Project no. 691735

REPLICATE PROJECT

Renaissance of Places with Innovative Citizenship And Technology

This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

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REnaissance of PLaces with Innovative Citizenship And Technology

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H2020-SCC-2015 Smart Cities and Communities

Innovation Action (IA)

5.6 ON -DEMAND EV MINIBUSES (BUZZ) DEPLOYED

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1. EXECUTIVE SUMMARY

The purpose of this deliverable is to describe the On-demand EV Minibus (Buzz) service, detail its implementation, extract the lessons learn so far and predict how it will develop in the future.

Buzz provides highly convenient, personalised 'A-to-B' journeys in a shared vehicle, offering new levels of service at an affordable price. The service is events based, with passengers booking transport to-and-from community events, clubs or "events" such as a connection to a rail or coach service. Passengers book transport at least one hour before the event is due to take place. With one hour to go they are texted their exact pick-up location and time.

The price is £1 each way, payable online or in cash to the driver. Buzz minimises its costs by only running when there is custom (passengers booked). Passengers will be able to book Buzz alongside the event it is serving, e.g. a link to book on the Eventbrite events platform or a link to book on a connecting rail service. Event holders are being encouraged to subsidise the transport (to increase the likelihood of people attending their event) and in this way Buzz can become financially sustainable.

Buzz is delivered in an electric "Hackney Cab", an accessible 6 passenger seat vehicle in which the seats are laid out in a social style (facing each other). The use of electrically powered vehicles to deliver multiple journeys will positively impact congestion, air pollution and greenhouse gas emission.

Esoterix hopes to transfer the service model to other local neighbourhoods. It believes Buzz can improve mobility sustainably and play a major role in combating loneliness and social isolation.

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2. REPLICATE

The main objective of REPLICATE project is the development and validation in three lighthouse cities (San Sebastián – Spain, Florence – Italy and Bristol – UK) of a comprehensive and sustainable City Business Model to enhance the transition process to a smart city in the areas of the energy efficiency, sustainable mobility and ICT/Infrastructure. This will accelerate the deployment of innovative technologies, organizational and economic solutions to significantly increase resource and energy efficiency improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas.

REPLICATE project aims to increase the quality of life for citizens across Europe by demonstrating the impact of innovative technologies used to co-create smart city services with citizens and prove the optimal process for replicating successes within cities and across cities.

The Business Models that are being tested through large scale demonstrators at the three cities are approached with an integrated planning through a co-productive vision, involving citizens and cities' stakeholders, providing integrated viable solutions to existing challenges in urban areas and to procure sustainable services. Sustainability of the solutions is fostered in three areas: economic and environmental and finally, fostering transparency in the public management.

In addition, the Model features the replicability of the solutions and their scale up in the entire city and in follower cities, particularly in three follower cities (Essen – Germany, Laussane – Switzerland and Nilüfer-Turkey) that are involved in the project and therefore, have access to know-how and results achieved on the project so they can apply the developed model. At the moment, there are 2 observer cities, Guanzhou (China) and Bogota (Colombia).

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3. INTRODUCTION

3.1 Relation to Other Project Documents

Apart from the reference documents described below the deliverable has no specific relation to other project documents.

3.2 Reference documents

This document is based in the following projects level documents:

Ref.	Title	Description
REPLICATE Grant Agreement signed 240713.pdf	Grant Agreement	Grant Agreement no. 691735
DoA REPLICATE (691735)	REPLICATE Annex 1 – DoA to the GA	Description of the Action
REPLICATE Consortium agreement signed December 2015 (7th December version)	Consortium Agreement	REPLICATE project – Consortium Agreement
REPLICATE Project Management Plan	D1.1 Project Management Plan (v.1) (29/04/2016)	REPLICATE Project Management Plan
REPLICATE District Management Plans	D1.4 District Management Plan San Sebastian D1.5 District Management Plan Florence D1.6 District Management Plan Bristol	REPLICATE District Management Plans
REPLICATE Communication Plan	D11.1 Communication Plan	REPLICATE Communication Plan

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Where there are contradictions, the documents listed above supersede this plan. The Grant Agreement is the contract with the European Commission so takes precedence over all other documents.

3.3 Abbrevations list

GA	Grant Agreement
CA	Consortium Agreement
DoA	Annex I-Description of the Action
EC	European Commission
H2020	Horizon 2020
PC	Project Coordinator
PL	Pilot Leader
PMP	Project Management Plan
TC	Technical Coordinator
WP	Work Package
WPL	Work Package Leader

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4. DELIVERABLE DESCRIPTION

The On-demand EV Minibus (Buzz) provides highly convenient, personalised 'A-to-B' journeys in a shared vehicle, offering new levels of service at an affordable price. Using electrically powered vehicles to deliver multiple journeys at the same time will positively impact congestion, air pollution and greenhouse gas emissions.

