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Watching the Swiss: A network approach to rural and exurban public transport☆

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ABSTRACT

Public transport in rural and exurban areas faces major challenges, with low population densities making it difficult to provide high-quality, high-occupancy services. While demand-responsive transport is sometimes prescribed as an innovative strategy for service provision, the network planning approach to public transport suggests that integrated timed-transfer or pulse timetable networks should be explored first. This paper examines the rural network approach using examples from Switzerland, which has among the highest rates of public transport use in Western Europe, as well as nationally-coordinated *Taktfahrplan* scheduling that extends deep into rural areas. The basic Swiss pulse timetabling technique is reviewed, along with the application of the approach to a remote rural case study in Graubünden's Lower Engadine and Val Müstair. Characteristics of pulse timetable networks and the wider rural network approach are considered, drawing broad lessons for their potential application elsewhere.

1. Introduction

Despite widespread planning policies to contain urban sprawl and promote compact cities, settlements in rural and exurban areas continue to expand across the developed world. A European Environment Agency report suggests that this growth is led by desires for detached or semi-detached houses in "suburban/rural" settings or "rural areas outside the city", and finds that families with small children are most likely to move to these areas (EEA, 2006, p. 20). In countries where detached housing is the norm (such as Australia, the United States and Canada), scenic rural areas also attract young families, retirees and others seeking lifestyle changes and cheaper housing (Butt, 2014; Winterton and Warburton, 2012, p. 329; Ghose, 2004).

Public transport in these areas is often poor, with services characterized by low frequencies, limited hours of operation, indirect routes and inconsistent connections between modes (Petersen, 2012). Both residents and visitors arriving from nearby cities have little choice but to drive, which further entrenches car dependence and associated transport disadvantage, along with possible congestion, parking and other environmental problems (Cullinane and Stokes, 1998, pp. 7–8). A lack of alternatives to the car may, in particular, restrict older people's access to health services as well as to other activities necessary for social inclusion (Ward et al., 2014).

With even lower population densities than suburban areas, rural and exurban districts are considered some of the most challenging environments for public transport provision, with dispersed travel patterns and limited overall travel demand making it difficult to provide high-quality, high-occupancy public transport (White, 2009, p. 164). According to Hickman and Banister (2014, p. 141), even "classic good practice examples such as Freiburg, Strasbourg, Amsterdam and Zurich… are often surrounded by relatively car dependent suburban and rural areas." Nevertheless, in considering strategies to reduce carbon dioxide emissions from rural Oxfordshire, they propose upgrades for local rail and bus, including new bus rapid transit lines, although how these would address fundamental rural public transport problems remains unclear (Hickman and Banister, 2014, pp. 163, 171).

In the face of such difficulties, proponents of 'demand-responsive' services have mounted the most significant challenge to conventional public transport. A 2008 report by the UK's Commission for Integrated Transport ('CfIT') calls for *A New Approach to Rural Transport*, on the basis that the quality of public transport outside large towns and cities in the UK is "patchy" and that services are "infrequent, finish early in the evening and do not run at all at weekends"(CfIT, 2008, p. 7). The report argues that the UK's

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rural areas would be better served by the large scale roll-out of demand-responsive transport, citing its use in the Netherlands and Switzerland, and contends that this would provide better services and achieve higher cost recovery (CfIT, 2008, p. 9).

Demand-responsive services usually use smaller vehicles (including taxis) in place of conventional buses, while still charging fares for each passenger, but vary the fixed routes and/or timetables that define other forms of public transport (Davison et al., 2014, p. 47). Some demand-responsive services are designed to feed other public transport, while others operate entirely independently. They may offer cost reductions for operators when replacing poorly-patronised conventional services, and typically promise a flexible service that can be tailored to different users' needs.

However, some analysts of demand-responsive services advise that flexibility should be limited to avoid jeopardising operating economics: they explain that collective modes work most efficiently when demand is concentrated, and that too much flexibility can fragment this demand (Enoch et al., 2006, p. 13). Despite the success of some enduring examples, demand-responsive services have often proven to be operationally complex and expensive, achieving vehicle occupancies little higher than taxis, while being unable to guarantee access during peak times or make reliable connections to other public transport (Enoch et al., 2006; Davison et al., 2014; Mageean and Nelson, 2003). Potential users are often unfamiliar with procedures adopted by individual schemes, and booking requirements may hinder spontaneous travel. Although there are often other institutional, legislative, and funding-related barriers to the implementation or continued operation of demand-responsive services (see Mulley et al., 2012), these service-related issues help explain why so many rural demand-responsive services do not progress beyond trials or niche transport roles (such as serving people with mobility impairments).

