

4 Smart Public Transport in Barbados:
Experiences with Smartphone Applications

J. R. Kotzebue and K. Bryan

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Towards Sustainable Transport and Mobility

Perspectives on Travelling and Commuting
in Small Island States

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4 Smart Public Transport in Barbados: Experiences with Smartphone Applications

J. R. Kotzebue and K. Bryan

Barbados has started to use ICTs to improve the mobility and services in public transport in the early 2010s. The small island state has a correspondingly small transport market because of its geographical position and size. The landmass of Barbados is approximately 430 square kilometres and approximately 286,000 people inhabit the island, which is comparable to a medium-sized city in Europe (EB, 2020; GovBA, 2020). More than 1.5 million tourists visit the island every year. The economic development highly depends on the telecommunication and transport infrastructure (Nurse, Stephenson, & Mendez, 2016).

With introducing smartphone mobility application, Barbados is following a worldwide trend of increasing ICT use in public transport. ICT is regarded as a key resource in enhancing sustainability (Gebresselassie & Sanchez, 2018). For example, many cities around the world have introduced automated fare collection systems and automatic passenger counting systems that collect data when passengers use smart cards or credit cards for the payment when they enter or exit the bus (Yap & Munizaga, 2018). GPS bus-tracking systems provide real-time location data and are used to inform passengers about the position and arrival time of the next bus (Singla & Bhatia, 2015). The collected data is then used to improve the transport management, support the transport development and can contribute to an Intelligent Transport System, which ultimately leads to better time management and better lives for city residents (Davidsson, Hajinasab, Holmgren, Jevinger, & Persson, 2016; Mallik, 2014).

Despite the opportunities, the investment in ICT in transport in Barbados has been limited. Three major types of public transport operators operating on the market: state-owned public busses, private-owned minibuses and shared right fix-route taxis (ZR). The state-owned public transport provider, the Transport Board (TB), has introduced an online (WordPress and Google-maps based) bus-route finder that allows user

to view bus schedules, routes and stops on a virtual map. Since 2010, four independently produced smartphone travel applications for passengers and tourists had been introduced on the market. However, the transport market in Barbados, and the Caribbean, differ significantly from established transport markets in the US, Europe, and Asia, and generally, in the Barbadian market there is little cohesive understanding of the specific needs of the customers, riders, operators and other stakeholders. Even more challenging, data about the use of the various transport modes are lacking. Therefore, this paper addresses two questions:

- First, to what degree do the public transport smartphone applications in Barbados address their target market?
- Second, to what extent do the applications address the transport needs, especially as it relates to the stated governmental goals?

In response to the questions, this examination identified major prospects through a literature review, analysed 87 customer reviews and the product descriptions. The book section starts with a brief description of the public transport policy and practice in Barbados, followed by an explanation of the analysis method. Subsequently, a presentation of the results, a discussion of the research question, and final recommendations for several measures for the further development of the use of mobility applications on Barbados' transport market will be made.

The Public Transport Policy and Practice

The Policy Framework

The public transport development in Barbados is based on a legal framework, but an overarching integrated and sustainable transport policy is lacking. Major policy guidance comes from transport-related strategic plans like the National Strategic Plan of Barbados, the Barbados Growth and Development Strategy and the Barbados Tourism Master Plan (table 4.1) (GovBar, 2007a, 2013a, 2014). The most recent direction concerning the digitalisation and the development of the public transport sector is provided in the “Barbados Energy Policy 2019–2030” that includes a strategic course for the development of the transport sector. The strategy focuses on the abolition of diesel and gasoline in the policy period, the reduction in the number of vehicles per capita, the improvement, convenience and attractiveness of public transport. A general goal is to promote the use of public transport. Moreover, the vision includes policy measures to

“establish the use of management technology in public transit”, e.g., using smartphone applications to verify arrival times of buses” (GovBar, 2019ap. 83).