The On-demand EV Minibus (Buzz) deliverable is described in the following sections:

- Service Model (Section 5) describes the service offered to the public -the mode of operation, the pricing, the branding and how it is being promoted.
- Electric Vehicle (Section 6) describes the vehicle being used for Buzz delivery.
- Proprietary Technology (Section 7) describes the key system components developed to run services – the passenger interfaces, the driver interfaces, the routing & scheduling algorithms and the back-end system.
- Business Model (Section 8) describes how Esoterix intends to make Buzz financially sustainable.
- Innovations, Impacts and Scalability (Section 9) describes the innovative nature of the service, the impact it has on the lighthouse area and how it can be scaled up and transferred elsewhere.
- Learning (Section 10) captures the lessons learnt during the project so far and how they have been encapsulated for influence on future work.
- Future Plans (Section 11) describes how the service can evolve within the lighthouse area and elsewhere.
- Conclusion (Section 12) summarises the main points of the deliverable.

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5. SERVICE MODEL

5.1 Introduction

The introduction of Buzz within the REPLICATE area needed to wait until suitable electric vehicles became available (see Section 6). In the meantime, Esoterix ran a Beta Trial, using petrol vehicles, in another part of Bristol in order to test service ideas and the performance of the technology in delivering them. Lessons learnt from the Beta Trial, and how Buzz differs from the Beta Trial, are commented on throughout this section. Buzz itself started operating on 17th January 2019.

5.2 Operation

Buzz is a fully dynamic events-based service with passengers booking transport to-and-from community events, clubs or "events" such as a connection to a rail or coach service. Examples include:

- Transport to-and-from a connecting train service at a nearby railway station, e.g. Stapleton Road, Montpelier or Lawrence Hill.
- Transport to-and-from a connecting bus service to Southmead Hospital, e.g. on Stapleton Road or from the Eastgate Centre.
- Transporting to-and-from a community event, for example a running club, a tea party for the aged or a leisure activity such as bingo.

Passengers book transport at least one hour before the event is due to take place. With one hour to go they are texted their exact pick-up location and time.

This is different to the Beta Trial where the transport was provided to-and-from a hub with connecting trunk road bus services. The Beta Trial service was effective at providing 1st/last mile transport for longer public transport journeys but there were drawbacks, namely:

- The service didn't serve local journeys not going via the hub.
- Only a relatively small area could be served as the service aimed to accommodate passengers travelling at any time throughout the day.
- The service had to be available throughout the day as trunk road buses passed through the hub at high frequency throughout the day. This meant vehicles were being paid to sit empty when there was no custom.

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Buzz addresses these drawbacks as any destination can be the location of an event, fixed event times means it can serve a larger area and the vehicle only runs when at least one passenger has booked.

5.3 Interoperability with the public transport network

Buzz interoperates with public transport in two ways:

- It targets a train or bus connection as an event. It will monitor the Real-time Information for that event and delay its departure from the connection appropriately. The real-time information for the connecting service is also provided to the passenger.
- It does not duplicate public transport, it instead extends the reach of the network. Buzz will not provide transport which can be made by an existing public transport service.

These aspects worked well in the Beta Trial.

5.4 Pricing

The REPLICATE area is home to significant social deprivation. Buzz pricing is consequently set at a £1 flat fare for each journey so it can be an inclusive service for the whole community. Passengers can pay online through their Buzz accounts or pay the driver in cash. The latter is necessary as there are residents in the area without bank accounts.

5.5 Branding

Buzz is the brand to be used in the REPLICATE service. The logo is reproduced below. This is designed to express movement and fluidity while being short and easy to remember. It is also a play on the similarity to the word 'bus'.

Figure 1: Buzz logo

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5.6 Promotion

Buzz is being promoted to the organisers of community events in the area, including Bristol City Council, and is advertised through their means of engagement, e.g. event booking sites like Eventbrite and social media such as Facebook.

Connections to bus and rail transport services will be promoted on-street where those connections will take place – the picture to the right is from such an on-street promotion for the Beta Trial.

Figure 2: On-street promotion

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6. ELECTRIC VEHICLE

6.1 Electric Minibus

The implementation of electric vehicles and particularly goods and passenger vehicles has been slower than anticipated because of battery life issues. The vehicles which were available on the market at the time the REPLICATE proposal was written were all subsequently withdrawn. This necessitated Esoterix seeking an alternative accessible, electric vehicle.

6.2 Electric Hackney Cab

The LEVC TX is a fully accessible, zero emissions 'Hackney Cab' released in the UK during 2018. It was selected as the electric vehicle to deliver Buzz due to the fact it is accessible, can seat up to 6 people in a social style layout (the seats face each other) and there is no regulatory problem with licensing (the vehicle is licensed by Bristol City Council as it has under 9 passenger seats) or operation (hackney cabs do not need to be e-hailed in the UK).

Figure 3: LEVC Electric 'Hackney Cab' (left) including access for wheelchair passengers (right)

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6.2.1 Requirements for operation

- Charging: The LEVC TX can use multiple chargers including 7kW, 11kW, 22kW and 50kW. There are several charge points available 24/7 in the REPLICATE area (see Figure 4).

