Generating opportunities for city sustainability through investments in light rail systems: Introduction to the Special Section on light rail and urban sustainability

Quality transport plays a critical role in perceptions, plans and devel-opment of sustainable urban centres and sustainable mobility futures (Banister, 2008; Goetz, 2013). On the one hand, transport systems and infrastructure can enhance economic, social and environmental perfor-mance of a city, and its wider region, through alleviating traffic conges-tion, reducing carbon emissions, and managing urban growth and development to boost city competitiveness (Banister and Berechman, 2001; Docherty et al., 2009). On the other hand, effective routes and connections can improve management of urban flows, provide better accessibility and enhance the quality of urban centres. Reflecting these opportunities for enhancing quality and performance of urban areas, as well as ongoing critique of mass transportation, the role of public transport remains a key focus within transport and urban research and, increasingly, within urban sustainability initiatives.

This Special Section focuses on Light Rail Transit (LRT) development and its role in wider sustainability initiatives, particularly those focused on economic growth and, to a lesser extent, social and cultural dimen-sions. Light rail is commonly recognised as an efficient, smart and lower polluting form of rapid transport that structures passenger mobil-ity in and around urban centres (Hickman et al., 2013). A common argu-ment associated with light rail (and transport investment more generally) is that it needs to be well integrated with urban planning. This theory, however, has not always been supported in practice (Docherty et al., 2009; Hickman et al., 2013), where competing objec-tives, financial issues, and institutional frameworks have not necessarily provided optimum conditions to unite the two (Banister and Berechman, 2001; Hickman et al., 2013). Research, therefore, has often reverted to analysis of light rail, independent of its wider context to-wards sustainable futures. In order to advance insight on light rail and urban planning, the papers in this Special Section provide in-depth dem-onstration of a range of effective links between light rail and sustainable urban development, including sustainable mobility agendas. Not all sustainability frameworks are examined here; for example, there is limited consideration on the social impacts of uneven development, or the reduction of carbon dioxide (CO_2) transport emissions. Collectively, however, the papers provide a lens to the vital role of light rail in bring-ing about certain sustainability opportunities, particularly in relation to sustainable urban futures in line with neoliberal agendas. The next sec-tion of this Introduction examines LRT and the concept of sustainability, before introducing the ten contributions to this Special Section.

LIGHT RAIL TRANSIT

As this Special Section demonstrates, light rail is a term that incorpo-rates a range of vehicle types. This range includes, though is not limited to, supertrams and driverless lightweight metros such as the Docklands Light Railway in London, Vancouver's Skytrain and Copenhagen's mini-Metro. Light rail is usually a lightweight, two-car articulated vehicle running on steel rails and electrically powered from overhead wires. Increasingly, however, there are examples of light rail powered through Alimentation par le Sol (APS) (ground power supplies), which serve to avoid overhead wires and limit interference with architecture, heritage or aesthetic qualities of historic city spaces (Olesen, 2014). Light rail is often positioned between, or in contrast to, other modes of transport: On the one hand, light rail avoids much of the heavy engineering of underground metro systems by using converted surface rail routes, largely segregated road alignments or short sections of tunnel (Knowles, 1992). On the other hand, it differs from bus-based systems which sometimes, but not always, run on segregated rights of way and offer less sense of fixity than light rail (Hass-Klau et al., 2003). Research demonstrates that light rail has considerable advantages over heavy rail (underground metros and suburban/commuter rail) as it usually has much lower capital costs (Knowles, 1992). It is also able to carry more passengers at higher speeds than bus systems and, unlike bus schemes, has proven ability to persuade motorists to switch modes and thereby reduce traffic congestion (Hodgson et al., 2013; Knowles, 1996; Knowles and Abrantes, 2008). Beyond these comparisons, light rail has often been noted for its iconic and modern image that holds a “mythical allure” (De Bruijn and Veeneman, 2009, p.358) for stake-holders (Binder and Knowles, 2013; Olesen, 2014). Thus, light rail can be conceptualised along a continuum of public transport between buses and heavy rail. This Special Section presents a range of systems under a variety of different names, including street trams, streetcars and ‘rychlá tramvaj’ (fast tram) systems, all of which are slight variants of light rail described above.