A more recent challenge to the focus on demand-responsive services has come from the network planning approach (Mees, 2010; Nielsen et al., 2005; Thompson and Matoff, 2003). The emphasis is on concepts that are the opposites of flexibility: permanence, reliability and simplicity (Vuchic, 2005, p. 570). Carefully planned, fixed public transport routes are combined in a single, stable network, bound together by opportunities for quick and convenient transfers. In rural areas, high-frequency routes (enabling random, untimed transfers) are rarely an option, so services must instead be timed to connect at selected hubs.

Such timed-transfer or 'pulse' networks operate in the suburbs of some cities in the United States and Canada, as well as within regions of German-speaking Europe (Vuchic, 2005, p. 224). Switzerland, with Western Europe's highest number of public transport trips per capita (Pucher and Buehler, 2012, p. 543), provides an obvious case for investigation, and is of particular interest because it provides a nation-wide pulse system that extends into remote rural villages. While demand-responsive services still play a role in many Swiss cantons, research for the CfIT shows very high subsidies per passenger carried (Mott Macdonald Consultants, 2008, p. 23). Other preliminary work also suggests that cantons making less extensive use of demand-responsive 'PubliCar' services achieve higher canton-wide public transport mode shares (Petersen and Mees, 2010).

This paper examines the rural network approach, as applied in Switzerland, as a way of reducing car use and providing high-quality public transport in rural and exurban areas. The context in which it developed and the method by which it is planned are briefly explained, before its application to one of Switzerland's most remote rural regions, the Lower Engadine and Val Müstair in the Canton of Graubünden, is explored. Characteristics of the pulse timetable-based approach are also discussed, along with required policy and institutional settings.

2. The network planning approach

In identifying the poor quality of public transport in the UK's rural areas, and calling for more taxi-based services, the CfIT report (above) observes that "connections between buses and trains are erratic, and examples of integrated ticketing are the exception rather than the rule" (CfIT, 2008, p. 7). This suggests that planning and institutional deficiencies are at least partly responsible for rural public transport's poor performance in the UK, although they are not considered at any length in the report. Even Hickman and Banister (2014, p. 172), who propose packages for upgrading conventional bus and rail services in Oxfordshire, suggest better network planning and integration only as a "supporting measure".

Proponents of the network planning approach, in contrast, would start by exploring the prospects for public transport service coordination. The Australian transport academic Paul Mees described how an integrated network could make high-quality, high-occupancy public transport possible in low-density areas (Mees, 2000, 2010). When comparing Melbourne and Toronto, he found that throughout Toronto's inner and middle suburbs, a comprehensive grid of frequent public transport routes had been planned to allow quick and convenient transfers wherever routes intersected. This created a 'network effect', conveniently linking a far greater proportion of passengers' origins and destinations than isolated transport corridors, and overturned the typical assumption that the costs of increased service would, as a rule, outweigh the revenue from improved patronage.

The idea was also taken up by others (Nielsen et al., 2005; Stone and Beza, 2014), or independently identified to explain the better performance of 'multi-destinational' rather than traditional radial transit networks in US cities (Thompson and Matoff, 2003; Brown and Thompson, 2008). Nielsen et al. (2005, p. 35) also make a useful distinction between a "tailor-made" approach, where services are customised for particular market segments at different times (e.g., peak-only expresses for CBD commuters), and the "ready-made" approach favoured by network planning proponents, where a catch-all service is provided using stable network structures and services available all day. All authors recognise the importance of carefully-planned route networks and convenient transfers.

Beyond the suburbs, in low density rural or exurban areas, services are invariably low frequency and must be timed to connect to allow quick transfers between different routes. Nielsen et al. (2005, pp. 116–119) recommend timed-transfer pulse timetables for "weaker" public transport markets, citing small cities in Germany's Nordrhein-Westfalen that restructured their bus networks and increased patronage, improved cost recovery and cut subsidies per passenger. Mees (2000, p. 282; 2010, p. 179) also suggests pulse networks, similar to those covering Zurich's suburbs and parts of rural Switzerland, as a preferred approach for rural and exurban areas.

2.1. The pulse timetable concept

The 'pulse timetable' or 'timed-transfer system' concept is not new. Vuchic's public transport textbook (2005, p. 224; see also Vuchic et al., 1981) outlines the basic technique of timed-transfer planning, noting that pulsing is also used by airlines at hubs, where planes arrive at a central point simultaneously to allow passengers to transfer in all directions, and that similar strategies are often used by public transport systems that keep precise schedules. Pulse timetables are used to serve the automobile-oriented suburbs of North American cities like Edmonton,