Table 4.1 Major Policy Strategies and Public Transport Goals

AGENCY	STRATEGY	DURATION	MAIN GOALS
Ministry of Economic Affairs and Development Barbados	The National Strategic Plan of Barbados	2006–2025	<ul style="list-style-type: none"> + Development of an efficient transport system and infrastructure. + Enhance access to public transportation, especially for persons with disabilities and higher age groups. + Reliable and adequate public transport system. + Private participation in provision of public transport. + Introduction of prepaid travel cards. + Exploring alternative fuels in public transport vehicles. + Implementation of appropriate traffic management systems and infrastructure. - Reduction of road fatalities.
Ministry of Economic Affairs and Development Barbados	Barbados Growth and Development Strategy	2013–2020	<ul style="list-style-type: none"> + Development of an integrated public policy and investment programme. + Development of an efficient transport system and infrastructure + Development of reliable public transport system. + Encourage use of mass transportation system
Ministry of Tourism and International Transport	Barbados Tourism Master Plan	2014–2023	<ul style="list-style-type: none"> + Comfortable waiting areas for public transport users at touristic transport hubs like airports. + Public transport facilities. + Improve and safety standards, organise and discipline minibus and route taxi service providers.
The Ministry of Energy, Small Business, and Entrepreneurship	Barbados National Energy Policy	2019–2030	<ul style="list-style-type: none"> + Greater percentage of electric (EVs) and hybrid vehicles. + Use of bio- and alternative fuels in public transport. + Establish a transportation information system. + Introduction of a renewable and clean energy into the public transportation system. + Convenient and attractive public transport options.

Note. Compiled by J. R. Kotzebue

The central government had also commissioned several transport studies to prepare a National Transport Plan. For instance, the government received financial and technical assistance from the World Bank in the 1990s. The programme had the stated objective of improving the physical transport infrastructure and road network. Additionally, the government intended to use the assistance to:

- Reform the public transport sector
- Improve the regularity framework to initiate a sustainable road maintenance system
- Digitalise the financial system of the Ministry of Public Works, Transport and Housing
- Privatisise the Barbados Transport Board and staff training

However, the programme implementation largely failed due to the lack of proper planning, evaluation, monitoring and control mechanisms (WB, 1999).

Goals from Barbados' Growth and Development Strategy 2013–2030

The Barbados Growth and Development Strategy 2013–2020 aims to develop an efficient transport system, infrastructure, an integrated public transport policy and investment programme. The strategy stresses sustainable green economic growth and development, which includes the transport sector (GovBar, 2013b). However, the strategy does not have a focus on transport, nor does it contain holistically clear strategic measures that address the entire public transport system and support the potentials of digitalisation. The Growth and Development strategy highlights the lack of mobile-internet penetration, though there is a robust internet infrastructure and high mobile and smartphone penetration. To address this, the government announced that it will develop a national ICT strategy, however, this still does not erase the concerns that policy guidance for application developers, especially as it relates to transportation application development, is still lacking (GovBar, 2013b, 2019b).

Transport institutions

Establishment of the Transport Board - 1955

Although the policy framework is in favour of public-private partnerships and power-sharing, the governance structure in the transport sector is highly centralised. The state-owned Transport Board (TB) – established in 1955 – is still the primary organisation for providing and maintaining the public transport facilities, including busses and terminals through the Transport Board Act. At the time of writing, it is evident that key suggestions from the reform programme hosted by the World Bank in the 1990s were

not implemented. The bank had suggested the privatisation of the TB, to allow it to operate in part or wholly under the influence of the free market.

The TB has the power to transport goods and passengers, maintain and operate the bus service, provide amenities and facilities for public transport passengers (GovBar, 1978).

Though the TB is permitted to create programmes for reorganisation, they are subject to the direction of the Ministry and thus the minister of Transport and Works. The minister appoints the chair and can replace members of the board, which strengthens the central character of the system (GovBar, 1978). Currently, the TB continues to financially depend on governmental support and struggles with growing debt. Passengers are increasing according to the available annual reports, many of which, since 2014, are not publicly available (GovBTB, 2010).

