Working Elements of a Dynamic Public Transport System

By

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A thesis exhibition presented to OCAD University in partial fulfillment of the requirements.

for the degree of Masters in Design in Digital Futures

OCAD U, 130 Queens Quay E Tower, Floor 4R, Toronto, ON M5A 0P6, April 4-6, 2024

Toronto, Ontario, Canada, 2024

April, 2024

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Abstract

Working Elements of a Dynamic Public Transport System is a research and design study based on the development of a reinvented public transportation system for Grand Cayman in the Cayman Islands. The research explores the current travel landscape of the island as well as the public transportation industry on a global and regional level, applying relevant technologies and related systems. The proposed design includes a two-part system with dynamic capabilities to utilize communication through technology and increase efficiency. An installation was developed to explore changes in behaviour and current practices of public transportation users. Public transportation, systems in technology and specific technologies and design thinking are mobilized throughout *Working Elements of a Dynamic Public Transport System*. Design Thinking both as an underlying methodology and as research method builds on a user centric point of view to develop more responsive systems that utilize the island's existing transit routes. Cognitive Semiotics in the context of signs and symbols applicable to transit was used to help drive the research process and is applied to drive the research process and Thinking Through Making in several creation of the prototypes and the final thesis exhibition.

Keywords: Transportation, Urban Design, Technology, Innovation, Communication

Acknowledgements

I acknowledge the Scholarship Secretariat Unit within the Ministry of Education of the Cayman Islands Government for funding my studies at OCAD University.

Dedication

I dedicate this thesis to my mom, who continues to give me the courage and support to push myself - you are the reason I am writing this thesis today. To my husband who continually supports and encourages me to always do my best. To my primary advisor Dr. Sara Diamond, my secondary advisor Professor Jeremy Bowes, my external advisor Cheryl Giraudy, and my university professors Adam Tindale, and Emma Westecott, who patiently coached me through this writing experience. Last but most definitely not least, to my family, friends and peers who provided motivation and inspiration through many discussions, moments, and experiences during my studies. Thank you all for being with me through this journey and pivotal moment in time.

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Glossary of Terms

TERM	DEFINITION
ZDTL	Zoned Dynamic Transit Line
MRTL	Main Rapid Transit Line
CIG	Cayman Islands Government
GPS	Geographical Positioning System
ICS	Intelligent Communication Systems
ITS	Intelligent Transport Systems
ICT	Information and Communications Technology
IOT	Internet of Things
MAC	Medium Access Control
GIS	Geographic Information System
CCTV	Closed Circuit Television
API	Application Programming Interface
IDB	Inter-American Development Bank Group
LED	Light-emitting Diode
LDR	Light Dependent Resistor
MaaS	Mobility as a service
ODT	On Demand Transit
OSI	Open System Interconnection
SOI	Sign, Object, Interpretant

Chapter 1: Introduction

Research Summary

Public transportation, systems in technology, specific technology applications and design thinking are explored throughout *Working Elements of a Dynamic Public Transport System* to inform the design process of creating a dynamic public transportation system for Grand Cayman. This thesis proposes elements of a dynamic public transportation system designed for the travel landscape of the island. In context, dynamic means flexible and able to adapt to context changes. The standard definition of the term 'dynamic' is (of a process or system) characterized by constant change, activity, or progress. This research applies principles from both definitions by introducing a two-part system, and by exploring communication through technology within a dynamic bus system. The new system, entirely of my design, focusses on efficiency and communication by introducing a dynamic approach of public transportation to the island utilizing some of the existing routes. The dynamic zone uses a call mechanism as a mode of communication between bus driver and passenger, turning the standard bus stop into a crucial communication device for the system. Ideas are generated through design thinking, creating a solid framework for each segment of this dynamic system.

The design manifesto addresses the issue of inaccessibility of transportation to rural areas and introduces a way to reduce the lack of communication between rider and bus while focussing on an overall goal of increasing travel efficiency. To supplement this project, the study of 'Cognitive Semiotics' and 'Thinking Through Making' provides knowledge and background that aid in the 'why' and 'how' behind the design. These research tools are used respectively to organize the thesis thought process with an underlying aim to modify both perspective and behaviours of public transit users in the transportation solutions put forth. These methods have a further application for generating design outcomes that can help combat a history in Grand

Cayman of reactive as opposed to proactive, user centred transit solutions. Ideas are explored with present and potential future issues in mind to provide solutions in the hopes of providing a solid framework for future development (*NRA Strategic Operations Plan 2022-2024 final draft 052022 - Cayman roads*). Figure 1 provides a visual of the thesis plan outline.

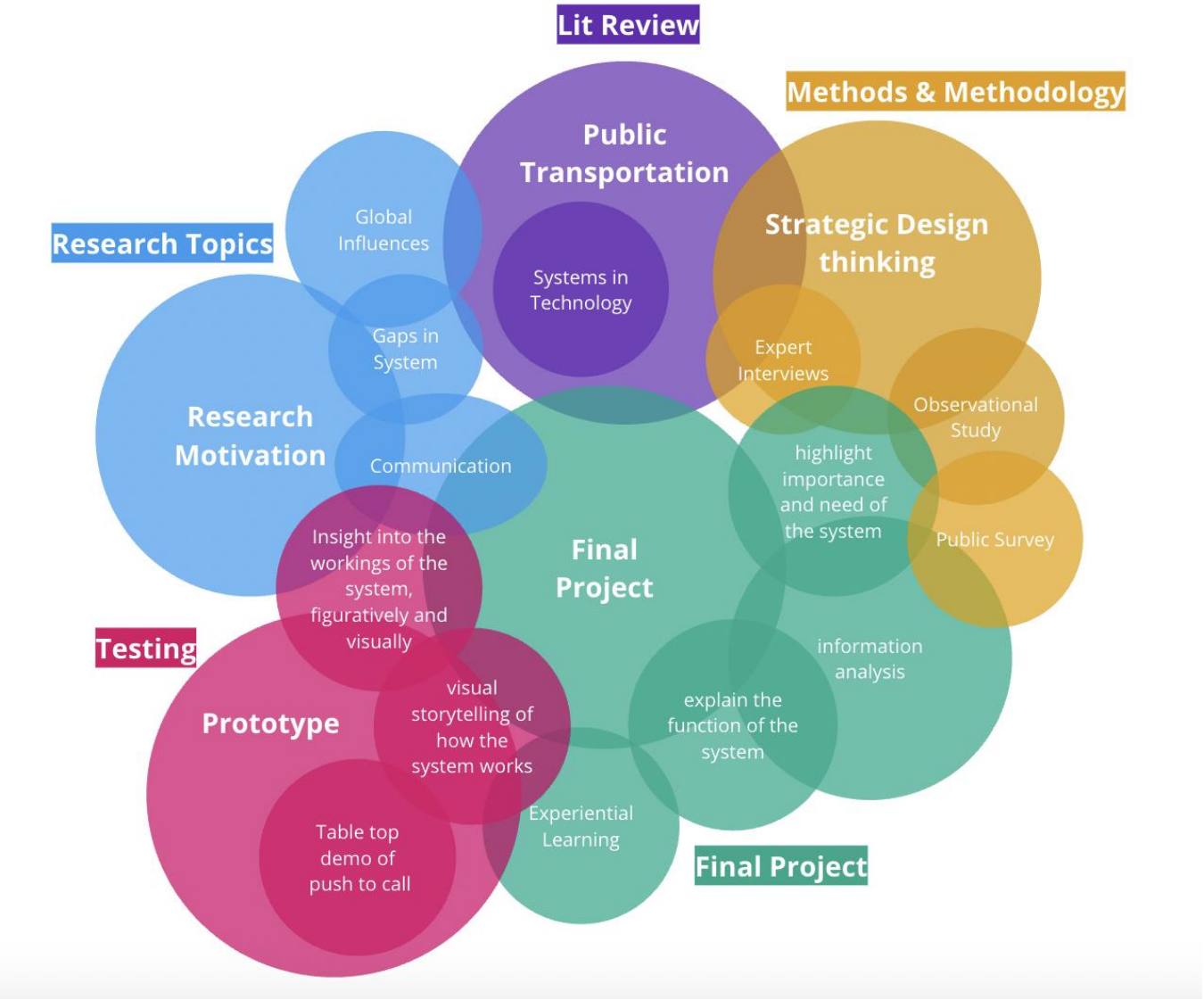


Figure 1: Diagram of Thesis Plan Process & Outline

Research Motivation

The Researcher's Family Background

I was born and raised in Grand Cayman, Cayman Islands. The fact that I have experienced increasing traffic congestion, new road patterns and minimal development of the public transportation system on the island, forms the motivation behind this research. In addition to this, patterns in the current travel landscape have highlighted alarming statistics, such as the steady incline in the importation of cars from 2018-2022 being 4790 per year with import fees ranging between 22-27%. (*New Vehicle Importation Restrictions Introduced*). This dependency on cars can be seen as one of the factors hindering the developmental process of improving and modernizing the public transportation system.