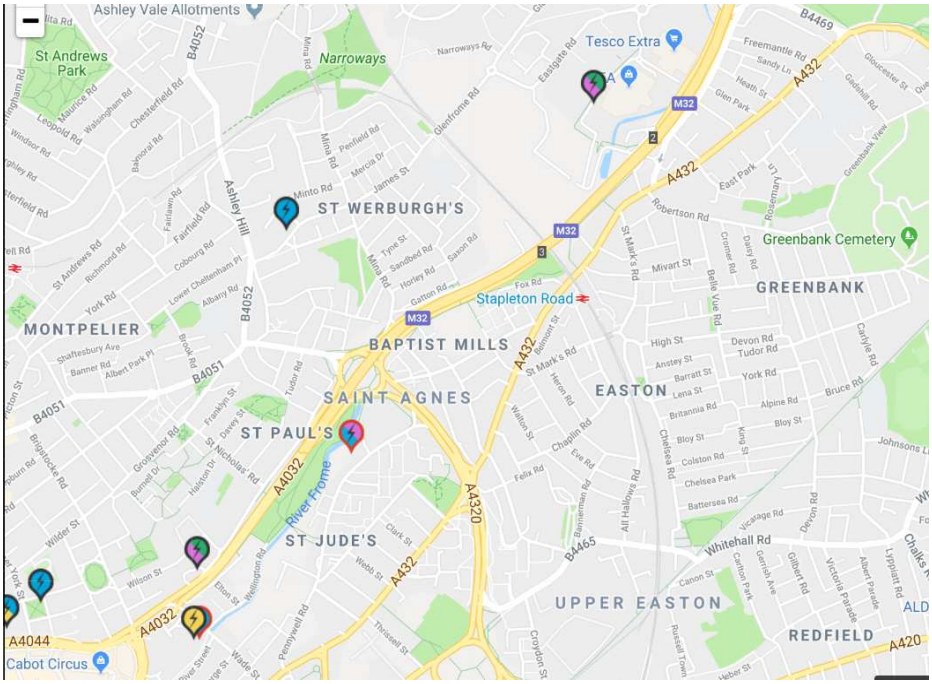

Figure 4: Electric charging points within or just outside the REPLICATE area in Bristol

- Range: 80 miles with a full electric charge; a further 297 miles if the range extender is activated. The electric range is more than enough for the REPLICATE service.

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- Drivetrain: the drivetrain of the LEVC TX is shown in Figure 5. The propulsion is always electric although the electricity is provided by a petrol engine when the range extender is activated.

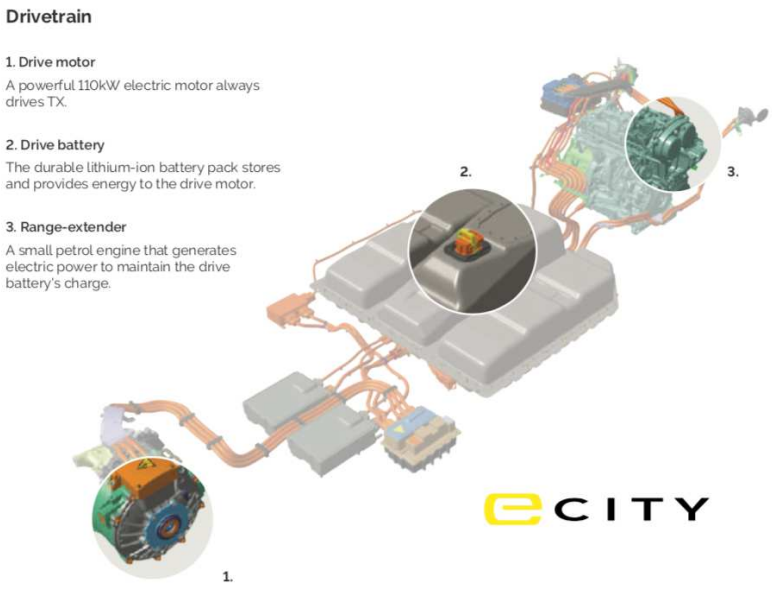

Figure 5: LEVC Electric 'Hackney Cab' drivetrain

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7. PROPRIETARY TECHNOLOGY

7.1 Introduction

This section summarises the technology developed by Esoterix to operate the Buzz service, namely the passenger interfaces, the driver interfaces and the back-end system.

7.2 Passenger interfaces

7.2.1 Booking

Passengers can book journeys through a web interface, an app or by phone in office hours (09:00-17:00 Monday to Friday). A registered user can also book on behalf of another passenger through an online interface.

When they book, so long as there remains capacity in the vehicle, they receive a time window for their pick-up. The exact itinerary of the vehicle is planned 1 hour before the event and the booked users informed of the exact pick-up time and location (Buzz is corner-to-corner rather than door-to-door unless mobility needs necessitate it). It is possible to attempt booking within 1 hour of the event, but the nearest pick-up point will be on the established route.

7.2.2 Fares

Any number of flat fares of £1 per journey can be bought and stored in the ticket wallet of the online passenger account.

7.2.3 Right to travel

Passengers with a smartphone can activate their ticket by clicking Scan On within the app. This opens the camera to scan the QR code which is on display in the vehicle (see Figure 6). This checks their right to travel, logs the time and location and which vehicle they are boarding.