LRT systems are increasingly developed in both major and provincial cities across the globe (Chen, 2014), including implementation in some less developed countries (Pacheco-Raguz, 2010), where it is recognised that improving the level and quality of internal and external connectiv-ity is critical for improving city performance and achieving sustainabil-ity goals. In some of the major cities, rail infrastructure is considered a critical component to develop a competitive city at a global scale (Niedzielski and Malecki, 2012). This dominant discourse reflects a neo-liberal urbanism focused on economic growth, and has been critiqued for its neglect of issues surrounding social inclusivity and social justice (Enright, 2013; Sari, 2015). Predominantly, light rail research includes evaluation of transport benefits (such as increased public transport usage and modal shift from cars (Knowles, 1996)), revealing that the most successful cities are able to deliver new light and/or heavy rail schemes as well as smaller schemes designed to eliminate road and rail bottlenecks. Research also analyses non-transport benefits – often referred to as wider economic impacts – which include land and prop-erty values, environmental benefits and urban regeneration (Dabinett et al., 1999; Hass-Klau et al., 2004; Knowles, 1992). Assessment of economic impacts has relied mainly on detailed Impact Studies that only consider immediate impacts of light rail, as with for example the Manchester Metrolink (Law et al., 1996) and Sheffield Supertram (Dabinett et al., 1999) (see Knowles and Ferbrache, 2014, for further details). Research has also investigated the role of light rail in transit-oriented development (TOD) and, to a lesser extent, in sustainable urban growth initiatives, including smart cities (e.g. Babalik-Sutcliffe, 2002; Cervero and Murakami, 2009; Edwards and Mackett, 1996; Goetz, 2013; Knowles, 2012; Olesen, 2014; Priemus and Konings, 2001). It is to sustainable urban futures, that this Special Section contributes.

This Special Section expands upon this literature by adhering to the call for integrated land use and transport planning, through examina-tion of light rail embedded in a range of wider contexts that speak to sustainability agendas. The research emerges from different cities from across the globe, including some that have not been much explored before, such as post-Communist cities in Eastern and Central Europe, and cities in the rapidly developing country of Turkey astride the boundary between Europe and Asia. The papers tend towards dis-courses of pro-economic growth, thus reflecting a neoliberal urbanism at the heart of this analysis. This is not a deliberate selection, rather it demonstrates the power of such discourses of transportation in more developed cities, and will need to be balanced in further research with consideration of other sustainability agendas, as the next section reveals.

SUSTAINABILITY

In the twenty-first century, there is a wide move towards greater sustainability in transport and urban areas through frameworks such as sustainable mobility, sustainable urbanism, sustainable cities and smart cities (Banister, 2008; Goetz, 2013; Hickman et al., 2013; Hollands, 2008). These involve a broad range of economic, social, envi-ronmental and institutional elements, with agendas that might include economic growth, accessibility, social equality, and CO_2 reduction (Banister, 2008; Hickman et al., 2013; Loo and Comtois, 2016). Argu-ably, transport plays a role in each of these sustainability agendas, though not always for the better (Farmer, 2011; Enright, 2013; Nolte and Yacobi, 2015).

Identifying key parameters of sustainable cities, Banister (2008, p.73) argued that there "should be over 25,000 population (preferably over 50,000), with medium densities (over 40 persons per hectare), with mixed use developments and with preference given to develop-ments in public transport accessible corridors and near to highly public transport accessible interchanges". These characteristics correspond with TOD initiatives to generate high-density and mixed-use neighbourhoods in station areas and along transit corridors (Cervero, 1998; Gibbs et al., 2013; Goetz, 2013; Hollands, 2008; Vanolo, 2014). For example, Goetz (2013) demonstrates the centrality of rail transit in Denver, Colorado, to the region's (TOD) urban development programme, yet despite some success, initiatives were held back by financial difficulties relating to the rail development. Similar conclu-sions concerning financing have been demonstrated by Knowles (2007) and Hickman et al. (2013), as a critical obstacle in the UK for achieving the type of urban planning and integrated transport invest-ment that is said to be vital to achieve sustainable cities as set out by Banister and via TOD.

However, sustainable cities and sustainable mobility go beyond development initiatives. There is also an increasing emphasis on improving the quality of the city life and environment, and shaping cities as attractive and socially interactive places to live in (thereby encouraging people to live and work in quality spaces of such a scale that they do not require a car) (Mulliner and Maliene, 2011).

Sustainable mobility is often considered to centre around greater use of public transport, cycling and walking - a key strategy to help shape sustainable futures in terms of healthier lifestyles (Woodcock et al., 2007). Light rail, in particular, is valued in this way as it has been integrated with cycling and walking paths in and around transit stops in cities promoting TOD, as well as some French cities.

