

Business models being trialled in the shared-ride on-demand niche, and challenges and barriers encountered.

Dr Tom Calvert*
Research Associate

Mr Steve Ward*
Senior Research Fellow

Dr Ian Shergold*
Research Fellow

Professor Graham Parkhurst*
Professor of Sustainable mobility

Dr Juliet Jain*
Senior Research Fellow

*Centre for Transport and Society, University of the West of England

Abstract

This paper evaluates the growing range of business models being applied within on-demand shared-ride road transport niches. Whilst examples of such services are long-standing; arguably as old as road passenger transport, new technologies have opened new niches. The services examined are drawn in part from those developed during an industrial-collaborative project within which the authors were partners, but also from similar initiatives observed in the wider sector during the project. The analyses draw upon information about services in the public domain, insights from being partners in the collaborative project and interviews with professionals responsible for innovations across the sector. Differences and similarities between the extant business models are examined, leading to illustrations which support a conceptualisation of the different approaches. A key innovation was the emergence of new models of partnership working, for example involving employers in part-funding flexible transport services. Challenges in partnering with employers included how to explain the business model to them and obtaining their acceptance that the service was appropriate for their needs. Established transport operators were also found to vary in their willingness to be involved in trialling innovative services. The largest difficulty was found in achieving sufficient revenue, however iterative progress was evinced in response to this challenge.

1. Introduction

With increasing digital technological capability available to operators and end users, new models for shared mobility are being tested by entrepreneurs in the transport sector. New shared mobility services have been argued to hold the potential to alleviate environmental damage and congestion (Lagadic et al., 2019), and also to increase affordable accessibility for disadvantaged groups (Brown & Taylor, 2018). However, technological advancements alone are not sufficient to achieve sustainable mobility, they need to be situated within successful business models (Parkhurst & Seedhouse, 2019). Britain's recent industrial strategy cites both the importance of emerging transport landscapes, shaped by 'new business models' for new forms of mobility, including ride-sharing and also automation and electrification (HM Government, 2017). This paper explores the types of business models being used by enterprises exploiting niches within the shared-ride, on-demand 'ecosystem'¹ and creates a typology of the services studied. The paper also explores challenges and barriers encountered by such enterprises. The authors' experiences with trialling transport services within a collaborative research and development project, the literature reviewed and interview data revealed business relationships, particularly with employers (as traffic generators) and transport operators, to be of importance in this sector and these are thus a substantial focus of the paper.

The paper's aims are explored through the experiences of six transport-sector innovators, occupying varying positions within the on-demand ecosystem. One of these (Esoterix Systems) was a project partner of the authors; an enterprise exploring proof-of-concept of different models, as part of an R&D project receiving national innovation agency funding. The other five were selected as offering diversity of approach and apparent business model. A literature review first positions shared-ride on-demand niches within contemporary and future transport landscapes, including briefly exploring the relevance of first/last mile needs,

¹ A definition by Moore (1993) of a 'business ecosystem', can be summarised as describing a system that spans different industries and which contains companies cooperating in relation to new innovations in order to create new products and satisfy customer desires.

automated vehicles and MaaS. Relevant conceptualisations of business models' components are then reviewed. After a brief summary of the research design, findings are presented: These examine the types of business relationships the services had, and also map services according to key aspects of their business models. Conclusions are then drawn on commonalities and differences between models.

2. Literature review

New forms of shared mobility are just one facet, along with a rise in transport system automation and digital interconnectivity, and a shift away from carbon-intensive liquid fuels, of what is identified by some as a 'smart mobility revolution' (Parkhurst & Seedhouse, 2019). Within this mix, the prospects of more collective mobility within business model applications distinct from traditional fixed route and schedule public transport operations offer alluring but uncertain commercial and social potential.

Enoch's (2015) review of evidence has suggested traditional forms of motorised transport are losing some of their dominance in favour of newer developments of shared mobility and on-demand services. Enoch highlights factors which may explain such a shift, including growing reluctance by the public sector to subsidise public transport, policy reflecting environmental concerns, improved connection between modes, and demand for mobility attendant on both young people driving less, but also ageing populations in some countries. Simulations have predicted important social and environment benefits arising from growth of more flexible, 'personalised' services. An agent-based model of Helsinki, for example, predicted opportunities to achieve cuts in emissions equal to those achieved through congestion charging, from a city-wide implementation of shared taxi and taxi bus services, (International Transport Forum, 2017). However, present transport patterns are entrenched and 'market forces' may need to be substantial in order to effect significant disruption (Enoch, 2015).

One area of opportunity for new on-demand services, refreshed by new technology, is the provision of first/last mile solutions that connect areas with a low density of public transport services to a variety of high frequency public transport corridors. Such services could reduce the barriers to accessing these networks by active modes (time, weather, carrying heavy bags, terrain, personal security, physical ability). It has been argued that the importance of the first/last mile has been underestimated (Razak, 2016), and that conversely the absence of adequate provision for it promotes car use whilst undermining public transport (Brons, et al., 2009; Cohen & Kietzmann, 2014). Commuting is a specific travel type which first/last mile services could particularly benefit (Crisp et al. 2018). Services catering for commuting could be integrated in the wider city network through 'multi-modal' smart ticketing (Crisp et al., 2018, p.9) and could particularly remove barriers to work where they serve suburban and peripheral areas. Crisp et al. reported public transport commutes to early morning shifts at an airport taking five times as long as they would by private car.