Global Influences

Globally, the adoption of technology in transportation has increased to respond to the imperatives of environmental sustainability and to increase efficiency in transportation. Technology has been pushed to the forefront of research, development, and implementation of infrastructure. In his book, *Sustainable Mass Transit: Challenges and Opportunities in Urban Public Transportation*, Abdallah states that in the United States, the Federal Transit Administration has received a steady increase of funds over the past decade for projects that are focussed on designing and implementing new technologically advanced systems. Abdallah further highlights the importance of focussing on strategies aimed at convincing people to use public transportation, a common issue in areas where personal cars are the preferred mode of transit. The consensus is that where public transportation is "plentiful, reliable, comfortable, safe and affordable" (Abdallah), people are more likely to consider it as a viable option.

The Union Internationale des Transports Publics/International Association of Public Transport (UITP) is a worldwide network for transport stakeholders and sustainable transport modes, on-demand transit being one of them. The UITP offers insights on initiatives that are taking place in transit. The UITP highlights focus areas that have become problematic in the past in the hope of helping new projects to progress smoothly in their development. Based on current behaviour and trends in the industry, UITP predicts a significant growth in on-demand transit, and funding to develop on demand transit options by 2030 (*On-Demand Mobility*). The goal is to have this research influence the design and development of Grand Cayman's public bus system that effectively uses technology to be more user friendly and convenient for both visitors and locals.

Geographical landscape and Size

Grand Cayman currently operates a small public transportation system designed to fulfil the previous population size. The system is not tailored for the current or projected sizable population of potential users. The evolution of the existing infrastructure of the travel landscape is in transition and has been recognized by the Cayman Islands Government as an issue that needs solving making the timing of this thesis work appropriate for the implementation of a new and efficient public bus system. The number of potential transit users, the existing bus routes and the opportunity for better utilization of the current bus fleet also contribute to the motivation around this research. In addition, the antiquated structure of the public transportation system further provides the opportunity for a new system to be implemented with minimal disruption. This means that changes can be adopted at a much faster pace and smoother manner in comparison to a geographical location where the public transit population is much larger, the public transportation system is complex and deeply rooted after years of movement and adaptation, for example the Toronto Transit Commission (*About the TTC*). The motivation behind the scale of the project stemmed from witnessing multiple short lived private

transit solutions attempted by start up's offering ride share services. The feasibility of a technologically advanced system on the island was also encouraged by research about and lessons drawn from other failed attempts in adjacent islands which will be highlighted further below. Given that Cayman already obtains public and private relationships in transportation, the thesis acknowledges the socio-economic impact and plans to uphold these relationships where best possible.

Gaps in the current Transit System

A literature review that considers Public Transportation, Systems in Technology, Design Thinking, Cognitive Semiotics and Thinking Through Making is the foundation of this study. The goal is to explore gaps in the transportation industry in Grand Cayman, Cayman Islands, to envision a more feasible public transportation system through the lens of user centric design.

Focus on Public Transportation

The research focuses on public transportation within the travel landscape of Grand Cayman, and integrates emerging technologies applied in other parts of the world. Understanding behaviours and habits of the current population will influence the design of the new system, impacting technology use and selection, implementation planning and design placement. Additional issues that prompted the thesis idea are issues in Grand Cayman regarding road congestion and lack of changes within the public transportation industry.

Road Congestion

Over the last decade in Grand Cayman, there has been an increase in imported vehicles resulting in a rise in road congestion across the island. The solution to the congestion have been to widen the roads to accommodate more personal vehicles and the increasing population (*New*

Vehicle Importation Restrictions introduced). Some individuals attribute another reason behind the increase in vehicle importation to be the lack of an updated public transportation system which repels potential transit users. Historically, changes to the road system in Grand Cayman have been the responsibility of the National Roads Authority who are responsible for new highways, road widening and traffic diversion to name several responsibilities. (*Rosita Ritch, Last updated 01 July, Cayman Islands Major Capital Projects for 2020).*

About the Researcher

The researcher's strengths are problem solving, strategic and creative thinking. Throughout their studies at OCAD University, key courses that have benefited this thesis and professional development are, 'From Data to Perception' and 'Cognitive Semiotics' where the researcher had access to insightful readings and exercises that were used to develop the creative problem-solving strategies outlined in this study.

Goals and Objections

The goal of this study is to redesign the entire public transportation system of Grand Cayman to significantly reduce the number of personal vehicles. The redesign aims to develop a dynamic system that is efficient, dependable, safe, accessible, one that betters the quality of life, with a specific focus on working commuters. How can a system allow for this, while introducing new and sustainable technologies? The proposed transportation system will rework the current layout of the public bus route in Grand Cayman to accommodate both a main transit line and a new on-demand zoned system while prioritizing communication through technology across various elements of the dynamic transportation system.

Research Questions

Primary

How can research inform the reconstructed design of public transportation in the Cayman Islands to consider the proposition of a dynamic public bus system?

Secondary

There are two key secondary questions arising from the primary query:

In what ways may we reduce the communication gaps between the rider, a back-end control system and the driver, while improving movement and efficiency within a public transit system?

How can an installation be used to explore changes in behaviour and current practices of public transportation users?

Significance and Contributions / Problem statement?

Scope and Research Limitations

Tackling a project of this magnitude means that before and after the launch of the new system there are multiple layers that would need to be addressed, researched, analysed, and evaluated for it to function. Given the time-period of this thesis, the focus is on the exploration of various technologies and processes that could be developed to realize a dynamic public transportation system and the development of a prototype.