When a non-smartphone user boards, the driver registers the boarding on the driver app (see Section 7.3), thereby updating vehicle capacity, and can accept cash if the passengers fare has not been paid.

Concessionary travel cards are also accepted as payment (enabled by an NFC reader connected to the driver app device), when the Buzz journey is to-and-from a connecting mass transit service on which that concessionary travel card is also valid.

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Figure 6: Buzz QR Code ticketing using smartphone app

7.2.4 Vehicle tracking.

The locations of in-service vehicles are shown on a map in the user account online / in app. The Driver App (Section 7.3) updates the location every 10 seconds.

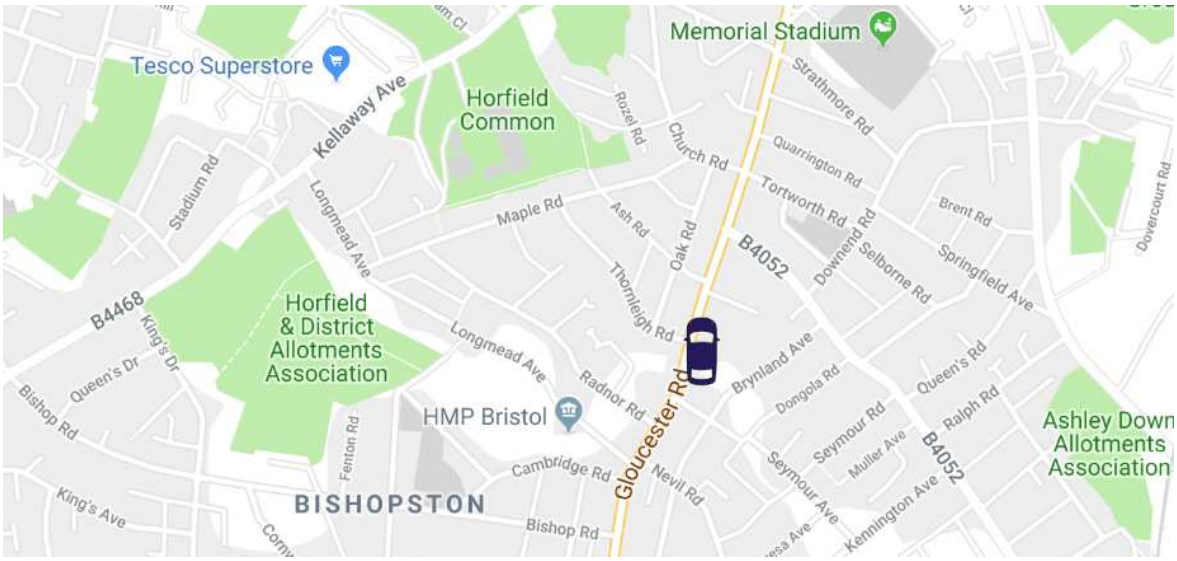

Figure 7: Vehicle tracking via the driver app

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7.2.5 Journey planning

The user can plan any journey by public transport within the greater Bristol area on the Buzz app (see Figure 8). The results include the use of the REPLICATE service Buzz, as and when its available, with any resulting connections to the rest of the public transport.

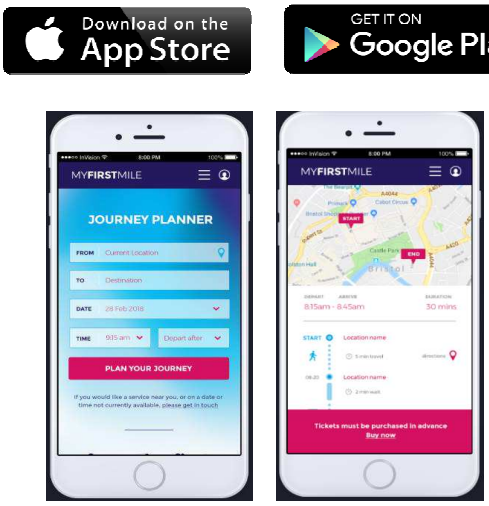

Figure 8: Passenger App available on the App Store and Google Play. The image on the left and right shows the in-built journey planner request and a journey planner result respectively.

7.3 Driver interfaces

7.3.1 Driver App

The driver app is available on Android devices.

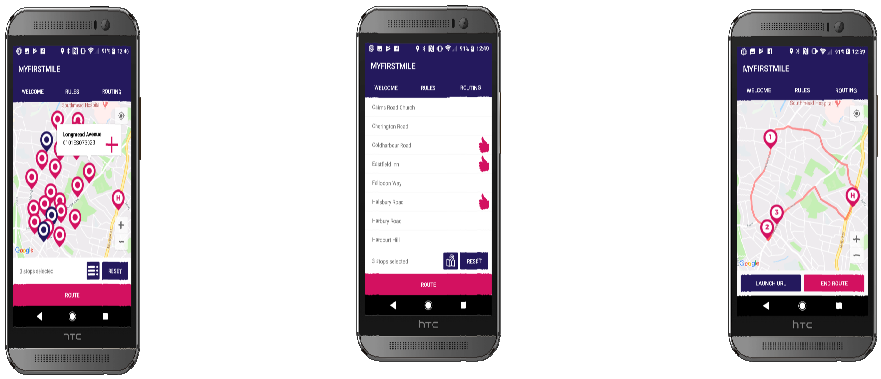

Figure 9: Android driver app. The screens show pick-ups on a map, in a list and on a route.