However, whilst such unmet needs represent a market for shared-ride services, there are also various factors which may discourage shared vehicle use for first/last mile legs. These include a negative correlation with affluence (Deka et al., 2010), excessive waiting and walking times (Zhang et al., 2015), a surfeit of journey distance through pick-up and drop-off of fellow passengers, discomfort of sharing a vehicle with strangers (Nguyen, 2013), and travellers being unwilling to pay the fare price (Calvert et al., 2019).

Prospects for shared-ride on-demand services are likely to be tied to mobility changes in general, with specific potential, and also uncertainty, attached to developments in both connected automated vehicle technology (CAVs) and the rise of new business models identified as 'Mobility as a Service' (MaaS). At present there is strong commercial and governmental interest in the development of automated vehicles (Cavazza et al., 2019), with some modelling suggesting automated vehicles could greatly increase accessibility (Meyer et al. 2017). Positive estimations of shared automated electric vehicles have been made, with some scenario analysis suggesting this mode could assume 14 to 39% of mode share. (Chen and Kockelman, 2016) and could lead to substantial reductions in the number of cars and parking places being used in cities (Burghout et al., 2015). However, the effects of widespread adoption of automated vehicles remain contested and heavily reliant on assumptions (Parkhurst and Lyons, 2018) and the business model under which they are provided

(Parkhurst and Seedhouse, 2019). This means that the true potential of automated shared-ride on-demand services remains uncertain. Integration with MaaS systems also holds potential for synergistic outcomes for shared-ride on-demand services. 'Whim' is an example of a MaaS system that has been claimed to have increased public transport use by 50%, leading to reductions in private car use, in Helsinki, (Finland), (Guardian, 2018). However, like many new mobility services, the commercial viability of systems like Whim is hard to assess due to significant contributions from external grant funding (Intelligent Transport, 2018).

Uncertainty exists then about how conducive future transport scenarios will be for shared-ride on-demand services. Uncertainty even exists without consideration of future scenarios, with a number of enterprises having already tried but failed to succeed in the sector. Kutsuplus a citywide service, run by Helsinki Regional Transport Authority, Uber Smart Routes, (providing on demand journeys along a set route), and Slide and Chariot (both shuttle commuter services) are examples that have failed and/or been withdrawn.

The fact that numerous shared-ride on-demand services are being launched to fill the niches discussed indicates that the technology needed to facilitate them – at least in terms of digital enablement, if not yet in terms of automation - exists. However, technological innovations need to be situated within an integrated business model (Christensen et al. 2006, cited in Cavazza et al., 2019). These models generally describe the logic by means of which a company creates and captures value (Aapaoja, et al., 2016). Such models have to adapt to changes in sectors if businesses are to remain profitable (Gassman et al. 2014). Cavazza et al. (2019) identify seven papers that have previously discussed business models in relation to automated vehicles, whilst business models relating to car-sharing have been discussed by Lagadic et al. (2019). The present study adds to this body of work through a comparison of business models for shared-ride on-demand services.

Numerous concepts have been put forward to represent what a business model's core components are. Osterwalder and Pigneur (2010) describe a 'Business Model Canvas' consisting of nine building blocks which leverage efficiencies in key partnerships, activities, and resources to create a value proposition for customers which is delivered through specific relationships and communication channels. Osterwalder and Pigneur (2010) identify five business models, of which the "unbundled" business model is particularly relevant to brokers of shared mobility services. Unbundling refers to companies focusing on one of three different types of activities: customer relationship businesses, product innovation businesses and infrastructure businesses.

Brokers of mobility services may procure innovative software systems from external providers to allow them to focus on developing the customer relationships and channels to deliver their innovative product offer. The brokers may also form relationships with mobility providers to supply the 'infrastructure' (e.g. buses, taxis). However, providers such as bus operators, for example, are often conservative in relation to risk. Go Ahead Group strategy, for instance, is to only tolerate low risk with regard to its core operational activities (Go Ahead Group, 2018). More adventurously, whilst First Group's latest Strategic Report (2018) noted increased risk from 'autonomous vehicles and on demand schemes', they also considered these to represent 'opportunities to grow and develop our market segments.' Our findings address issues encountered by mobility brokers in such partnerships.

The new mobility services can be viewed as attempts to redefine the mobility landscape in order to reflect "significant shifts in social practices and expectations, facilitated by advanced mobile information and communications technologies" (Pangbourne, et al., 2018 p34). However, due to the challenge of innovative thinking, Gassman et al. (2014, p.3) argue that innovative business model ideas must "master the balancing act of bringing in stimuli external to an industry to achieve novelty while, at the same time, enabling those within an industry to develop their own innovative business model ideas". This would appear to be a good description of many of the new mobility services, which are often led by small start-up businesses that have limited experience in transportation planning (and perhaps with fewer entrenched views on how transport systems "should" operate) who partner with existing mobility providers such as taxi, bus and coach operators.

Building on the inclusion of 'key partners' in Osterwalder and Pigneur's (2010) Business Model Canvas, Boons and Lüdeke-Freund (2013) group relationships as 'upstream', with suppliers, or 'downstream', with customers. For shared-ride on-demand enterprises these upstream relationships can include traditional transport operators or with employers. The relationships with the latter may vary: for example, employers may be the customer who contract with the mobility service supplier for staff transport, or the supplier of mobility demand to the shared demand service. The first findings section examines the "Key Partners" building block that the businesses studied depend on. The findings then go on to categorise businesses according to further key components of business models identified by Osterwalder and Pigneur (2013).