Thesis Structure Outline

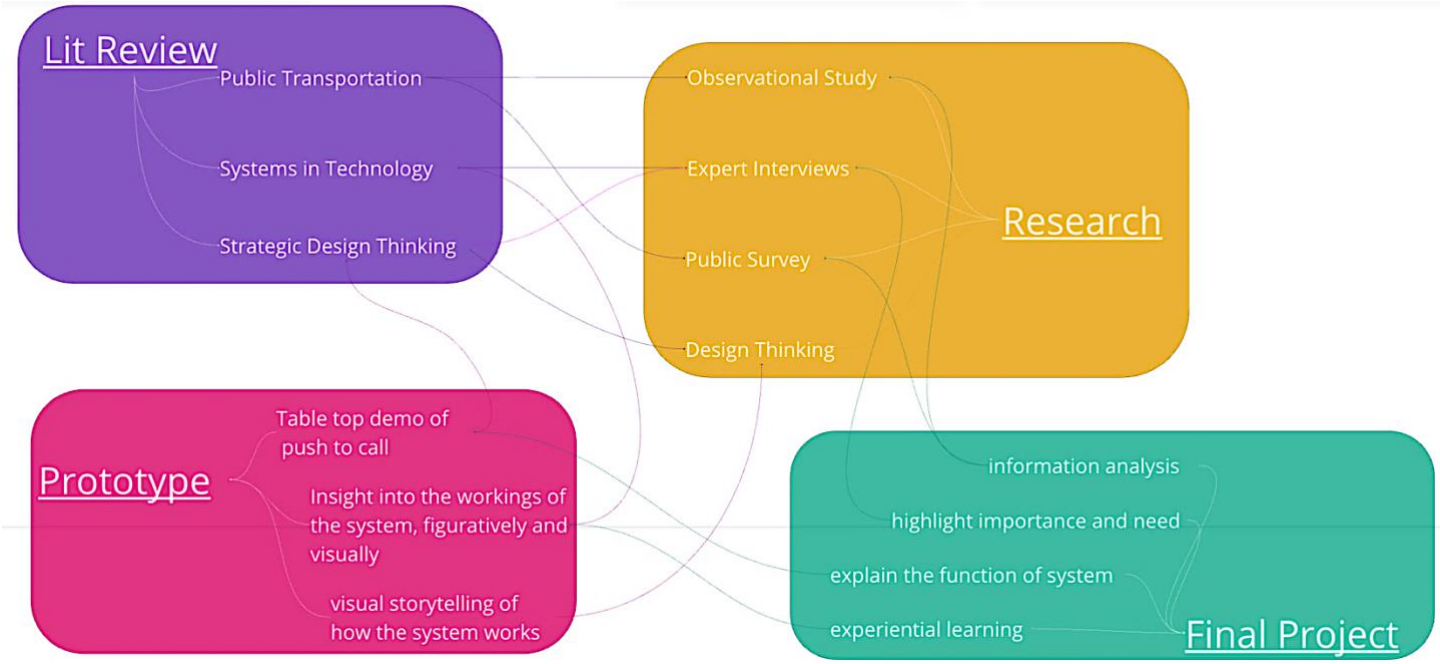


Figure 2: Thesis Process Structure

The research process outlined in Figure 2 was supported through an overview of the transportation industry and technology applications in transportation and strategic design. Understanding these topics in unison helped to build foundations and establish research parameters to attain a fully rounded analysis of the travel landscape in Cayman. Interviews with government officials, experts in the industry within the Caribbean and worldwide introduced different perspectives that could be used in the design thinking process of the study. A survey of transit users, combined with observational studies provided insights regarding barriers and opportunities to improve the current system. Combining the initial inspiration for the project with this new collection of information was useful in understanding the best way for the project to be presented. The exhibition presentation is an amalgamation of an explanation of research findings, a display of experiential learning, and a demonstration. The final project was initiated by thinking on a large scale with no space or financial limitations.

At the same time, the final project emerged through iterations and feedback from a series of prototypes. The ideal prototype was to create an environment where users scan in at an "actual" bus stop, a bus arrives and users begin a short journey informed by information from research findings, the meaning behind the study, how the system that I have designed works, and the goals of the overall research. The final project houses these ideas on a smaller scale where users scan, sit in a chair and are provided with the illusion of riding a bus while receiving the information mentioned above through video format.

Chapter 2: Background

Contextual Review

The Cayman Islands

The analysis from an independent study conducted mid- research may inform the background and critical context of the project. The current bus system in Cayman consists of 9 bus routes governed by the laws of Cayman and driven by individual bus owners. The vehicles used are minibuses which typically seat maximum 16 passengers. The bus shelters are provided through Rotary Cayman and are used as a form of advertising. (*Rotary Central Cayman – We Are People of Action*, n.d.) Studies show that the population of the Cayman Islands is rapidly increasing (*Cayman Islands' 2021 census report* - eso.kyw). Due to trends and effects of population increase seen in other countries around the world, traffic will add to congestion and safety challenges (Retallack and Ostendorf). With this increase, facilities and current business systems and practices will need to be adjusted to accommodate the movement of a larger population. There will be more people who will travel to work, more customers for restaurants, hotels, businesses. More road construction will be the priority strategy because the response to

growth has historically been a reactive method of expanding roads and increasing housing developments, as opposed to an initiative-taking approach with long term predictions in mind (*How Cayman's infrastructure is leading the way in the Caribbean*, Morgan).

Similar Travel Landscapes

To develop a strong background, this thesis is supported by further readings that highlight developing countries and related public transit in regions like Cayman. Of relevance is *Introduction to Sustainable Public Transport Solutions in Latin America and the Caribbean (LAC) and Asia*. Several similar patterns in Latin America are found in relation to Cayman. In particularly, the increase in cars, population growth and "…lack of institutional transit infrastructure to cover the demand and absence of appropriate transit planning…." This thesis study considers solutions in relation to the LAC and Asia travel landscape, to enable a push for more sustainable framework towards public transit and highlight urban mobility concepts that can be adapted. (Jauregui-Fung, Franco).

To continue regional exploration, '*Public Transportation in the Caribbean'* highlight consistencies in transportation through Caribbean countries including Jamaica, St. Lucia, Barbados, Guyana, Trinidad, and Tobago. In this paper, these countries are referred to as developing countries. While this is not a term typically used to describe Cayman, the method of using a minibus as the main vehicle for the public bus is similar. The paper also mentions that paratransit modes and shared taxis are also offered, both of which provide flexible transportation options including door-to-door transportation and book to call methods. There are points that resonate with the Cayman travel landscape and might find strategies proposed in the thesis to be of value:

- Barbados has a high transport demand with narrow roads making traffic congestion common.
- Traffic volumes and residual congestion is increasing in Jamaica with road development happening on an as need basis.
- Guyana's development has resulted in concentrated business and commercial communities, increasing the issue of bottle necks.
- St. Lucia is facing structural issues involving travel routes due to the geographical makeup of the island.
- Trinidad and Tobago have implemented dedicated public transport routes which emergency vehicles also have access to.

These issues are highlighted to display the similarities within countries in the Caribbean region and further recognizes the importance and necessity for strategy and design in public transportation. However, it can be said that the scale in which technology being prioritized as a solution for public transportation, was not seen as a priority in the development and efforts within these countries.

Literature Review

Overview

The literature and contextual review for this study explores Public Transportation, Systems in Technology and Design Thinking, Cognitive Semiotics and Thinking Through Making, and helps demonstrate the approach to this study. These bodies of knowledge support the topic as a whole and build a foundation for the project scope.

Public Transportation

On-Demand Public Transportation

As defined by the Cambridge dictionary, public transport is a service, "a system of vehicles such as buses and trains that operate at regular times on fixed routes and are used by the public" (*Public Transport*). Over time, the trend of on demand transportation (ODT) has become popular. ODT operates by relaxing the norm of fixed required routes of operation through the following steps:

1. A customer chooses a pickup or drop off location. That location depends on whether the system at hand operates via zoned pick-up areas only, designated collection spots, or specific times for pick up/drop off.
2. Payment is made for the service based on the options offered by the company.
3. The transit vehicle will follow the optimized route to collect that passenger.
4. If there is an app, riders can track the bus in real time.
5. The rider boards the bus showing proof of purchase and are then taken to their destination.

(Tzventarny and Minelli).

This form of transportation differs from a fixed transit system whereby a predetermined optimized route has been created with a series of strategically placed bus stops accompanied by an established schedule for each vehicle operating along that route (*Types of Transit Systems – RHIhub Transportation Toolkit*).

Another form of transport is the flex route. This method combines fixed and on-demand route models by having both fixed stops and the ability to conduct on demand services. This form of transportation was typically designed to reduce wait times for transportation vehicles and to reduce the travel time to fixed collection points, (University of Virginia et al.).

Sustainability

'Sustainability' is a term at the forefront of the motives and views regarding transportation policies The term sustainable means "able to continue over a period of time." This is a fundamental word used in the field of transportation as the demand and desire to support system and vehicle design built for longevity grows. Transit systems are developed to accommodate factors such as a growing population, environmental changes and demands of society that in turn affect the socioeconomic disposition of the area in which the system operates. 'Sustainability' can also be used as an intentional driver behind design thinking. This affects the desired outcome of most construction and system implementation revolving around public transportation infrastructure (Hester et al.).

Implementing sustainability – environmental and fiscal - to be at the forefront of design and policy making requires encouraging a shift in thinking to focus on topics such as accessibility, growing location of population, residential and commercial properties, delivery service routes and telecommunication as well as environment impacts. This is a contrast from a time where across the world, the focus behind the design of transportation was mostly on mobility, which is movement from place to place (Transportation Research Board). Planners must implement practices such as strategic foresight planning and trends analysis to gain a long view of systems that they administer and design. Using these methods require monitoring of a geographic location to make contextual predictions on what its future could be. This makes room for design thinking and planning (*What Is Predictive Analytics?*).

Industry Trends

Technology integration – ensuring that all technologies that are deployed in a system speak to each other - is a trend in transit that can be implemented through various touch points of a transportation system. Understanding the trends that can affect those touch points will help in the development and planning of a system. It is important to highlight not only trends of usage, but also highlight technology that has been developed to answer the demand of improving the quality of transportation. ICS and ITS provide the basis of technology used within the transportation industry (Taniguchi et al.).

The 'Travel Movement Improvement Program' was established in the USA to introduce evolving trends and new transit techniques to current transit systems with an aim of streamlining the implementation of technologies and communication. This shift opened the transportation industry to new forms of data processing and new land forecasting techniques along with short and long-term improvements which boosted interest in travel and travel quality as opposed to only focussing on moving from point A to B, (Weiner).