Establishment of the Transport Authority - 2007

As the World Bank has recommended in the 1990s programme, the government established a Transport Authority (TA) in 2007. According to the Transport Authority Act, the major aim is the planning of a public transport system, monitoring and regulation of the public transport system, driver licencing as well as up-to-date information. This latter task includes the maintenance of a digital public transport database. Even though the authority advises the Ministry, the minister gives direction to the general policy of the Authority, approves the appointment of the director, the employment posts within and the Authority's finances (GovBar, 2007b). Whilst the law determines that the Authority has to develop a 5-year development plan for the public, the plans are not published on the TA's website.

The TA is also responsible for administering licenses routes and permissions to private operators who operate the privately owned ZR that can carry 5 to 15 passengers, and minibuses serving 11 to 24 passengers on fixed routes. Thus, the TA did not replace the Transport Board, which remained excursively responsible for providing bus terminals, operating and maintaining the public transport fleet, comprising 28- to 42-passenger busses (GovBA, 2021).

Despite the moderate reforms, Barbados has no free-transport market. The transport system and policy are centralised with little monitoring, evaluation, or control mechanisms. The transport market is non-transparent about the passenger numbers, the operating bus fleet and the number of vehicles. For instance, information about passenger numbers can be misleading, while the available interim reports of the TB state

that the numbers of passengers are increasing in the state-owned public transport, an independent study states that passengers per vehicle are decreasing because of the increase of private operators (GovBA, 2009; Gwilliam, 1996). Anyway, up-to-date data is lacking. This situation creates uncertainties for application developers to invest in the Barbados transport market. A policy that supports, guides, and ensures collaboration and transparency in the transport sector would be central to encouraging the growth for application developers and transport-system providers.

Regardless of the lack of a national transport policy and ICT development guidance, the transport market could benefit from the further development of ICT use because private transport operators offer on-demand services and would allow commuters to have greater visibility into their (private operators) availability.

However, due to a lack of data, transport demand and supply is unclear to all parties involved, including public transport owners, operators and commuters. This results in an unsustainable situation, because frequently, operators run below their capacity or provide too little transport opportunities, which increases the waiting time of potential passengers. Furthermore, private transport providers run without a schedule and the busses of the TB merely have a fixed starting time and location, and no fixed times to reach designated stops. Due to many of these challenges, punctual transport planning and modal switching are nearly impossible. Hence, it is important to assess the opportunities for the mobility applications that have already been introduced.

Method

Defining Mobility Application

ICTs in mobility and transport have many dimensions, but a clear definition or criteria for mobility application are absent. Scholars used broad criteria to classify a mobility application, e.g., the relevance for transport behaviour and the need for making trips (Cohen-Blankshstein & Rotem-Mindali, 2016; Gössling, 2018). However, this definition allows for broad interpretation and can deliver an enormous number of applications. For instance, Gössling identified nine dimensions that define a transport application (Table 4.2) (Gössling, 2018).

Table 4.2 Nine Dimensions of Transport Applications

Travel Information	Remote working	Convenience
Planning and Routing	Payment & price comparison	Space and distribution
Sharing	Safety	Health and Mobility

Note. Adapted from Gössling, 2018

Smartphone applications can have relevance for almost all human behaviour like e.g., education, art, and culture. However, his study has a narrow perspective focusing on the following dimensions of transport applications:

1. Travel information
2. Planning and routing
3. Payment and price comparison
4. Multi-modality and sharing

Other criteria for inclusion into this study were:

1. Accessibility, which means the application had been offered on a smartphone through Google Play or Apple App Store.
2. The application must be in use.
3. It must address at least one of the highlighted dimensions, e.g., provide real-time traffic information, vehicle position, departure and arrival time, multi-modality, ridesharing, and is used for the organisation of demand transport.