3. Research Design

The evidence presented in the subsequent findings was collected from three main sources. Much of the understanding of the Esoterix services is derived from the authors having been partners in a collaborative research project within which three novel services were trialled. As part of the project the authors undertook contextual research and evaluation which included collecting data from stakeholders, service end-users and service partners.

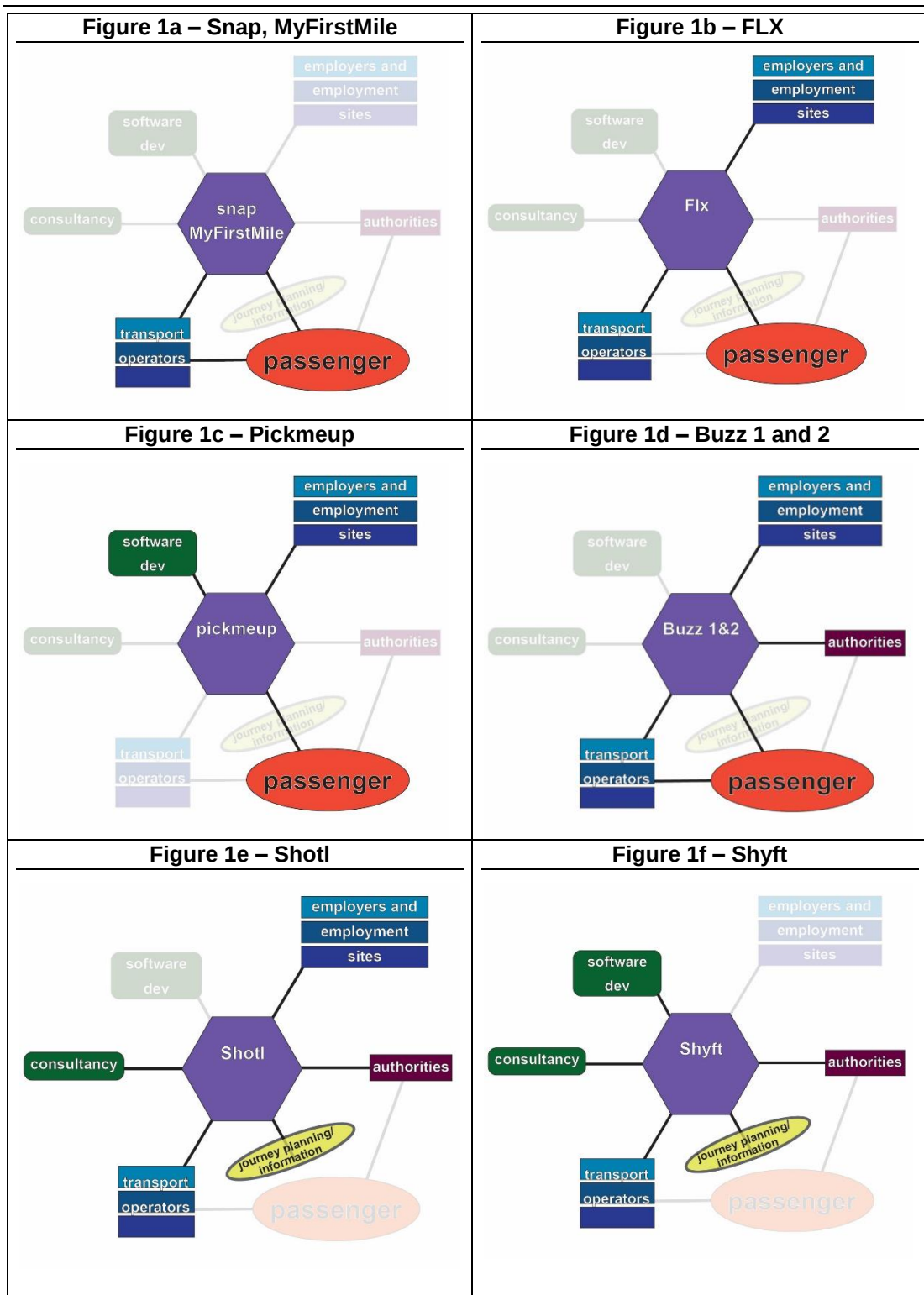
Business models can be applied to businesses as a whole or to specific services or products that they provide. To illustrate, there are many global corporations that sell a wide range of very different products and services. The present study examines business models at the level of the specific services rather than at the company level. Thus the three different Esoterix services are treated as having variant business models, despite being developed by the same business.

In order to explore the wider context of shared-ride, on-demand services, and the challenges these encountered, and to present the experiences of Esoterix in that broader context, services run by other businesses were also examined. These services varied in key respects: They included some UK and some international examples, some services that served end users directly and others which did not, and also examples that varied in scope. Information about these businesses was gleaned through online review. However, this tended to focus more on service information for end-users, and less on how the business model of the service functioned. Fifteen businesses were thus approached for an hour-long interview to discuss the operation of their business models more widely, with five consenting. An additional dedicated interview was conducted with Esoterix to ask any remaining questions about their business models. Two of the six interviews were in person; the remainder were completed by telephone or video call.

Data were analysed through inductive thematic analysis (Braun and Clark, 2006) to identify common and useful themes. This analysis, extant literature and experience from the collaborative R&D project resulted in a focus on business partnerships as a key aspect of the relationship models constructed in the findings. Other themes in the data led to the typology-by-triangle approach used in the findings section. The triangle figure format is derived from the 'Iron Triangle' concept often referred to in project management (Atkinson, 1999). This conceptualises the completion of projects being bound by the three points in a triangle such that moving nearer to one of the points means moving further away from at least one of the others. Our use of triangles to classify the services in a typology relies on informed judgement and carries the caveat that, in the majority of our triangles, the three points are not constraints on each other in the manner that time, cost and quality are in project management. Thus, the diagrams support the text and provide indicative visualisations only.