One of the forecasting techniques found in (Anjomani) is a model called "ELUENT." This stands for, 'Economy, Land Use, Environment, and Transportation,' and can be used as a blueprint when land mapping. This type of model evaluates the land on which a project will be built, the demand for needs in that area and what those needs will be, along with it is potential for development, providing useful information for transit planning. Transport trends across the world can be seen to have a similar trajectory over time. Noussan et. al., evaluate some of these trends across Europe, North America, China and East Asia, Latin America, Middle East and North Africa (MENA), and Sub-Saharan Africa. Topics such as decarbonization, digitalization, and Mobility as a Service otherwise known as 'MaaS,' are discussed along with infrastructure trends and the planning to accommodate these changes. MaaS, has been dubbed as the new

way of thinking whereby travellers using different modes of transit are updated in real time on their journey. It is a trend that has begun to build a tighter relation between communication and transportation allowing users to plan journeys using apps such as Google Maps and City Mapper.

Systems and Technology for Transportation

ICS & ITS

Intelligence and computing have made its way to public transportation with practices such as Intelligent Communication Systems (ICS), and Intelligent Transport Systems (ITS) which are now becoming key factors in the industry. While recognizing their importance, this thesis does not focus on these emerging technologies.

ICS

Intelligent Communication Systems is an umbrella term which houses anything that allows technology to interact with and work digitally. This includes cloud computing services, communication networks and 5G. (*What Is ICT (Information and Communications Technology?)* In transportation, products such as global positioning systems (GPS), Advanced Traveller information systems, and electronic boards are uses of ICS that subsequently fall under the newer category of ITS. These systems help with navigation, while updating drivers and passengers on relevant and real time information (Agarwal and Alam).

In back-end systems, data driven mobility is a trend worth highlighting. This is where companies plot data collection points and use that information to plan and execute new routes or study new travel patterns among riders. The information can help notify planners on traffic congestion, average speed, bottlenecks during certain times and other information that could

be useful for strategizing. This comes with its own drawbacks where data privacy can become a concern (*Connecting People and Places through Data-Driven Urban Mobility*).

ITS

Intelligent Transport Systems are structures put in place to gather and store travel information. These systems help optimize travel routes by collecting real-time data and using that data to increase travel efficiency, safety, and convenience. (*ITS Standards – Intelligent Transport Systems*)

Systems Integration

Many systems developed with today's technology follow an approach that combines multiple layers for the system to work seamlessly, see transportation system layers below in Figure 3. There is a 'layer of perception' used for collecting real time data. This layer focusses on various forms of sensors from pressure to wireless to ultrasonic sensors throughout a transit system. There is a network layer that uses the ability to communicate data and information at high speeds. Thirdly there is the application layer where processing and analysis takes place, (*Zhang and Lu*). The application layer can be responsible for providing the wireless communication needed for intelligent systems within public transportation to operate.

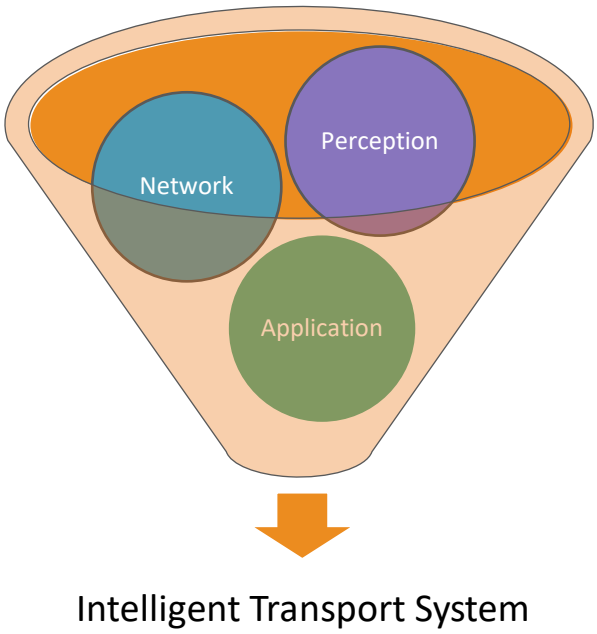


Figure 3:Network Layers Within a Transportation System

Communication in Transportation

The conversation about upcoming communication strategies in the transportation sector emphasizes the crucial need to opt for technology that can seamlessly shift and adapt across different devices which allows for smooth and seamless communication. Several issues surrounding the capabilities of these networks include the speed at which information is sent, changes in algorithms, the stability of the information and the quality of the information once it arrives at the receiving end. Zhang and Lu explore approaches to these issues by creating a vehicle movement model based on a 7-layer model called the Open System Interconnection model. This model combines multiple layers of IoT's (Internet of Things) to create a cohesive network. To name a few, the 'physical layer,' is responsible for scheduling purposes, and the 'MAC layer' is responsible for the wireless transmission (Zhang and Lu). System with agile capabilities will be put in place in the back end of transit systems communication networks. It is important to note the complexity of these systems as it directly affects the scope and capabilities at hand when designing the framework for a new transit system.

Strategic Design in Transportation

Cognitive Semiotics in Design

Cognitive semiotics covers the study of sign and sign usage, literally and figuratively. This study can be applied to a public transit plan to create a design thinking pathway that increases overall efficiency and aids in behavioural changes towards public transportation. Thagard defines Cognitive Semiotics as a complex field of study that encompasses "the mind, intelligence, philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology." The Encyclopedia Britannica defines semiotics as is the study of signs and sign-using behaviour (*Semiotics | Definition, Theory, Examples, & Facts | Britannica*). Brandt explores both definitions as he demonstrates the ways in which signs and symbols can be used interchangeably. However, the positioning of these signs within a system, how they are used and the communication behind what they are used for is what produces meaning that allows people to understand a communication. These signs and symbols typically have connotations that were developed and used over time, causing an automatic action from humans who see them. For example, a stop sign is strategically placed using a specific colour and shape. Due to the longevity of the existence of this sign, it is seen as a symbol that is tied to the action of stopping whether words are attached to the sign or not. Placing this sign in the wrong place could cause issues because of the meaning attached to it. If a stop sign were placed in the middle of a freeway and people associate this sign, or the colour, or the shape with the motion of stopping, people would comply without any further instruction. In design terms, this can be associated with the rule of past experience (*Gestalt Principles of Design with Examples and Infographic*).

Words also have significance in relation to human behaviour. For example, the word ‘gate’, is associated with entry, or passing through. This word can be assigned to a passageway or a physical structure, either way, the meaning stands the same. Designing new signs and symbols to encourage new ways of thinking based on an unfamiliar product that is being introduced becomes tricky. However, paying attention to the ‘why’s and how’s’ of the interpretation of existing signs and symbols helps with the design process. Another example is the pulsing blue dot in Google maps signify a user’s specific location using a circle shape, and the motion of a pulse which can be representative of being alive.

The use of cognitive semiotics in design thinking has been apparent in many systems used in today’s transportation industry. Atã and Queiroz highlighted an example of how cognitive semiotics is used within the London Underground transport system by taking an SOI approach (Sign, Object, Interpretant). It is considered a classic example of best practices in data visualization. In Atã and Queiroz’s example, Pierce’s semiotic triangle (*Brandt*) shown below in Figure 4 is used to break the design of the London Underground map into three sections. The overall system is the ‘sign’, the problem of space in transportation within a city is the ‘object’, and the shapes indicating direction and place as the ‘interpretant’. These three elements work together by using various cognitive triggers to build relationships between sign, signal, and direction. Cognitive semiotics as a form of design thinking can also be seen in payment systems, wayfinding and signaling. An example of where this theory is applied is in the bus stop within the dynamic transit zone mentioned, where there is emphasis on instructional signage, color theory and user interaction.