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7.3.2 Routing & Scheduling

The driver app indicates the route for the driver to follow and updates in real time should one or more passengers' book onto a route whilst the vehicle is delivering it.

7.4 Back-end

7.4.1 Reservation Data Flow

The flow of the data reservation process is illustrated in Figure 10. It indicates how reservations, journey requirements and stop details are encapsulated separately.

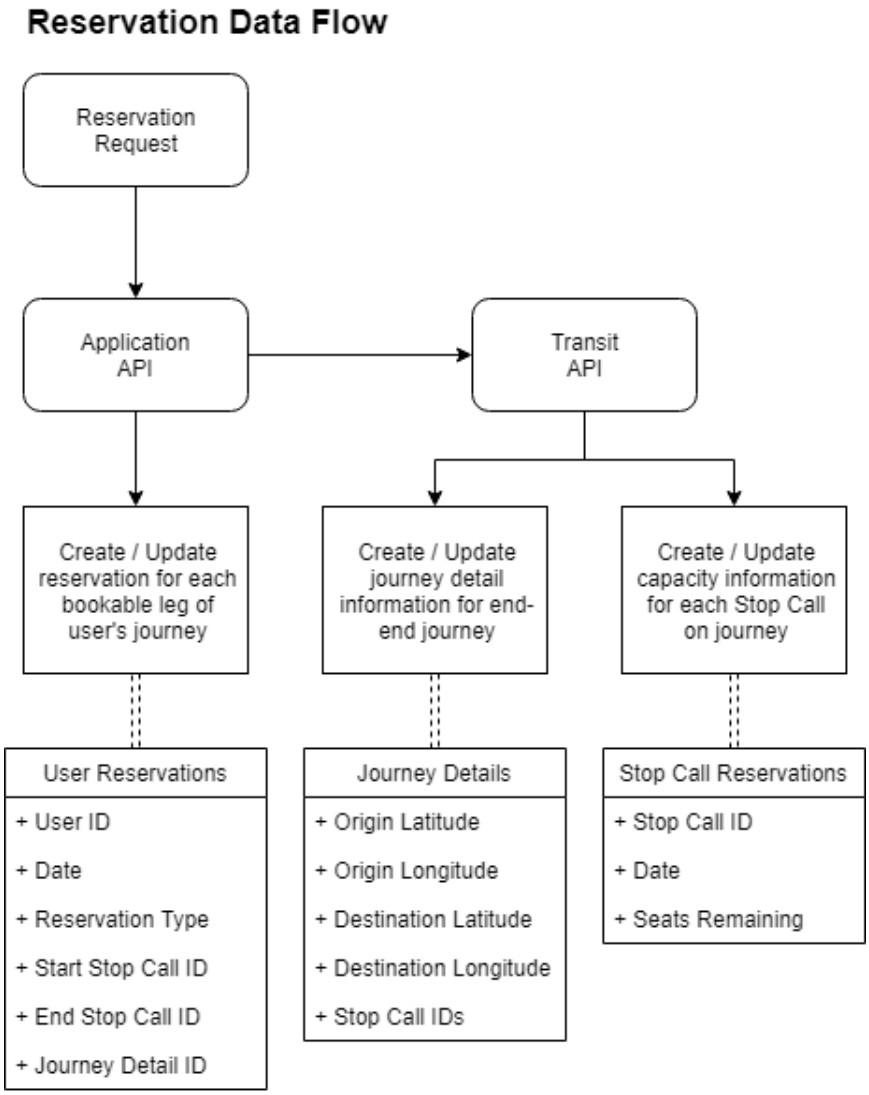

Figure 10: Reservation process data structures

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7.4.2 Reservation and Route Data Structure

The data structures used to implement the reservation process are illustrated in Figure 11. An object orientated design has been employed to ensure the software can be easily re-factored to support services with different reservation paradigms.