Sustainable mobility is also valued as a societal goal to bring about greater inclusivity and equality among the urban population. As Farmer (2011) indicates, these goals can be at odds with city (economic) growth objectives. For example, lower-income families have been displaced as transport infrastructure has been developed, not only through the demolition of housing, but also in relation to gentrification and the rising costs of land and housing prices adjacent to transit stops and lines (Enright, 2013). Land value capture is often perceived as a benefit (see Knowles and Ferbrache, 2015), but this depends who is evaluating the impact. The result is that public transport can lead to frag-mentation and exacerbate inequality between, for example, middle-class and working-class populations. Cresswell's (2006) case study of New Orleans' African American residents who were unable to escape the city as flood waters rose, reveals the critical politics of race and pub-lic transit mobility, and the type of questions that future research around LRT might valuably contribute to the broader context of sustainable urban futures. In addition, Farmer (2011), explained the social exclusion that was exacerbated by public transport investment in Chicago which follows a common pattern of light rail transit development in the USA of provision of high quality light rail services serving middle-class white neighbourhoods, while neighbourhoods of working-class com-munities (Latino and African-American, for example) are provided with slower services based on bus systems. In this way, light rail has been conceptualised as a means of social exclusion failing to bring about sustainability in terms of social equality.

Olesen (2014, p.18) argues that light rail is embedded within initia-tives for "redesigning the city, the struggle for space, the backbone of the public transport network and urban development, economic feasibility, the choice of technology sustainability, and accessibility." This phrase seems to capture the diversity of roles that LRT can play. LRT clearly has potential to influence sustainable city futures. However, despite its potential value, light rail has not always been as well developed, based on competing ideas of sustainability, and the need for integrated planning and transport investment. In the latter case, this is particularly apparent in the UK where there has been a dearth of modern light rail and metro systems in provincial cities (Knowles, 2007; Docherty et al., 2009), and it has been noted that some existing systems have underachieved (Babalik, 2000; Crocker et al., 2000; SDG, 2005). Prob-lems include the difficulty of integrating LRT into existing and new urban policies (Knowles, 2007; Olesen, 2014), and failure to recognise that light rail alone is not enough to stimulate sustainability; additional conditions are important for success of the system, including supportive land use planning policies, inward investment, land value capture and urban regeneration initiatives (Banister and Thurstain-Goodwin, 2011). Current research presented in this Special Section explores some of these dimensions to light rail with sustainable urban futures.

The collection of papers includes examples of light rail in the United States, Canada, Western, Central, Northern and Eastern Europe, Turkey, South Korea and China. The selection represents existing light rail lines, planning policies, inward investment, land value capture and urban regeneration initiatives, and light rail systems. While the papers are relevant to post-service based and knowledge economies, the geographical limitation and lack of represen-tation from developing countries reflects the geographical scope of the literature on light rail more broadly. While there are fewer light rail systems in less developed cities (i.e. in Africa, South America and parts of Asia) compared to developed cities, there is a need for further research from those parts of the world.

THIS SPECIAL SECTION

The collection of papers includes examples of light rail in the United States; Canada; Western, Central, Northern and Eastern Europe; Turkey; South Korea and China. The selection represents existing light rail lines, planned extensions, and new lines under construction or as potential systems. While the papers are relevant to more service-based and knowledge economies, the geographical limitation and lack of represen-tation from developing countries reflects the geographical scope of the literature on light rail more broadly. While there are fewer light rail systems in less developed cities (i.e. in Africa, South America and parts of Asia) compared to developed cities, there is a need for further research from those parts of the world.

The ten contributions are divided into three groups examining (i) wider contexts in which light rail is developed (i.e. sustainable mobility programmes); (ii) wider economic impacts of light rail; and (iii) the financial measures through which these might be achieved. Starting with those papers that embed, or argue for synthesis between light rail and urban planning initiatives, Olesen and Lassen provide analysis of light rail systems in France and Norway through the lens of spatial planning initiatives. In doing so, they argue for conceptualising light rail as part of complex urban development projects. Their case studies - Angers and Bergen - demonstrate clearly how light rail, on the one hand, is shaped by its grounding in its particular city and, on the other hand, how the city (through urban structures, planning and design practices) is shaped by light rail. This spatial impact of one upon the other demonstrates the close connection between transport and urban design, and land-use planning.

Positioning public transit within wider urban development frame-works, King and Fischer argue that US streetcars are the core of strategic amenity packages to bring about strategic planning goals, including increased land values, and property development benefits. They demonstrate the value of light rail in terms of spatial planning, over more immediate transport benefits/ improvements, thus emphasising the role that role that light rail plays as a tool to enhancing sustainable development initiatives associated with economic growth.