Accordingly, four mobility applications were identified on the public transport market in Barbados. The first was introduced in 2016 and others followed in 2019. All apps were offered free to the user, but one application has in-app purchases that offer certain services for additional costs. All applications except for one are Barbadian companies. Currently, no international service provider is offering on-demand transport and ride-sharing, but there is one local company offering both these services.

The Literature Review and Content Analysis

This section comprises two parts, a literature review and the content of the analyses of the customer reviews and product descriptions. The content analyses were conducted using MAXQDA, a qualitative data analysis program.

Literature Review

The review of literature from the field revealed that numerous empirical studies, which analysed smartphone applications, saw potentials in the three sustainability dimensions: social, economic, and environmental. The literature highlights the social potentials for travellers and public transport providers. For instance, a major potential is real-time information about traffic congestion, passenger numbers and occupancy rate (Nelson & Mulley, 2013; Simonyi, Fazekas, & Gáspár, 2014). Others include building and creating trust in the applications and supporting commuters' day-to-day activities (Schmitz, Bartsch, & Meyer, 2016).

From the economic perspective, experiences show transportation apps alter users' perception of transport costs and value (Shaheen, Cohen, Zohdy, & Kock, 2016). For instance, applications aim to attract car owners and older people to use public transport because of the cheaper or more economical cost of use (Hounsell, Shrestha, McDonald, & Wong, 2016; Schütze, Schmidt, Liimatainen, & Siefer, 2020). While it is frequently highlighted that the applications have a positive economic effect on the users, few empirical studies have been found that measure this effect on the public transport providers.

Notably, it has been shown that the choice of the transport mode has numerous environmental effects. For example, a positive effect on the overall carbon footprint as well as energy efficiency, since more users are using fewer vehicles to get from their places of origin to their destination (Singh, Gurtu, & Singh, 2020). Table 4.2 shows the general potentials taken from the reviewed literature. While the initial content analysis demonstrates the providers' perspective, a second content analysis was also carried out to examine the customers' perspective.

Customer Reviews and Product Descriptions

In this analysis, 87 customer reviews and the product descriptions were examined. These were published on the distribution platform, on other travelling platforms that inform customers about the apps, and the provider's social media site. Although the reviews give an opinion of customers, the results need verification by further research. A reason is that, e.g., the app providers could have manipulated the reviews. For instance, one of the providers only had positive reviews that were all published in the same month and year while another provider did not publish any reviews on the distribution platform. Table 4.3 shows the keywords that were used to analyse the application's information and customer reviews.

Table 4.3 Applications' Sustainability Dimension, Potentials and Keywords

SUSTAINABILITY DIMENSION	POTENTIAL	KEYWORDS
	+ increase, support / - reduce	
Social Travellers	+ Everyday activities + The willingness to travel + Journey planning, long, mid and long term + Self-determination + Informed choices + Orientation	Information, plan, useful, safe, easy, choice, good, nice, love it, helpful, ok, real time, life destination Wrong information, uncertain, not working, poor, bad, useless
Social Transport Providers	+ Real-time information, traffic, congestion, passengers, occupation rate + Route instruction + Announcement of service	Real time, life destination
Economic Travellers	+ Travel incentives + Price comparison + Switch of transport modes	Compare, price, bus, taxi, PSV
Economic Transport Providers	+ Ridership + Transport marketing + Fleet efficiency	Efficient, waiting time
Environment Travellers	- Carbon footprint	Environment, health
Environment Transport Providers	+ Fuel efficiency + Energy efficiency - Congestion	Energy, environment

Note. Compiled by J. R. Kotzebue

Results

The Product Descriptions

The content analysis of the application descriptions shows that all application providers offer supportive information for travelling and better planning. Three providers highlight the benefit of real-time information, like the vehicle location. Three applications' descriptions stress that transit across Barbados becomes better and easier to plan. Two providers state that the apps offer a more convenient way to get transport whilst another one advertises customer safety. One provider underlines the potential for taxi drivers to increase income. Other identified keywords as listed in Table 4.3, like environment, energy, efficiency, waiting time, real time, were not included in the analysed applications' descriptions (Table 4.4).