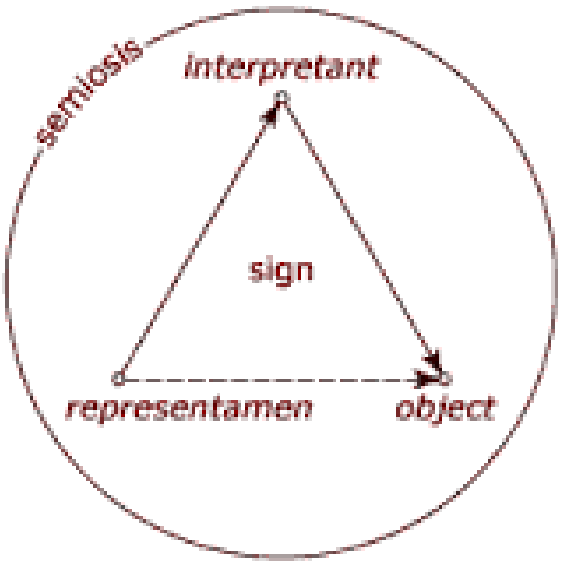


Figure 4: Pierce's Semiotic Triangle

Design Thinking

Thinking through design, commonly described as design thinking, is a process that involves multiple steps. The site 'Voltage Control' (*What is Design Thinking?*) illustrates a breakdown of three categories, conceptualize, explore, and actualize. These are further broken down into five major design thinking stages; empathize, define, ideate, prototype, test and implement. Each stage comes with its own challenges; however, the conceptualization category is where the foundation of design is developed. This is the stage where innovation through design is important. Best practice is to develop designs that are unique, using ideas that avoid repetitive mistakes or distasteful design from previous versions or designs that may have had negative impacts in the past. Bruce Mau touches on this topic when speaking about design and design failure. Typically, failure can be seen in a negative light, but in design, it can be positive as it provides a blueprint on how to move forward with other choices, (Mau, Bruce and Jon Ward. *Mau MC4*). David Dunne speaks about innovation and its beginning steps starting with large disruptive ideas and later becoming incremental to adjust to realistic expectations, (Dunne, E).

Another method of design thinking is the creation of personas. Personas represent aggregates of data rather than actual people. This method helps to outline the type of user desired to achieve project goals. Designing a persona gathers information from population data and actual people and combines it to create the ideal user. Given that this thesis design is user centric, creating personas also offer the benefit in the design process by highlighting potential user habits and expectations. This is especially useful to compare in user testing as different personas have conflicting needs from products and services (Dam and Siang). This study gathered data to create the ideal persona through survey distribution and analysis shown in Chapter 4: Research Findings.

Concepts were shared in the survey questions for this thesis that prompted recipients to 'think big' in relation to the future of public transport in Cayman and makes selections. The user engagement was beneficial in understanding what transit users in Cayman want and expect from a new design. Personas were then created to plan the transportation system.

Chapter 3: Methodology and Methods

Research Methodology

This thesis explores public transportation as a research topic while applying Design Thinking and Cognitive Semiotics. Design Thinking is a methodology that is often used to understand wicked problems such as public transportation. Public transit is defined as a wicked problem due to the many moving parts and complexity of a system that needs to be strategically built for longevity and serves a wide demographic. Budget, continuous development, changes in

technology and trends often affect the outcome of a transportation system (*GIS as a Tool to Solve "Wicked" Problems*).

The goal is to create and design a system that is as sustainable as possible, but due to these moving parts, adjustments will always need to be made in the future. Within the context of Grand Cayman's travel landscape, this study contains research that is focussed on current user engagement within the transportation system, the general perspective of transportation in Grand Cayman along with insights on local and international industry best practices. Therefore, this study approaches this wicked problem through design thinking by encompassing mixed research methods exploring both primary and secondary, quantitative, and qualitative research (Dunne).

The research methods combine surveys and secondary data, accompanied by observational studies of behaviour and technology (Beynon-Davies, Paul). Quantitative research elicits information that builds an understanding of the travel landscape in Cayman. Knowledge was gained through surveys, statistics and observational studies taken from public bus users in Grand Cayman. Qualitative research information was gleaned from expert interviews, and secondary online research (*Qualitative vs. Quantitative Data*).

The benefit of approaching this study from a design thinking approach is to ensure the product is aligned with the Cayman demographic and is user centric. Research will influence guidelines that provide approaches to design a dynamic on demand service.

Research Methods

Quantitative Research

Statistics

The census provided the most recent statistics found in Grand Cayman. This information helped form the image of what the current travel landscape looks like from a government perspective. Data regarding cars per household, number of citizens, population, geographical statistics are available over multiple years, hence it sets a good premise for outlining a future trends analysis (*Cayman Islands' 2021 census report - eso.kyw).*

Survey

A survey was developed to elicit first-hand information from the public on their views and use of public transportation. The survey also included information about the recipients' demography to form an idea of the types of people that travel around Grand Cayman. The survey was designed to highlight information that could be used to connect the census report, which is retrospective, with current data.

Observational Studies

To get first-hand experience of the system and how it works, observational research was conducted on two of the main routes that operate within the public bus system on Grand Cayman. This was done in an unintrusive format where the researcher documented information of individuals in their natural habitat without interference. These results were compared with opinion surveys (*Observational Studies*).

Qualitative Research

Expert Interviews

Expert interviews are often used to collect market insights and trends that can be funneled into useful information for growth and development of the transportation system (*Expert Interviews*). Two sets of expert interviews were conducted to gain insight on the transportation industry both local to Cayman and internationally. The Cayman interviews were designed to collect information about planning and development of transportation from a Cayman landscape and industry best practices. International interviews considered trends from a global perspective.

Applying the Research Methods

Survey Details

A survey was created using Microsoft Forms to gather information about travellers within Grand Cayman. It covered the following topics:

1. Demographics: Age, occupation, and location of survey respondents.
2. The Public Bus system Re-imagined: The option to share what features of public transportation they would like to see and whether they would ride a system that included these features.
3. General Transportation Usage: What type of transportation is most used on island, the time it takes for most people to commute and if the surveyor takes the bus, how many times, how long it takes for them to reach a bus stop, and their main reason or motive for using the bus.

4. Travel patterns: What factors influence travelers' choice of transportation. This is asked so that an understanding can be made of what is most important to travellers.

The survey was approved by the Research Ethics Board of OCAD University and was prefaced with a consent form that filtered out participants under the age of eighteen. It was delivered via a Facebook ad manager from December 1 – 30. Because of the ad distribution, survey respondents remained anonymous to allow for a more genuine collection of answers.

Observational Study Framework

The purpose behind observational research was to build a repository of information that could be used to inform decisions for the map, the system and process design. This research method monitors the behaviour of current practices of users of the system from a passenger and driver perspective. Parameters for this study include gathering quantitative data regarding timing between stops, process of boarding and departure, price, length of journey, the condition of the bus and the traffic intensity on the roads at the time of the journey.

As the concept of a dynamic transportation system will be new to Cayman's travel landscape, this research method can help determine what types of behaviours and habits could affect the implementation of a new transportation style. Behaviours will be examined from a cognitive point of view to discover any new elements that could or should be implemented and used in a new layout, format, and process. The goal here is to gain a better understanding on ideas that can be used to enhance or alter existing behaviours among the public bus system users yet are appropriate to their culture.

Expert Interview details

The expert interviews were conducted in one-on-one meetings where a series of 6 to 10 questions were asked. The questions were tailored specifically to the interviewee.

The government official from the Cayman Islands, Mr. Eric Bush, Minister of Planning, Agriculture, Housing and Infrastructure was asked if and what plans were being made to combat transportation issues in the country, questions relating to the current public transportation unit, issues in development in terms of the transportation unit reformation, about technology and how this would affect any new development they had in their plans, infrastructure, electrification, motives, barriers and budget. An interview with Mr. Durk Banks, the Director of transportation for the Cayman Islands was also requested to gain further insight specific to the public transportation department.

Khalil Bryan, the Executive Director and co-founder of Caribbean Transit Solutions discussed Beep bus and EasyTrak two subsidiaries of Caribbean Transit solutions which both operate using real time tracking information. The systems use data to analyse routes and behaviours. This conversation was crucial to understanding from a technological standpoint how real time tracking works in a similar landscape to Grand Cayman.

Anthony Dionigi has a history of working within various transportation industries around the world. Anthony was the Senior policy advisor for the Ontario Ministry of Transportation in the public sector, Transit Supervisor of the City of Fort in the province of Saskatchewan and is now assisting a project in a transport planning institute in Vienna. Questions for Anthony were tailored around industry trends, best practices, and differences seen across industries,

information about development and the time periods of those developments along with information about on-demand transportation specifically.

Chapter 4: Research Findings

Survey Results

The survey was distributed online anonymously throughout the month of December, 2023 and was completed by 500 people living on Grand Cayman. Below is a detailed analysis of these questions and answers of the survey's four sections: Demographic, The public Bus System Reimagined, General Transportation Usage (with a pubic bus specific section), and Travel Patterns acompanied by screeshots taken directly from the survey results page.