4. Findings

The section begins by introducing the services and also reviewing the structure of their primary business relationships. Conceptual diagrams of these structures are given in Figures 1a-f. In these diagrams the central hexagons represent the content of the service provided by the business interviewed, whilst the peripheral boxes (besides the ellipse representing the passenger), represent business partners relied upon for other elements necessary to the service.



Snap is an intercity coach journey service that serves several locations around selected UK cities. Snap's services have a degree of flexibility, only running when and where there is demand.

MyFirstMile was developed by Esoterix and was intended to implement taxi-bus feeder services to and from nearby trunk road bus services in partnership with a bus operator. MyFirstMile operated set routes in the morning, and in the afternoon returned passengers more directly to their morning pickup points.

As can be seen, in Figure 1a, both Snap and MyFirstMile had a simple business relationship model, comprising a 'mobility broker' role mediating between customer and operator. The businesses in question developed their own software, do not own vehicles and have operators as their one main type of partner. Snap started by paying the coach operators for the operating costs of each journey but was progressing gradually towards an 'Airbnb model' where the operator undertakes the cost of running the journey with Snap taking a share of the revenue. The Airbnb model requires operators' trust that there will be enough demand to avoid losses. An additional challenge in Snap's relationship with coach operators was that drivers were not always adept with smartphone technology. The Snap interviewee reported finding high quality drivers can be an issue and considered the company may have to invest in order to achieve this, as poor service by drivers is a problem for Snap, as well as for the operators.

In the case of MyFirstMile, the local authority was engaged to ensure the service complied with regulations. The primary local bus operator played a positive role in making the service possible, facilitating multi-modal ticketing and possessing the power to say 'yes, make it happen' (Esoterix interviewee). As such what financial risk there was fell to Esoterix and the bus operator.

Flx (Figure 1b), run by Go Metro, is being trialled with commuting professionals in Cape Town (South Africa). The employer made employees aware of the service but did not contribute financially. Flx initially attempted more substantial partnerships with employers, but found arranging these a long process, with employers often lacking the budget to ultimately participate. The service sought to group colleagues working at the same business by home postcode. Flx's marketing focused on the depiction of an improved commute experience. Like Snap, Flx's software matched demand (grouped employees) with operators; Flx did not own assets or operate services. A future option is for an operator to incorporate Flx software in its own operations. Hence, the operator could become an intermediary who promotes the technology to its own clients.

Pickmeup (Figure 1c) is an on-demand ridesharing minibus service, operated by Go-Ahead Group subsidiary Oxford Bus Company in Oxford (UK), where it serves an area in the east of the city, including peripheral business parks. Conventional buses were not considered appropriate due to low density of demand. The service partnered with Via, a software platform provider, but Go-Ahead Group took most of the financial risk. The service also partnered with business parks and Individual businesses, which were approached to encourage use of Pickmeup's corporate dispatcher service, by which a minibus can be summoned for an employee or guest. However, Pickmeup reported that businesses did not always initially grasp the features of the service offered.

The **Buzz services** (Figure 1d), created by Esoterix, sought to improve accessibility to distribution parks on the periphery of Bristol, UK. Esoterix deployed a 'holistic business model' (Esoterix interviewee), establishing the principle that everyone who benefits from a transport service should contribute to it. In that sense, the employers are both customers and partners. They benefit through reduced recruitment costs, but are also a channel through which Esoterix reached the final end user: the commuter. A local social enterprise (SevernNet) played a central role in service development. SevernNet, motivated by improving transport provision in the area, provided a point of contact to initiate discussion with employers. SevernNet had the local knowledge and contacts and were useful in local practicalities such as knowing who to contact about, e.g., a lack of bus stops, but would not on their own have had the resources to initiate the services. Some of Buzz's technology was provided by Esoterix and some by its technology project partners. Esoterix also brought funding and "the drive...to make it happen" (Esoterix interviewee). For Buzz 2 local authorities provided some support through match funding employer contributions. Passengers registered for the Buzz 1 service via Esoterix but the service was provided by a contracted operator. Esoterix reported that for Buzz 1 the operator was a somewhat reluctant partner.

Shotl (Figure 1e), based near Barcelona, Spain, concentrated mainly on continental Europe, leasing its software platform (including algorithm, passenger app, driver app and operator app) largely to authorities and operators running subsidised public transport. As part of its service Shotl also provided software support and the data they captured. The strategy was the familiar

concept for on-demand services of improving efficiency by replacing traditional large-bus underused public transport with smaller, on-demand vehicles. A key client for Shotl was the transport operator with a concession license for the public transport in a given territory. Usually, however, the local public administration was also involved, with the decision to engage Shotl coming from the municipality. Shotl leased its software for a fixed amount, so in this model the revenue risk fell on the authority or operator. Shotl was supported by a range of consultants. Some were “experts in mobility and in the territory” (Shotl interviewee). These consultants helped identify specific local mobility problems that could benefit from Shotl’s services. Shotl also partnered with organisations providing public transport payment solutions and route planning apps and considered such integration important. The interviewee noted that transport operators could be conservative, and were not always motivated to increase efficiency when they are paid through subsidy per km.