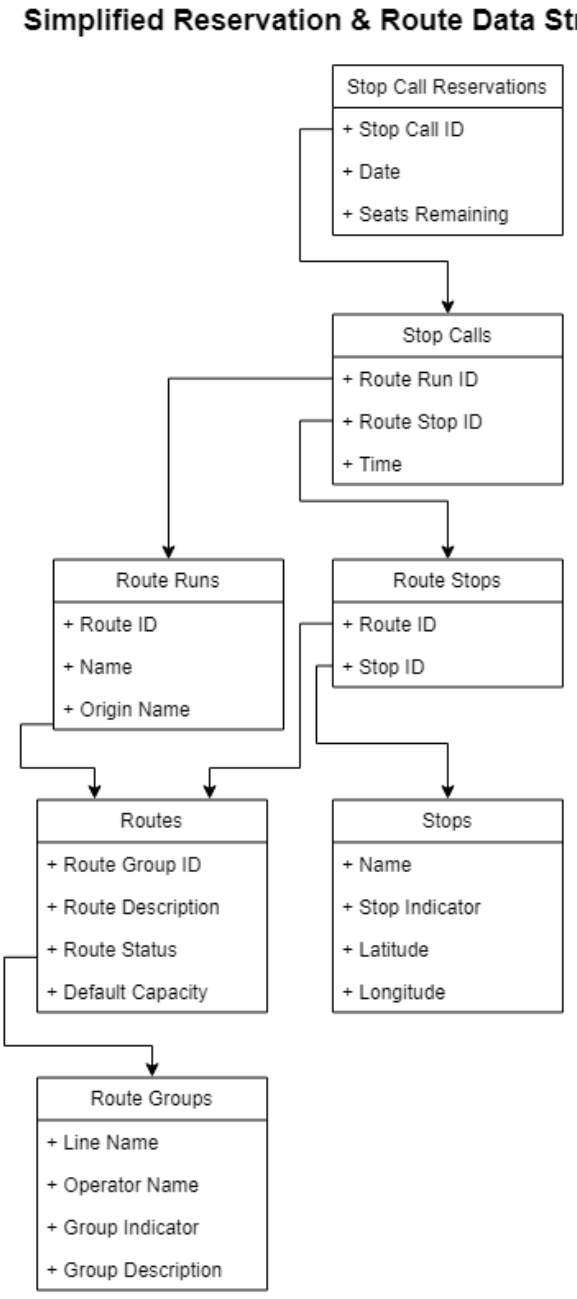

Figure 11: Reservation process data structures

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8. BUSINESS MODEL

8.1 Landscape

Transport is a derived need. People rarely buy journeys for the ride but because they need to get somewhere else. This makes it very price sensitive service and perceptions of what journeys should cost are often far lower than their actual cost. Financial sustainability comes with high occupancy, but some services will always be low demand or will start with low demand and take time to reach solvency. This is a perennial problem for citizens, operators and society in the UK where the deregulated market in the 1980s has led to a shrinking of the public transport network to core, profitable routes leaving individuals and communities isolated from amenities, education and employment opportunities.

The resulting reliance on the car causes well documented (and daily suffered) traffic congestion and air pollution, particularly in cities like Bristol. New business models are needed which recognise the broader benefit of shared transport services and distribute the cost among all those who stand to gain.

8.2 Holistic Business Model

Esoterix has, over the course of the REPLICATE project, developed a holistic business model canvas that shares the burden of the difference between operating costs and acceptable passenger fares, as illustrated in Figure 12 below.[1]

Two forms of financial contributions are required:

- **Per-journey subsidy**. The contributor provides a subsidy for each relevant passenger journey delivered. Examples are:
    - An employer subsidising travel to work for an employee. This can make the employer more attractive to candidates looking for work.
    - A mass transit operator returning part of the fare they receive from a connecting passenger in return for bringing them that custom.
    - A local authority subsidising transport for apprentices or a charity subsidising transport for older people.

[1] Business model developed with valuable input from other project partners within WP7

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- **Pump-priming**. The contributor provides funds to cover the costs of service introduction and the shortfall in revenue whilst the service is growing. Examples are:
    - A local authority pump-priming a service to an out-of-town business park to encourage sustainable economic growth.
    - A grant awarding body pump-priming a service to meet the awarding body's economic, social and environmental goals.