Demographic

Question 1: Age

Out of the 500 survey respondents, 10 of them were under 18 and were therefore rejected from completing the survey. 159 individuals aged 30-39 filled out the survey putting this age group at the majority. The high interest from this demographic informs design decisions. A user persona was then developed based on the wants and needs of this particular age group. However, age 19-20 will also be considered given that 122 of the survey respondents fall within that age bracket as shown below in Figure 5.

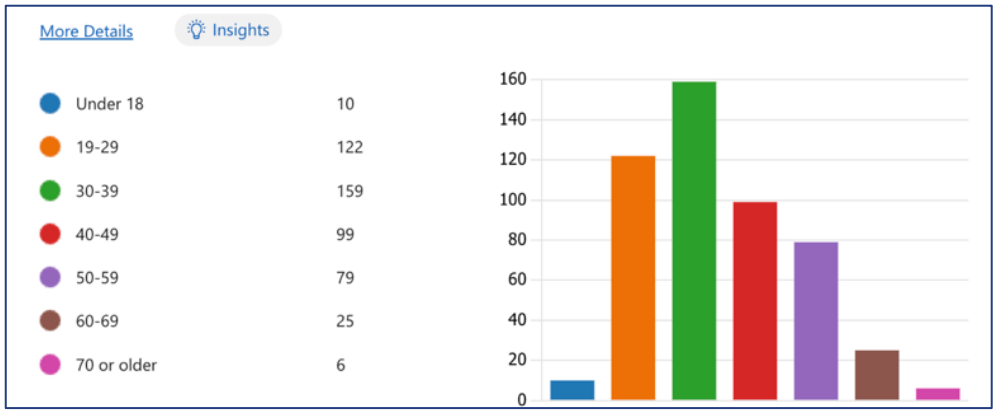


Figure 5: Survey Results - Age

Question 2: Area of residence

The largest area of residence was the capital of Grand Cayman, George Town. 142 survey participants noted this as their area of residence, followed by 99 people in West Bay and 77 people in Prospect. The rest can be seen below in Figure 6. From these results, there is a higher interest in public transportation from the central part of the island, however, this could also be an indication of the breakdown in population density between districts. These answers can help the design process by informing decisions on stop placements, frequencies and route design.

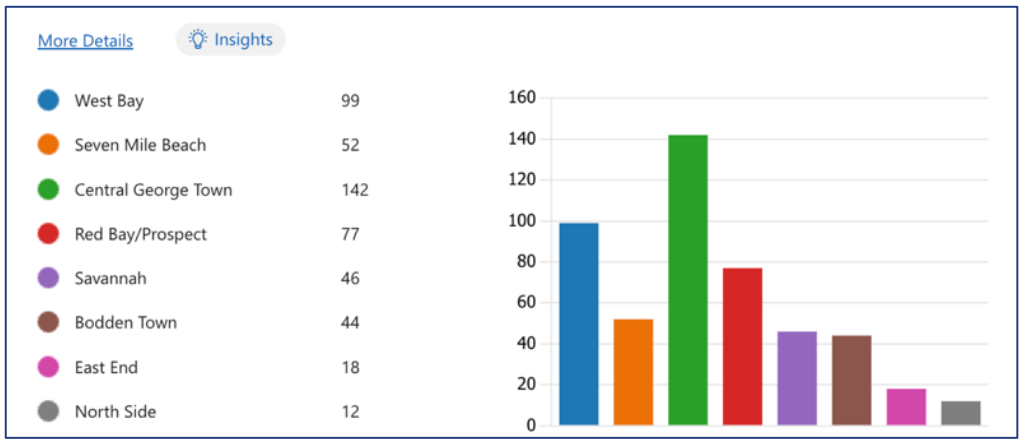


Figure 6: Survey Results - Area of Residence

Question 3: Occupation

There were 380 participants listed as employed as shown below in Figure 7. This was by far the largest category. Occupation was included to gain even more insight on the system's likely persona and can suggest focus points around route designs. For example, if the majority of participants were self employed, an assumption could be made that there could be less commuters as they may adhere to a work from home regime, which could take pressure off of rush hours and bottle necks. If the majority were retired, then there could be a shift in focus for accessibility needs. In this instance, as the majority of survey respondents were directly employed. This affected the route design of the main transit line and the decision to offer a route that heavily accommodates two densely commercialised areas.

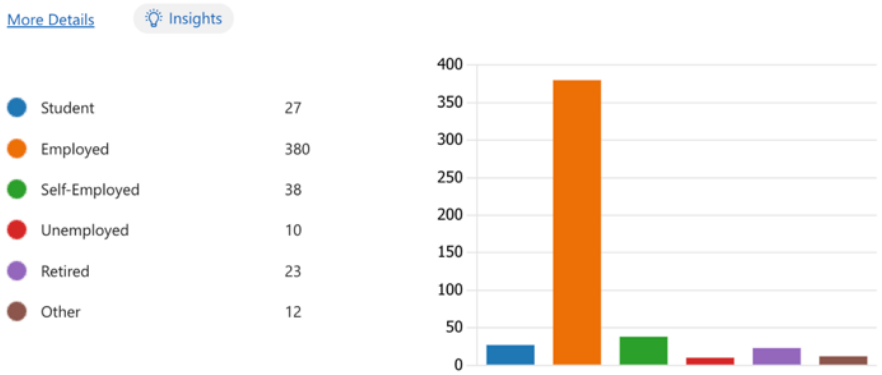


Figure 7: Survey Results - Occupation

The Public Bus System reimagined

Question 4: What features would you like to see in a reimagined public bus system? (Please select all that apply)

This question was included to support design decisions based on user desires, as opposed to needs. To do this, users could select all that apply to limit restrictions and decision paralysis. The answers to this section were based on research from the literature review and the expert interviews highlighting features and pain points found in transportation systems locally, regionally, and globally. The options were:

- Real-time tracking of buses so I know when my bus will arrive.

- Flexible routes based on passenger requests (on-demand public transit)
- Cashless payment options
- User-friendly mobile app to plan my travel and track my routes.
- Shorter waiting times
- Features for people with disabilities
- More convenient bus stop locations

The most popular answer was real time tracking of the bus followed by a mobile app and cashless payment options, the rest of the results can be seen below in Figure 8. These results directly affect the system design priorities and the technologies chosen for these designs. My system design proposes a bus service that would serve customers in the heavily populated areas of Cayman and an on-demand service that would respond to the needs of neighbourhoods. GPS tracking, and a customer facing platform that also allows customers to pay are considered and support the first design component. The lowest option, with support from only 187 participants, was flex based routes. Yet this solution has been proven effective to solve congestion and serve distributed users in the research conducted in the literature review. On demand services was chosen as the least important option for survey participants; however, it can also be seen as an indication that this type of service is something that users of the current travel landscape are not used to. This can inform the implementation process to account for a steep learning curve, and it encourages the practice of cognitive semiotics to be used in depth to reconfigure the way signs are interpreted around transportation on Cayman. These results combined with methodologies highlighted in the literature review and the Cayman travel landscape inform the decision to make this design user centric with features such as vehicle tracking a customer facing platform, 2-hour ride time tickets and the convenience of having access to a dynamic and structured system.

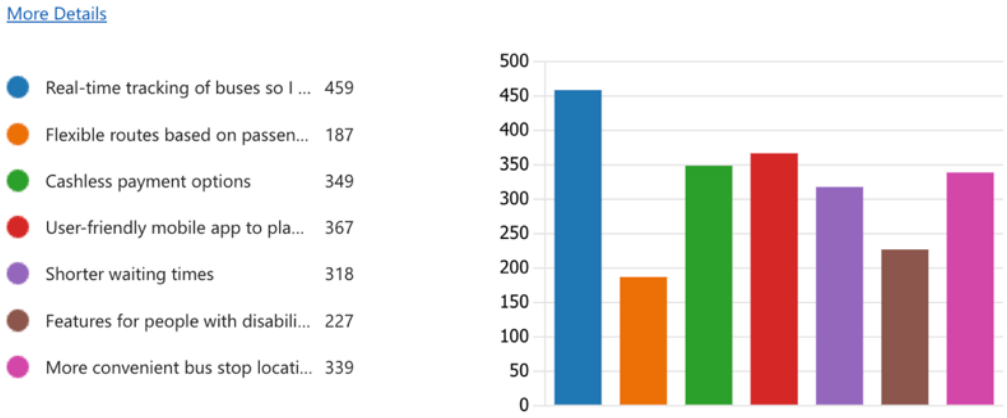


Figure 8: Survey Results - The public Bus System Reimagined

Question 5: Would you consider riding public bus transportation system if it included any of the above?