Shyft (Figure 1f) sought to aggregate and integrate service information about micro-transport operators running minibuses, taxis, and transport services supporting local communities; information which journey planners and MaaS platforms tend to overlook. Shyft did not interact directly with service end users and did not own vehicles (to avoid exposure to cost and risk). A key feature of the business model was to share information on others’ platforms. At the time of interview Shyft was still under development and not fully operational.

Shyft was using subcontracting extensively. For example, the Shyft platform had been adapted from that of another technology company. A partner, with experience of ‘how an operator thinks’ (Shyft interviewee) liaised with the operators, as this met the need ‘...to translate what we do and what we can do into [the operator’s] language’. The Shyft interviewee argued that operators can be risk adverse and are cautious about what Shyft offered. For instance, some operators are concerned that additional demand might overwhelm their existing service capacity. Shyft was prospecting in a climate in which operators can be overwhelmed by offers from technology companies. However, the Shyft interviewee considered that, in the face of threats to their market share from sources such as the ‘transportation network companies’ (e.g. Uber, Lyft, Ola), operators are motivated to become more collaborative and less competitive. For example, it was reported that operators at a Shyft workshop were willing to discuss sharing of assets.

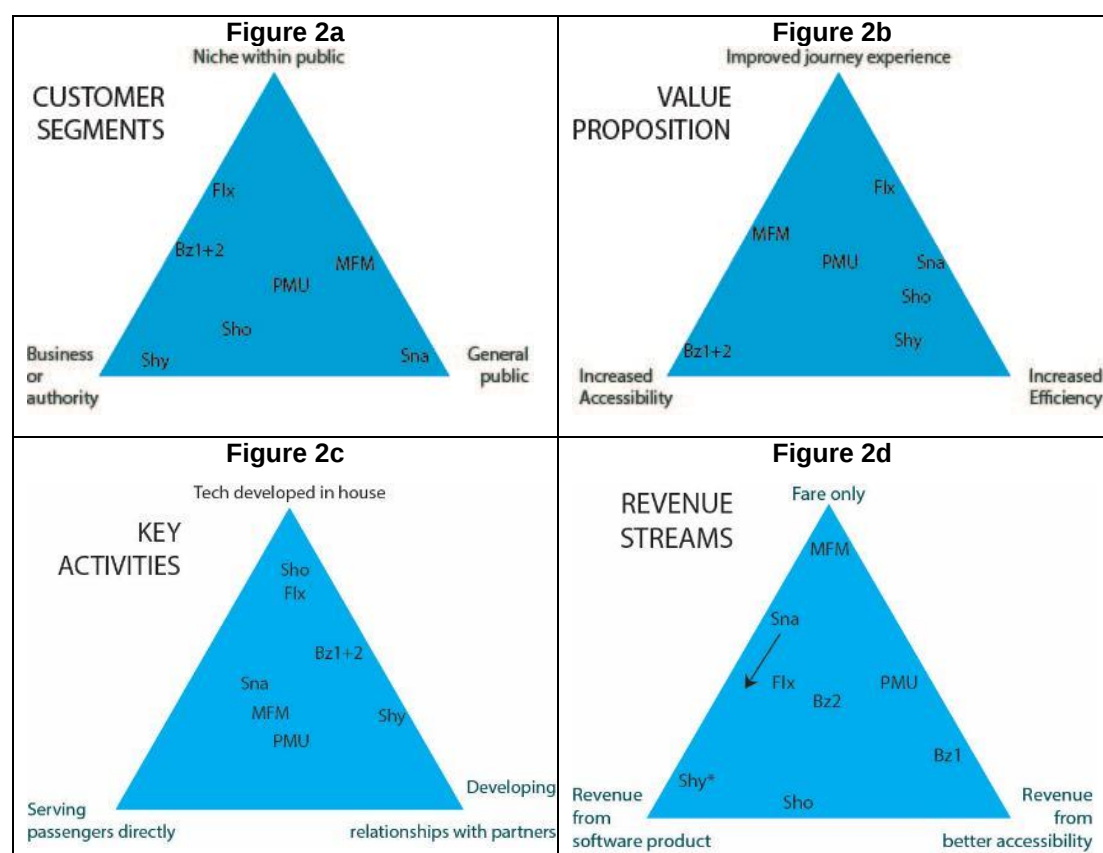
To synthesise the findings on partnership types, a particularly consistent theme emerged around operators and employers. There can be a significant clash of cultures between technology enterprises offering software solutions and transport operators. Operators are not always technologically proficient (the coach drivers in Snap for instance) and may struggle to engage with digital technology companies directly. They were also portrayed by some as being reluctant, conservative or risk adverse. This tendency is apparently reasonable, as most of the interviewees associated the major risk of innovate service operation as lying with the parties who owned/leased and/or operated vehicles and several underlined that they had no intention of so doing. Additional reluctance may arise from the fact that operators are not always seeking increased demand (as Shyft indicated) or increased efficiency (as Shotl commented). However, there was also evidence of more positive partnerships with operators: Some of Shotl’s early adopters were envisaging the sector changing, and Shyft reported operators becoming more collaborative and less territorial towards each other. MyFirstMile was greatly facilitated by the primary local bus operator. Some of Snap’s operators are confident enough in the demand through Snap that they have elected to pay the operational costs themselves and take 80% fare revenue. It is important that enterprises specialising in new technologies understand both the operators’ world and language, and local mobility needs. It could be argued, for example, that MyFirstMile patronage suffered from the affluence and entrenched car use of the area being served. Several enterprises studied relied on partners to inform them about local operators and transport landscapes. Such partners included local authorities, consultants and a local social enterprise.

