions, policies, users, interest groups, etc. with regard to a certain topic or a technology. It is mostly characterized by a high degree of stability, with innovation being rather incremental. Because of technological lock-ins, innovation trajectories are relatively linear (Geels, 2012).

Niches and socio-technical regimes are embedded in the socio-technical landscape which "includes spatial structures […], political ideologies, societal values, beliefs, concerns, the media landscape and macro-economic trends" (Geels, 2012, p. 473). While