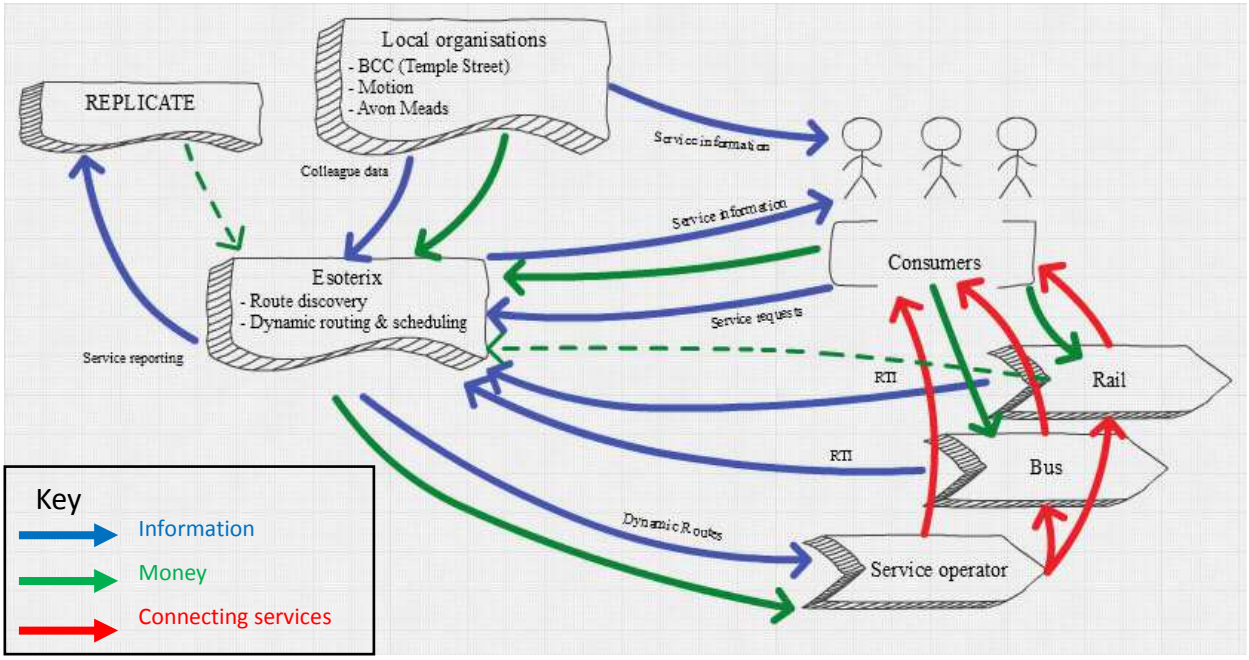

Figure 12: Example holisitic business model for on-demand EV minibus (Buzz)

8.3 Buzz Business Model

The roles discussed in the last section are going to be filled in REPLICATE as follows:

- **Per-journey subsidy**.
    - Bristol City Council. The council runs several initiatives in the area and it will subsidise transport which makes those initiatives successful. An example is a running club which normally has a high attrition rate.

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- Other event holders. Esoterix is keen to offer transport for events, particularly for the mobility disadvantaged. Events have a natural collation of demand for transport to-and-from a location at the same time, and the transport can be made available alongside the event itself on booking sites such as Eventbrite.
- Connecting bus transport. Esoterix is coming to an arrangement with First Bus, the largest bus operator in Bristol, whereby it provides connecting bus tickets as part of its 1st/last mile service and only passes on part of the price of that ticket to First.

- **Pump-priming**.
  - REPLICATE is effectively pump-priming initial operations. The service will therefore be tuned to its project goals, delivering affordable services for communities in electrically propelled vehicles.

8.4 REPLICATE Service Continuing Viability

The long-term continuation of the service depends on its hours of operation.

- **Off-peak**. Taxi drivers are not fully employed in off-peak hours and are willing to work at a fixed hourly rate rather than sit idle at a taxi-rank. Since the platform – booking, payment, ticketing etc. – is fully automated, the Buzz service can continue to operate off-peak so long as the hourly income exceeds the vehicle cost. This may require some per-journey subsidy but not an excessive amount.
- **Peak**. At peak hours the taxi drivers can expect to find plentiful custom at a metered rate, which is well-above the fixed hourly rate discussed above. Consequently, drivers will provide Buzz services as peak times only if
  - The fixed hourly rate approaches that available from metered work. There is unlikely to be enough per-journey subsidy to achieve this. Or
  - The amount of off-peak work is significant enough to be able to contract drivers for time blocks covering off-peak and some peak. This is the case in the first 6 months of the Buzz service thanks to REPLICATE pump-priming.

In summary, Buzz can continue to operate in the long term in off-peak hours (with some support from event owners) but not in peak hours until there is enough off-peak work to leverage driver peak hour contributions.

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9. INNOVATIONS, IMPACTS AND SCALABILITY

9.1 Introduction

This section covers the impact of both Buzz and the Beta Trial. Future impacts from Buzz service will be detailed in the progress report documents.

9.2 Innovation solution

The Beta Trial had a large impact on the industry in the UK. It was the first "microtransit" service to extend the network (rather than duplicating it) and to be fully inclusive, catering for all passengers.

It has been front page news in the most widely read industry periodical and Esoterix staff have presented at conferences alongside the likes of Uber and Google (see Figure 13).


LOCAL TRANSPORT TODAY

POLICY | PLANNING | FINANCE | DEVELOPMENT

First trials taxibuses to feed passengers onto main routes

Bristol Metrobus is ready to roll

Treasury will hold purse for rail upgrades

Seven steps to speed-up cycle scheme delivery

PROVIDING INDEPENDENT NEWS & ANALYSIS SINCE 1989

TOP10

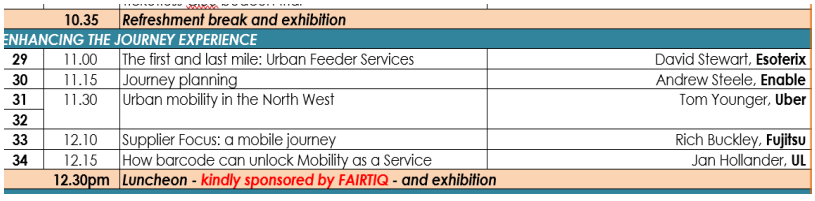
	10.35	*Refreshment break and exhibition*	
ENHANCING THE JOURNEY EXPERIENCE			
29	11.00	The first and last mile: Urban Feeder Services	David Stewart, **Esoterix**
30	11.15	Journey planning	Andrew Steele, **Enable**
31	11.30	Urban mobility in the North West	Tom Younger, **Uber**
32			
33	12.10	Supplier Focus: a mobile journey	Rich Buckley, **Fujitsu**
34	12.15	How barcode can unlock Mobility as a Service	Jan Hollander, **UL**
	12.30pm	*Luncheon - kindly sponsored by FAIRTIQ - and exhibition*	

Figure 13: Example dissemination in the UK in the Local Transport Today periodical (left) and presenting at the Transport Card Forum conference alongside Uber (right)

Buzz will add extra interest to that generated by the Beta Trial by being the first "microtransit" service to self-organise itself around the purposes for transport rather than trying to provide any transport for anyone at any time (which is proving very difficult to provide in a financially

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sustainable way). The event-based approach to transport can be particularly relevant in rural communities which have no major public transport services.