Five of the services examined in the study involved employers in some way. Employers offer an opportunity as customers/partners. They can be customers due to desiring improved access and commutes. They can be partners through organising (often time specific) demand. Peaks in demand can be an issue when vehicles are underutilised for the remainder of the day. The different approaches highlight two options for attracting commuters on an employer-

specific basis. The first is to offer a superior commute experience (perhaps more attractive to more affluent professionals); the second is to offer accessibility to less affluent employees who would otherwise depend on inadequate access by traditional public transport. Similarly as with operators, the Pickmeup interviewee reported that, for employers, a technology-enabled mobility service can require some explanation, translation and persuasion. Thus both Esoterix and Go-Ahead Group reported ‘courting’ employers as time consuming, although this is presumably less time expensive than approaching employees through different avenues.

Customers and generation of the value proposition

In addition to exploring relationship structures, the interviews located the services in terms of additional business model components. Osterwalder and Pigneur (2010) defined these as including the services’ target customers, what they provide that their customers may value, some of the most important processes by which these are provided, and how they receive revenue.



*In the early stages of its development, at time of interview, Shyft had not finalised how it would seek revenue.

Customer segments (Figure 2a)

A business must consciously decide which segment(s) of customers it serves (Osterwalder & Pigneur, 2010). The services studied variously targeted other businesses and organisations, the general public, and/or a niche market. Shyft and Shotl did not identify end users as direct customers. Shotl’s primary customers were the operators and authorities providing services. They considered their early adopters to be transport providers who were a) sufficiently-well-resourced to purchase their services and b) considered that at “some point this game is going to change and the cities will be publishing calls for tenders, where they will be asking for solutions based in efficiency and based in software” (Shotl Interviewee).

In contrast, some other businesses were either directly or indirectly engaging end users. They can be focused on certain groups of trip makers. Buzz 1 and Flx, for example, catered for employees of participating businesses only. Other services (MyFirstMile, Pickmeup, Snap)

had non-exclusive business models, open to any traveller. However, these may still have certain niches of end user in mind. MyFirstMile sought to attract commuters desiring first/last mile services. Pickmeup sought, amongst other things, patronage to business parks and Snap is significantly patronised by students and young professionals. It should be noted that, as Pickmeup also receives revenue from businesses and business parks, all three triangle points of Figure 2a are relevant to it, to some degree.

Whilst it would be beneficial in sustainable mobility terms for services to attract end-users from private car use, the interviews provided little evidence of this occurring by the time of study. Flx was an exception, which may relate to its South African operating context, in reporting having attracted 60-70% of its users from cars. Go Metro attribute this success to a low initial price for the user, and customers' realisation that not having to drive has benefits for the commute experience and travel time use. In contrast, MyFirstMile struggled to convert users from car from within the area it served, the population of which is older and more affluent than the Bristol average.

Generation of the value proposition (Figure 2b)

As Figure 2b indicates, the businesses examined provided three main products or services that could have value for their customers. Improved journey experience can be achieved through improved travel times, walking distances or in-vehicle experience. Of all the services, Flx perhaps laid the greatest emphasis on providing a superior commute experience for its corporate clientele. This included superior time travel use, due to not having to drive and time saved by not having to park. Pickmeup sought to offer a personalised service. For instance, driver and passenger each knew the other's first name through the booking system. In addition, although this may be a feature of scale, having a relatively small team of drivers meant people can get to know each other relatively easily over time. Snap also sought to offer a superior travel experience, through providing a high quality of vehicle, encouraging customer-oriented driver behaviour, and having demand-oriented pick-up points outside the city centre. Shotl-supported services sought to improve journey experiences by reducing waiting time and travelling time.

Facilitating increased accessibility was a recurring theme amongst the services examined: it was the main value offered by the Buzz services, whilst providing first/last mile access to commuters was a major aim of MyFirstMile. Similarly, providing access to business parks is an important motivation of Pickmeup.

Intuitively, increasing the efficiency of transport provision might be inherent in all on-demand services and applies to most of the businesses interviewed. It was a particularly explicit focus of Shotl, Snap and Shyft. Shotl partly offered gains in efficiency by providing raw data and analytical reports to the customer, which can be used to inform future mobility plans. Again, Pickmeup was in the middle of the triangle due to the broad focus of the business model, as was also the case, although to a lesser extent, for Shotl.

Key activities (Figure 2c)

Although start-up businesses face a wide range of tasks, three key uses of staff time mentioned in interviews were creating and operating technology, serving passengers (and drivers) and creating and maintaining relationships with partners, particularly employers and transport operators. Innovative digital technology is the speciality that a number of the businesses studied offered. Whether technology is created in-house or outsourced is an important decision. Providing it in-house can be time expensive. Thus eleven of the fourteen staff members at Shotl were spending most of the time on technical activities, with only two undertaking business development, and just one, marketing. For Esoterix, technology tasks were also taking significant amounts of staff time. Snap was creating all the necessary technology in-house, which had been time consuming due to the 'trial and error' basis of ab initio development. Go Metro also reported creating all the technology for FLX in-house. As noted, Shyft was contracting out to other businesses for some of its technology needs.

For the businesses that serve end users directly, serving their needs requires significant staff time. Snap, for example, has 'trip controllers' who assist drivers and passengers. The customer service aspect also takes time for Pickmeup, whilst Esoterix sought to conserve

resources by minimising the communications they sent out to MyFirstMile passengers. A number of the businesses reported that creating and maintaining relationships with organisations that are partners/customers could also be particularly time consuming. The Pickmeup and Esoterix interviewees reported spending lots of time promoting their services to businesses, for example through networking at events such as 'business breakfasts'. Pickmeup needed to spend time making sure businesses understood their service offer and Esoterix also mentioned efforts to keep existing partners happy with the assurance they were receiving good value.