One of the most significant findings is that the majority of survey respondents agreed to consider riding the public bus if it included some of the above features. There were only 16 who opposed public transit as a solution, see below in Figure 9. This can mean that there is interest in public bus transportation but that people are not satisfied with available services, resulting in some of the previous findings shown in the contexual review of this thesis where it is shows statistics of the car to population ratio on the island.

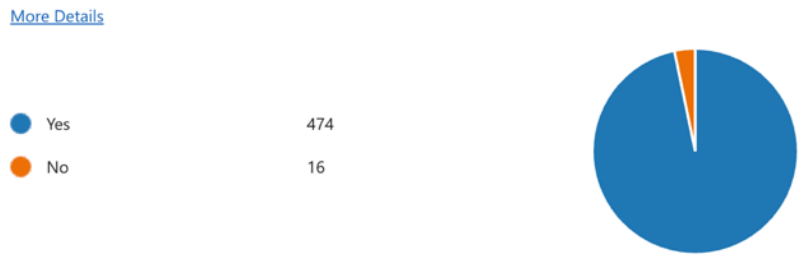


Figure 9: Survey Results - Would You Consider Riding the Bus if…

Question 6: What type of transportation do you primarily use?

Answers to this question verified the statistics found in the contextual review that indicated the car to people ratio on the island. The survey results reveal that 404 of the 500 participants use a personal automobile as their primary mode of transportation. This data point indicates that the highest amount of respondents from this sample use personal automobiles. It can also be an indication of the demographic that had access to or interest in the survey. This question grounds the research as it is information from a user perspective as opposed to government statisics. This result implies that if the survey was to be taken again, and distributed to a larger sample size over a longer period of time, there could be similar responses. This can be used as leverage when communicating budget and necessity for a system revamp, seeing that the current budget for public transportation is providing a service that most people would do not use.

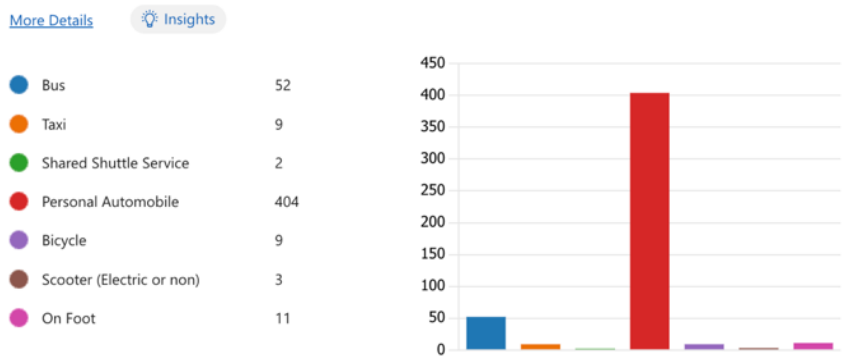


Figure 10: Survey Results - Primary Mode of Transit

Bus Transportation

Question 7: On average from point A to point B, how long is your total commute?

This is the beginning of the subsection that catered only to public bus users. This subsection was answered by 52 participants and was created to focus on the current public bus users and provide real life perspective given the lack of information that can be found about the current

system online. 25 respondents indicated that their travel time is 10-29 minutes as seen below in Figure 11. Subsequently, 16 users indicated that their travel time is 30-49 minutes. As traffic is seen as an issue on island, this question was asked to offer a real time perspective into travelling on a public bus on island. At first glace, it may look like the average travel time on island is only 30 minutes. However, given that most of the survey respondents reside in the capital, and are employed, it supports traffic concerns, as the island is small and the commercialised areas are concentrated within the capital area. This result could also imply that the bus system is slow and it impacts their commute time by having to wait for a ride, whether that be due to scheduling or traffic.

Figure 11: Survey Results - Commute Time

Question 8: How frequently do you use public bus transportation in a typical week?

This result revealed that 31 survey participants use public transportation daily, next were 17 participants using public bus 2-3 time a week. This gave a good indication that the answers provided from this section of the survey are accurate and thorough, because of the survey respondents' frequent use of the public bus. The researcher has reason to believe that the answers are based on average usage as opposed to one-off experience. It also highights that there is a demographic who needs a daily public bus service. See results in Figure 12 below.

Figure 12: Survey Results - Transportation Usage

Question 9: On average, how long do you have to walk to reach a pick-up point for public bus transportation?

This question directly informs the route design and placement of proposed bus stops within the system. The design accounts for short walking times in between stops for accessibility and to take weather conditions on island into account, which being heat and rain. Twenty-three of the survey participants walk 0-5 minutes, however as mentioned in previous sections, this could be due to the benefit of living in the city center. Collectively, the survey respondents who walk 6-10 minutes and 11-20 minutes to get to a bus stop, make up twenty-five of the fifty-two survey participants, surpassing those who only take 0-5 minutes. This result could be due to the district they reside in, or it could be an indication of inconsistency in the design of the current bus stop locations. For the purposes of this study, it shows that bus users are having to walk too far to get to a bus stop and is addressed in the design process and route creation and bus stop placements.

Figure 13: Survey Results - Walking Time

Question 11: On average, what is your main reason for using public bus transportation?

Out of the 52 participants, 44 use the public bus to travel to work/school. This question gives the researcher motivation for the planned system design. It directly informs route decisions, and it further justifies the travel persona and their predicted needs. This result also directly impacts question 7 when asked about the total commute time. If 25 of the public bus survey respondents require 10-29 minutes for their total commute and forty-four of them travel to work or school, that can mean that most of the public bus usage is also taking place during peak travel times. This information is used when outlining the schedules for the main rapid transit line and informing decisions on the quantity of busses that could be required for the dynamic transit zones.

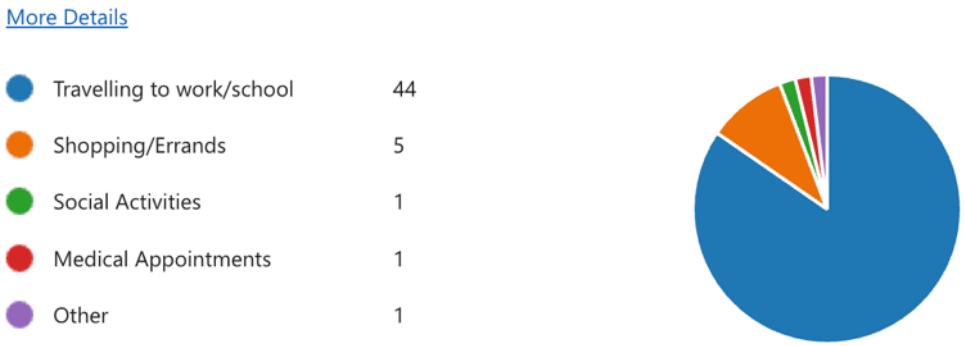


Figure 14: Survey Results - Reason for Using Transport

General Question

Question 11: What factors influence your choice of transportation? (Please select al that apply)

The question was asked to gather the sense of urgency that transit users have when it comes to prioritizing features. This does not eliminate any of the options from being incorporated into the design. It influences the decision-making process of what should be prioritized from a user point of view, and then informs the decision-making process of when and how that element should be implemented into the process. The most popular answer was convenience. To the researcher, this amalgamates the route design, vehicle option, bus stop placement and

technology used within the system and puts it into perspective from a user centric point of view.