Table 4.4 Frequency of Keywords in the Product Descriptions

KEYWORDS	FREQUENCY
Information	10
Plan	7
Easy	5
Helps/better	3
Choice	3
Convenient	2
Safe	1
Income	1

Note. Compiled by J. R. Kotzebue

The Customers' Perspectives

Considering the customers' review of the applications, the content analysis shows that most customers experience the applications as good, helpful, and satisfying. Information being provided is often mentioned. At the same time, customers stressed in their review that some of the applications are not working properly, displayed wrong information, and create uncertainties (Table 4.5). Additionally, the analysis shows a divided picture. While some customers find the applications easy and useful, almost the same number of customers express disappointment and discouragement in their reviews.

Table 4.5 Frequency of Keywords in the Customers' Reviews

KEYWORDS	FREQUENCY
Good/helpful/satisfaction	17
Not working	10
Information	7
Easy	6
Discouraging	6
Wrong information	5
Disappointment	5
Useful	4
Uncertain	3
Plan	2
Choice	1

Note. Compiled by J. R. Kotzebue

Discussion

The Potentials

The study revealed several potentials for app developers to connect more deeply with sustainable three dimensions and with the Government's goals (Table 4.1). According to the literature review, mobility apps have potentials in all three dimensions of sustainable development, social, economic, and environmental. However, the literature reviews also showed that environmental potentials are presently less in the focus of the application developer and providers. For instance, a study highlighting the potentials of apps stresses their ability to enable social communication, foreseeing travel conditions, and locations (Wang & Fesenmaier, 2013). Other studies confirm that users utilise a travel app because they communicate, need information about the mode, time, conditions, and buying tickets. Users did not mention environmental information or reasons (Jamal & Habib, 2019; Meng, Kim, & Hwang, 2015).

The findings of this study reveal that the application providers mention the positive environmental effect of using public transport and shared mobility. However, applications often lack a function to inform users about the environmental effects of their behaviour. It is notable that none of the offered applications in Barbados includes a function that informs users about the carbon footprint or energy efficiency, for example. Also, the economic aspects are hardly addressed. Merely one provider highlighted that taxi drivers can generate extra income with the benefit of the app. No provider spoke about savings from taking public transport. We can therefore see that the application developers primarily focus on the social aspects in the use of their apps.

When we refer back to the Barbados Government's stated policy, one of the main development goals is to create a green and sustainable transport sector. According to this study, the apps support customers in their travel behaviour but they do not necessarily encourage them to change behaviour or to switch transport mode because of economic or environmental reasons. In this regard, the applications have further potentials for growth to align with the identified sustainable development goals and governmental goals.

The Challenges

The challenges mainly relate to in-app purchases and content biasing. From the analysis of the application product description, all providers highlight that the apps will

inform the users and that the application will help to manage and to guide them. For instance, some applications provide background information about places of interest and offer live information about the vehicles. However, this study reveals that apps may also contain wrong information, which discourages customers and may create uncertainty or disappointment. Similarly, the apps' content can be biased and sometimes does not always have the goal to guide customers towards efficiency, informed choices, and self-determined outcomes, as highlighted by the literature. For example, one app mainly provides sponsored content, and crucial information is linked to in-app purchases. Here, the content mainly serves the so-called "behaviour targeting". The application generates data to identify the consumers' preferences, to display personalised promotional content and to sell certain products. This is opposed to providing robust transportation information (Mishra, 2020).