Revenue streams (Figure 2d)

From a commercial point of view, a fundamental aim of any private company strategy is to turn sufficient profit in order to provide a return on invested capital (and ideally to provide some support to further development). For start-ups in particular, another strategy is to achieve sufficient perceived market value that other parties wish to invest in the company or buy it outright. Significantly, none of the interviewees volunteered profitability as a feature of their success to date. However, at least in the short-to-medium run, the Buzz 2 service had achieved financial sustainability. Some of the services, MyFirstMile for example, sought the majority of their revenue from fares. As mentioned, Snap was moving towards brokering demand and supply and taking a share of revenue. With Flx, most of the fare that the passenger pays is going to the driver and the operator who owns the vehicle. Flx adds a fee for use of the technology and data, and for business development, and running the service. A number of interviewees referred to the challenge of achieving sufficient revenue from fares (including Esoterix and Oxford Bus Company). Specifically, Flx reported the challenge of receiving enough fare revenue when the operator is being paid a fixed fee, and when there were only two main peaks in demand per day (the am and pm commutes).

A number of the services, including Pickmeup and Buzz1 and 2, sought to derive revenue from monetising accessibility. In addition to fare revenue Pickmeup, for example, monetised accessibility through its corporate dispatcher option, and also through businesses and organisations paying for their employees/members to have some free rides. The model through which the Buzz services achieved revenue through facilitating accessibility had evolved from Buzz 1 to Buzz 2. For Buzz 1, Employers at the sites served could subscribe to the service enabling their employees to use it and then had options of how to whether and how to recoup from its employees. For Buzz2, the employers made up the difference between operating costs and fares paid directly to the services by participating employees.

5. Conclusions

Only eight services were chosen for study from among the plethora being trialled in the shared-ride on-demand landscape. Even with this narrow selection, it is hard to accommodate them in one meta-model summarising the business models. Both the relationship diagrams and typologies by triangle suggest substantial differences between the business models supporting the services examined: substantial variation arises amongst the services examined, in the customer segments targeted, the nature of the value the service delivered, the proportions of time spent on different activities and the sources of revenue prioritised. Differences also exist in the complexity of the business models. Snap and MyFirstMile, for example, exhibited relatively simple structures in terms of their business relationships and revenue strategy. Pickmeup instead was associated with multiple types of partner, and multiple revenue streams. Further differences existed in whether the business was delivering only a component (such as a technological component) within the service being offered to the end user or whether it was seeking to be the primary service provider, i.e., to develop a brand with high visibility to the end user. The position of the chosen business model positioning on the dimensions had important implications for the levels and types of financial risk encountered.

However, commonalities also existed between the models. These were apparent in the small range of partner types typically being engaged (operators, software developers, employers). However, were the sample of businesses studied to be increased, it is likely that there would be a wider range of partnership types encountered. The points of the triangles also represent commonalities amongst the services such that, in the majority of cases, at least one point in each triangle was of substantial relevance, for each business.

A feature exhibited by some of the services was iterative learning when faced by challenges: Snap's evolution of its revenue structure and changes from Buzz 1 to 2 were examples. The primary challenge for the services examined emerged as achieving sufficient revenue. Buzz 2 had become financially sustainable. However, in general whilst every service could report elements of success, such as patronage figures, financial profit was rarely mentioned, and a number of the services had been sustained in their early years by external grant funding, often from research and development funding agencies.

However, notably, most of the services were trying to monetise something other than or in addition to fare revenues, with services like Pickmeup and Buzz seeking multiple revenue streams. Similarly to evidence about profitability, there was little direct confirmation in the research data of the wider sustainability benefits claimed for the new 'smart mobility' actually being achieved, although socioeconomic benefits can be indirectly inferred from increased accessibility and there was evidence in one case of reduced car use.

A second group of challenges exists around the reconciliation of different perspectives: for the technology-enabled services to be successful, technology companies, operators, and other stakeholders must be able to understand each other's objectives. This can be a time-consuming process. That it is necessary, however, reflects Gassman et al.'s (2014) statement (reported above) that innovative business models must balance bringing new elements (in this case technological) to a sector, with understanding the experience of those actors already present in the sector. A number of the services benefitted from third parties helping bridge gaps with these actors. Operators' enthusiasm may be hampered by the risks they may encounter in becoming involved in new services. However, there was also evidence of more positive aspects of relationships with operators, including an increasingly collaborative outlook, and in some cases an impetus to encourage the new services, being evinced by the operator.