9.3 Social impacts

Buzz will make it easier for those without a car to access jobs and services, sustaining the economy and improving quality of life. It also wants to provide transport to events with direct social impact. For example, it will deliver people collectively to a sports club, helping form social bonds and joint motivation, and it will provide transport to-and-from social events which combat social isolation and loneliness.

9.4 Environmental impacts

Buzz will measure the primary energy consumption and the total CO2 emissions of the service in operation. By contrasting against the modes of transport users would otherwise have taken, it will be possible to calculate the primary energy, air pollutants and CO2 emissions saved per journey in Buzz.

9.5 Replication and scalability potential

There are several potential suitors for the transfer of Buzz to their geographic locations, including the cities of Newcastle and Manchester and the counties of Kent and Gloucestershire. Esoterix has an advantage over other operators in its inclusive nature, its data-led approach and its holistic business model. But other microtransit companies (in the Uber mode) may be prepared to operate at a significant loss in order to gain market share.

Esoterix is interesting to speaking to the other REPLICATE cities and follower cities to assess the potential for commencing Buzz operations in other European countries.

9.6 Economic feasibility

Buzz will not have long to establish commercial sustainability. Nevertheless, the holistic business model will attract subsidies from the local authority, agencies and charities once it is established. A flexible arrangement on supply means the service is never incurring cost when there are no journeys to deliver.

9.7 Impact on SME´s

Sections 9.2 & 9.5 described the impact that the Esoterix SME is now having on the UK market. Esoterix is also keen to work together with other SMEs capable of adapting and innovating in their operating models and services. It is working with the following SMEs due to REPLICATE:

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- City Fox Group. A PHV & PSV operating company keen to explore new operating models.
- Classic Taxi. A Hackney Carriage company introducing electric taxis into Bristol.
- Urban things. A mobile ticketing company trialling new ticketing paradigms.

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10. LEARNING

10.1 Lessons learnt

From the Beta Trial:

- More consideration should be given to demographics when designing a service. The Beta Trial operated in a relatively affluent area with a high average age and high levels of car ownership. The people attracted were generally younger, public transport using individuals. BUZZ will operate in an area which is less affluent, with a low average age and low levels of car ownership.
- More engagement with the community could have improved service visibility and encouraged faster take-up. In Buzz the service will in general only run with that engagement by tying provision to community events.
- Sharing is not a barrier to people using the service. In fact, the experience of sharing was generally positive.

10.2 Problems identified

The main problems facing Buzz have been:

- Availability of Electric Vehicles. The REPLICATE proposal was submitted at a time when there were electric minibuses on the UK market; there are no longer. Electric Hackney Cabs are now an attractive alternative and this change was approved by the project.
- Budget. Most of Esoterix' operating budget was mislaid during the submission of the final REPLICATE bid. Esoterix can fund operations for 1 vehicle for up to 2 years but only for part time services until a level of financial sustainability is reached.

10.3 Risks and mitigating activities

The biggest remaining risk is achieving financial sustainability given the budget difficulties described above. In mitigation Esoterix has arranged for flexibility in supply, meaning it is mainly only paying for the supply when the transport is being used.

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10.4 Dissemination activities

Buzz and the Beta Trial was disseminated at:

- Transport Card Forum, Manchester, 26th September (David Stewart)
- Collaborative Mobility Conference, London, 26th/27th September (Liz Davidson)
- Smarter Travel Live, Liverpool, 17th October (Siobhan Myles)

This Project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 691735

11. FUTURE PLANS

Esoterix' future plans include

- Participation in an extended MaaS trial in a UK city with an Integrated Transport Authority. Manchester, for example, has conducted a MaaS trial to attempt to change citizen behaviour but hasn't yet include affordable 1st/last mile transport services.
- Participation in a service for more rural communities. The service will be hub and spoke based around mass transit hubs and focus more on maximising the supply side, with volunteers and community transport organisations providing journeys for the community which help decrease social isolation and loneliness.

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12. CONCLUSIONS

The REPLICATE Buzz service will benefit from the lessons learnt during the Beta Trial service:

- Buzz will engage directly with citizens by providing transport for events, ranging from local clubs and activities to connections with longer distance mass transit.
- Buzz will be highly affordable, offering journeys at £1 each way, to ensure that price is not a barrier to take-up in a relatively disadvantaged area.
- Buzz will save money by only operating when events are booked. Buzz can become commercially sustainable with contributions for the transport sourced from event organisers who realise the benefit it provides them.