The study also reveals a difference in potential regarding the product's usefulness. While the literature and providers stress the benefits of travel planning, customers rarely mention this advantage explicitly. One reason could be that applications often allow and foster on-demand behaviour by providing information about real-time (actual) conditions. Therefore, users can freely decide and are not forced to pre-commit to a certain option, and this means that customers may plan less in advance and become discouraged when applications seem not to be working (Hey, 2005). The users may not recognise that the outcomes may be related to the time of day that the customer is searching and the actual availability at-the-moment in time.

Transparency

Generally, the bias in reviews does not allow for full transparency. Only one developer published all reviews, while others published reviews only in the beginning or just positive ones. However, it is important to note that scholars consider customer satisfaction, service reliability, information quality and responsiveness important factors for the trust of customers in any digital service (Cho, Yoo, Jeon, & Choi, 2019; Kim, Xu, & Koh, 2004). The factor of trust and credibility is also linked to the availability of customers' reviews, as they provide an important source of information about the service. Therefore, some transport applications in Barbados give little orientation. They, accordingly, limit customers' choice as they do not have a full overview of their options.

Other Limitations

Other app limitations are more structural in nature and rely on the deployment of required digital infrastructure features. For instance, limited real-time data are rooted in the insufficient digital infrastructure. Another potential limiting aspect is that users' smartphones are sometimes the limiting factor. Some users also have smartphones with insufficient storage that create malfunctions of the application, or they have cell phone plans, which have limited or no-data access in the billing cycle. Additionally, the costs for the data use might exceed the personal benefits so that may cause users to rate apps in a negative way.

Many of the potentials that are mentioned in the literature are related to apps that are designed for a transport system with fixed time schedules and routes. This does not reflect the reality of the Barbadian transport system. One has to keep in mind that the Barbadian transport system functions mainly with unscheduled and variable routes. If app developers do not consider this aspect properly, this can reduce the usefulness of apps for customers and multi-modal transport users.

Finally, to enable the most useful outcome for the customers, there should be greater cooperation between transport providers and application providers. In the case of the state-owned TB busses, the government could consider collaborating in a public-private partnership.

Conclusion and Recommendations

The chapter questioned to what degree do the public transport smartphone applications in Barbados address their target market, and to what extent are the transport needs. When considering merely the results of the content analysis, it becomes clear that the smartphone applications in Barbados only partly match the highlighted opportunities. The identified opportunities have three dimensions: the social, economic and environmental, but in Barbados, the applications primarily focus on the social aspects. Nonetheless, most users are satisfied and find these apps helpful.

This work also discussed how the lack of transparency around customer reviews for some applications might lower the overall trust in all the applications. As shown, only one developer fully displays all of their reviews. We can see that opportunities, like applications, providing better detailed and informed options and opportunities to plan, can be greatly improved. In general, there is little guidance and consistency of reviews

on the market, so customers are often on their own when they are searching to find appropriate smartphone applications.

Nonetheless, it may continue to prove difficult for the transport providers and application developers to come together when public transport largely depends on the government's policy. The TA regulates the number of vehicles through licences and the routes for private transport providers, like minibus owners and route taxi drivers. The state-owned TB runs and maintains the public busses. For both segments – privately owned or publicly operated – there is no mandate to install GPS devices, and there is little to any central coordination of routing and management. This makes it difficult for developers to invest in the market and to develop applications that largely fulfil the needs of the passengers. A holistic transport and ICT policy is lacking, and implementing this policy in the near term would streamline and enable the development of the transport application industry.

Based on the presented findings, we recommend that the government create more partnerships with transport operators and application developers who are focused on transport optimisation. The collaboration should be accompanied by studies and technologies that monitor and evaluate the development of the apps to create appropriate mobility applications. The study shows that the missing policy framework creates uncertainties in the small market so that international developers do not invest, and existing local and regional applications and application developers cannot fully develop their opportunities.

If the government has the goal to create a smart, green, and sustainable public transport system, it is necessary to create a supportive environment for public transport operators, application developers, and to steer applications so that all the social, economic, and environmental dimensions are realised.

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