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References

- Aapaoja, A., Kostianina, J., Zulkarnain and Leviäkangas, P. (2016) ITS service platform: in search of working business models and ecosystem. In: *World Conference on Transport Research*. Shanghai China, 10-15 July 2016.
- Atkinson, R. (1999) Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of project Management*. 17 (6), pp.337-342.
- Boons, F. and Lüdeke-Freund, F. (2013). Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. *Journal of Cleaner production*, 45, pp.9-19.
- Braun, V. and Clark, V. (2006) Using thematic analysis in psychology. *Qualitative research in psychology*. 3 (2), pp. 77-101.
- Brons, M., Givoni, M. and Rietveld, P. (2009) Access to railway stations and its potential in increasing rail use. *Transportation Research Part A*. 43, pp. 136-149.
- Brown, A., and Taylor, B. (2018). Bridging the Gap between Mobility Haves and Have-Nots. In: Sperling, D. (2018) *Three Revolutions*. Washington, DC: Island Press, pp. 131-150.
- Burghout, W., Rigole, P. and Andreasson, I. (2015). Impacts of shared autonomous taxis in a metropolitan area. In: *Proceedings of the 94th annual meeting of the Transportation Research Board, Washington DC*, 11-15th January, 2015.
- Calvert, T., Jain, J., Parkhurst, G., Shergold, I. and Ward, S. (2019) New opportunities for on-demand shared-ride services to deliver modal shift and inclusive travel. In: *The 17th Annual Transport Practitioners' meeting*. Oxford. 10-11 July 2019.

- Chen, T. and Kockelman, K. (2016). Management of a shared autonomous electric vehicle fleet: Implications of pricing schemes. *Transportation Research Record*. 2572 (1), pp.37-46.
- Cavazza, B., Gandia, R., Antonialli, F., Zambalde, A., Nicolai, I., Sugano, Y. and Neto, A. (2019) Management and business of autonomous vehicles a systematic integrative bibliographic review. *Int. J. Automotive Technology and Management*, 19 (1/2).
- Cohen, B. and Kietzmann, J. (2014). Ride On! Mobility Business Models for the Sharing Economy. *Organisation and Environment*, 27(3), pp. 279-296.
- Crisp, R., Ferrari, E., Gore, T., Green, S., McCarthy, L., Rae, A., Reeve, K. and Stevens, M. (2018) *Tackling transport-related barriers to employment in low-income neighbourhoods*, Joseph Rowntree Foundation, UK.
- Deka, D., Carnegie, J. and Bilton, P., (2010). What Does It Take for Shuttles to Succeed? Comparison of Stated Preferences and Reality of Shuttle Success in New Jersey. *Transportation Research Record: Journal of the Transportation Research Board*, (2144), pp.102-110.
- Enoch, M. (2015) How a rapid modal convergence into a universal automated taxi service could be the future for local passenger transport. *Technology Analysis & Strategic Management*. 27(8) pp.910-924.
- First Group. (2018). *2018 Strategic Report*. Available from <http://www.firstgroupplc.com/-/media/Files/F/Firstgroup-Plc/indexed-pdfs/2018-ARA/pincipal-risks-and-uncertainties.pdf> [14 June, 2019]
- Gassman, O., Frankenberger, K. and Csik, M., (2014). The St. Gallen Business Model Navigator - working paper, St Gallen: University of St Gallen.
- Go Ahead Group (2018) *2018 Strategic Report*. [Online] Available from: <https://www.go-ahead.com/content/dam/go-ahead/corporate/documents/2018annualreport/Strategic%20report.pdf> Accessed [14th June 2019]
- Guardian,(2018) Private companies want to replace public transport. Should we let them? *The Guardian*, 29 March.
- HM Government (2017) *Industrial strategy: building a Britain fit for the future*. London: HM Government.
- Intelligent Transport (2018). MaaS Global secures €9 million in latest funding round. *Intelligent Transport*, September.
- International Transport Forum (2017) *Shared Mobility Simulations for Helsinki*. Paris: ITF.
- Lagadic, M., Verloes, A. and Louvet, N. (2019) Can carsharing services be profitable? A critical review of established and developing business models. *Transport Policy*. 77(C), pp.68-78.
- Meyer, J., Becker, H., Bösch, P. and Axhausen, K. (2017) Autonomous vehicles: The next jump in accessibilities?. *Research in Transportation Economics*. 62, pp.80-91.
- Nguyen, D. (2013). *Fair Cost Sharing Auction Mechanisms in Last Mile Ridesharing*. Dissertations and Theses Collection (Open Access). Available from: http://ink.library.smu.edu.sg/etd_coll/93 [Accessed 30/05/2019]
- Moore, J. (1993) Predators and prey: a new ecology of competition. *Harvard Business Review*. 71(3), pp. 75-86.
- Osterwalder, A., and Pigneur, Y. (2010). *Business Model Generation*. New Jersey: John Wiley & Sons.
- Pangbourne, K., Stead, D., Mladenović, M. and Milakis, D. (2018) The Case of Mobility As A Service: A Critical Reflection On Challenges For Urban Transport And Mobility Governance. In: G. Marsden & L. Reardon, eds. *Governance of the smart mobility transition*. UK: Emerald publishing, pp. 34-46.
- Parkhurst, G. and Lyons, G. (2018) The many assumptions about self-driving cars – Where are we heading and who is in the driving seat? In: *The 16th Annual Transport Practitioners' Meeting*, Oxford, England., 5 - 6 July 2018. Available from: <http://eprints.uwe.ac.uk/36997>
- Parkhurst, G. and Seedhouse, A. (2019). Will the 'smart mobility' revolution matter? Chapter 15 in: Docherty, I. and Shaw, J., eds. (2019) *Transport Matters*. Bristol: Policy Press pp. 359-390.
- Razak, S. (2016) Last Mile Commute: An Integral Component and Driver of Sustainability of Passengers Accessibility in Urban Transport, Portland, Oregon: Sustasis Foundation.
- Zhang, D., Zhao, J., Zhang, F., Jiang, R. and He, T. (2015) Feeder: supporting last-mile transit with extreme-scale urban infrastructure data. In: *Proceedings of the 14th International Conference on Information Processing in Sensor Networks*, April 13-16, 2015, USA, pp. 226-237.