In the third paper, Valenzuela-Montes et al. examine how stake-holders in Granada, Spain, perceive and understand the benefits of light rail in the context of sustainable mobility policies and goals. They demonstrate the significant capacity of light rail, as perceived and understood, to promote different urban mobility policies around issues such as accessibility, intermodality, environmental quality, urban integration and efficient management. These goals, as well as the pack-ages used to achieve them, share features with those of sustainability agendas. This is a comprehensive view of what light rail might achieve, though how compatible these agendas are in practice remains to be seen.

Focusing on the potential of light rail systems, Kołoś and Taczanowski analyse the impacts of light rail in Poland, Slovakia, Hungary, Czech Republic and Austria, to argue that it is a feasible project to introduce new systems in other central-European medium-sized cities. Principally, such systems can help to alleviate transport problems, but they are also shown to adhere to European transport initiatives and provide opportunities for wider growth impacts, including city image boosterism. This paper and the next provide insight to light rail and urban initiatives in post-socialist cities.

Seidenglanz et al. focus on larger cities in central Europe, which already have experience of tram lines. Prague, Bratislava and Brno, in the former Czechoslovakia, used to operate ‘rychlá tramvaj’ (‘fast tram’) systems which the authors examine to ask whether their rejuve-nation is more a legacy of socialism than an opportunity to develop a functional city transport system that reaches the technical accordance of light rail. The larger-scale post-socialist city, it is argued, has a need for sustainable mobility grounded in environmental factors and smart city solutions. Moreover, in the papers by Seidenglanz et al. and Kołoś and Taczanowski, the common EU Transport Policy provides a context to support development of rail-based transit systems, including financing of transit in cities where local or national funding has not been readily available.

Together, these five papers demonstrate some of the potential, as well as actual, policy packages and goals within which light rail is increasingly situated, and sometimes justified by academics and stake-holders. A further justification of the benefits of light rail emerges in analysis and evaluation of its impacts.

Knowles and Ferbrache draw from an extensive review of published and unpublished literature to consider the wider economic impacts of light rail on cities across the globe. Their analysis demonstrates the role of light rail in widening labour market catchment areas, stimulating inward investments, unlocking previously hard to reach sites foR development, triggering fresh growth, raising land and property values, and enabling TOD. These impacts represent some of the key goals of urban renewal and regeneration initiatives, reflecting neoliberal urbanism.

Focusing on land use impacts, Goetz and Supata present results from the Denver metro region, USA, to argue that rail transit lines have been especially successful in consolidating commercial land use around them, but less so residential land use. These outcomes are linked to TOD and sustainability strategies for high-density, mixed-used development.

Gadzinski and Radzimski consider some more of the immediate impacts of light rail by examining how proximity to the Poznan Rapid Tram system affected nearby residents in terms of travel behaviour, residence satisfaction and apartment prices. The system is found to be motivational for a significant portion of residents in each of these areas, though good accessibility was key to this. Such findings facilitate the argument of sustainable mobility for designing and developing urban centres that provide high levels of accessibility via quality transport connections. These three contributions on the wider economic impacts of light rail help to demonstrate the significant benefits (and potential problems) that LRT can generate in cities. Central to realising such benefits is the need to recognise that light rail does not operate alone and needs to be part of wider initiatives of the type examined in the first quintet of papers.

The final two papers provide insight to further complementary factors to bring about successful light rail. Both draw on Turkish examples to demonstrate the importance of efficient funding and man-agement schemes to enable light rail to realise its potential. Babalik-Sutcliffe focuses specifically on the way that local transport in Ankara, Istanbul and Izmir is planned and operated through quasi-government subsidiary companies, rather than being a fully public service. Compar-ing the three cities, she demonstrates that planning coordination, intermodality, fare integration, and system performance are impacted differently by the three different models being used. The findings are used to argue for the need of a clearly defined planning framework that integrates all transit services into a shared vision for transport planning and operations.

The final paper, by Alpkokin et al. also examines how effectively cities plan and finance their light rail schemes. With analysis from Turkey, again, this paper focuses on smaller cities, finding that route selection and design is well coordinated with present and future devel-opment for land-use, particularly in relation to re-organisation of high-way corridors, though less so for buses. They argue, however, that there is scope for improvement through involvement of private actors, in a similar way to those in Turkey's larger cities examined by Babalik-Sutcliffe.

The papers in this Special Section thus provide insight to the role of light rail in broader sustainability-related initiatives, the benefits these might bring, as well as some of the disadvantages, and how they are managed and may be improved. Overall, these measures are embedded within discourses that promote improvements, growth, development and enhancement of urban quality and performance towards fostering sustainable cities.