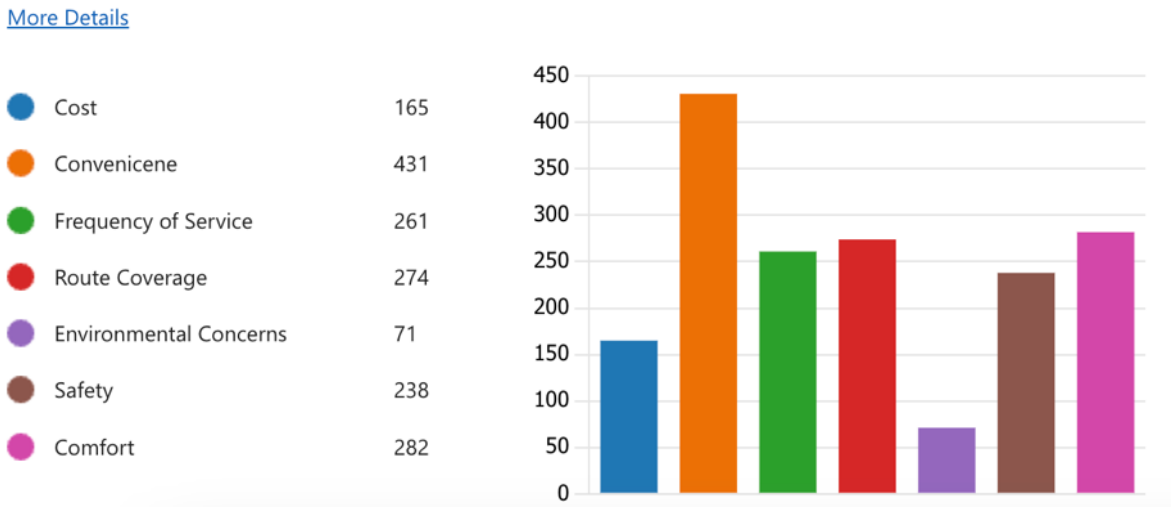


Figure 15: Survey Results - Factors Influencing Choice

Conclusion

The survey was completed by a sample of from residents of Cayman in a short period of time and overall, the results imply that most of those individuals are interested in a new transit system. The consensus is that travel is typically carried out for the purpose of every day activities and it could be inproved through efficiency and convenice. The survey revealed that there isi nterest in redesigned system and eludes to the fact that the people of Cayman can be converted from car to transport under new circumstances.

Expert Interviews

Expert interviews were conducted with national, regional, and international professionals. A summary of these responses can be seen below.

National Interviews

Minister of Planning, Housing, Infrastructure, Transportation and Development.

Two expert interviews were conducted with Mr. Bush to gain understanding from a government perspective of the travel landscape in Grand Cayman. He provided the following key takeaways:

- Cabinet will form a strategic head for all transportation to form one solitary public transportation unit. This will include the three standing departments: National Roads Association, Department of vehicle and driver's license and the public transportation Unit.
- Analysis for enforcement on collisions over the years has been increased to issue efficient engineering and standards, education, and emergency responses.
- When asked about on demand transport, the answer was focussed on re-designing an adequate bus system and route plan first.
- There has been conversation around deploying a mobility apps like ride share services.
- The goal is to reduce or stop road fatalities; On average there are currently ten fatalities per year.
- Plans for the next 50 years look to provide long term solutions that can accommodate for substantial growth in population in hopes of combating the issue of traffic bottle necks on island.
- There is a national CCTV system that has been in operation for over 15 years, with over four hundred cameras. Due to the country having no central entity to take care of mobility, the information from these cameras is not being used. The plan is to utilize the existing imagery and use the information from the back end for strategic purposes.

This interview helped the researcher to understand the different priorities within the travel landscape of Cayman. This supports the design process and provides preliminary expectations of what should be involved int he strategic development of the system design process.

Director of Transportation

Speaking with Mr. Banks helped the research by providing insight on what the government is responsible for regarding transportation on island. He provided the following insights:

- The Cayman Islands Government does not own or operate any public transport vehicle/s. All vehicles are privately own and operated.
- The Public Transport Board regulates all Public Passenger Vehicles. As the Government the Public Transport Board must operate within all Acts (formerly Laws) including the Bill of Rights which requires the Government to adhere to private citizens right to privacy, and the right to family life and not to breach their rights.
- The Government must also ensure it does not breach the Data Protection Act when communicating with the public concerning privately own vehicles operated as Public Transport.

This information is useful for understanding what is and is not allowed in terms of legal and policy specific purposes. This interview helps determine parameters that will need to be applied to technologies within the system. For example, it is necessary to know whether the bus driver is legally allowed to know the end destination of a passenger, or can a company access information entered when creating an account of purchasing a ticket. It helps the researcher understand where funding is available for aspects of the system.

Regional Interview

This purpose of this interview was to provide insight on how a new form of technology in transportation was implemented and received by a country with similar cultural challenges. Khalil provided insights around the systems used on island called EasyTrak and BeepBus:

- The purpose of EasyTrak was to provide high level tracking solutions for current public transportation companies operating in the Bahamas.
- The transit solution to Barbados was fueled by lack of efficiency in public transit.
- Caribbean Transit Solutions is a business name that housed the transit solution companies EasyTrak (tracking platform), BeepBus (bus specific tracking) and BeepCab (taxi specific tracking).
- EasyTrak utilised a platform from a company in Canada called Geotab. This provided the platform for the vehicle tracking to run and was designed to meet travel needs of Barbados.
- BeepBus utilized a platform called Nimbus which provided the app with route planning. There was a connected piece built to have this platform operate with Geotab to provide the live route tracking capabilities.
- The code for this platform was written by developers in JavaScript and information was collected via an Application Programming Interface (API). This allowed for the data to be extracted and analysed for future planning.
- There was no need for new vehicles as the hardware for tracking was implemented into the diagnostic port of the vehicle, or hardwired and runs on the vehicle battery.
- The IDB provides funding for Latin America and Caribbean funding development projects (*IDB | About the IDB*).

Given the similarities in culture and travel landscapes, an interesting point to highlight is that over time, there was less demand for BeepBus, and even less demand for BeepCab, resulting in both initiatives being shut down, respectively. The consensus was that the priorities of the companies were focussed on saving time by applying behaviours and patterns from international influences rather than designing a system with local residents. Hence these systems and designs did not align with the local users whose focus seemed to be more on economic value. In addition to this, while the product had international financial support, there was no support from the local government.

International Interview

Anthony Dionigi shared insights from a global perspective. Topics in this discussion covered reoccurring themes in public transit, policy making, differences within public transportation systems in various areas of Canada and Europe, suggested technologies, and potential project timelines were discussed. The key takeaways from the interview are:

- Recurring themes noticed across different transit systems during Anthony's career involved:
    - High operational capital costs, difficulties in sourcing initial funding and funding for further development.
    - Improving current systems, obtaining public interest, and developing new strategies for progression.
    - The debate on strategic focus regarding moving people from cars to busses versus improving the current service for those who do not have the option of a car.
- Developing a transit system for the private sector can allow more flexibility in terms of design and decision making as opposed to public entities where there are layers of standing policies within a governing body.

- Major differences noticed between countries is with technological advancement and the perception of transportation by country.
- After being part of the implementation process of a small four route system in Alberta, Anthony shared insights on a step-by-step process to developing a new public transit system.
    - Step 1: Obtaining direction from council. This happened when residents started demanding public transit to the neighbouring city.
    - Step 2: Getting approval to conduct a study on the needs, wants and type of system that would be a best fit.
    - Step 3: Survey residents and put together a proposal to say how it could be implemented and include costs.
    - Step 4: Marketing strategy and new branding.
    - Step 5: System implementation

- Expressed hurdles included waiting and shipping time for the busses, hiring drivers equipped for the job, cleaning, maintenance, schedules, and contract management. Some of these steps were outsourced to private contractors and the city.
- Best practices include app-based system for transport, cloud-based programs for storing large quantities of information used to run the system, GPS tracking to ensure safety and reassurance of riders and cashless payment options.

Responses from this interview were useful in understanding the operational processes of transport systems in smaller cities and towns within larger countries from a policy maker's standpoint. An interesting point for this interview was Anthony's experience with Vienna's public transit where usability is high. The system has a transferable and electronic form of

payment where one ticket or pass can be used across multiple vehicles, operation hours are long, prices are affordable, routes have wide coverage, and the system is described as “the backbone of the city” (*Vienna’s Public Transport*). This provides motivation to the research by suggesting that the attitude towards transport is highly influenced by the overall quality of service being provided.

Evaluation

The expert interviews collectively informed this thesis on international best practices, examples on what a similar project looked like within the Caribbean and insights on policies that will be used to inform next steps in building the strategy for planning, developing, and implementing a new system.

National	Cabinet will form a strategic head for all transportation to form one solitary public transportation unit. Plans for the next 50 years look to provide long term solutions that can accommodate for substantial growth in population in hopes of combating the issue of road fatalities and traffic bottle necks on island.
Regional	The purpose of EasyTrak was to provide high level tracking solutions for current public transportation companies operating in the Barbados. There was no need for new vehicles as the hardware for tracking was implemented into the diagnostic port of the vehicle, or hardwired and runs on the vehicle battery.
Global	Countries have diverse views on technological advancement and the optimal delivery of transportation.. The debate on strategic focus regarding moving people from cars to busses versus improving the current service for those who do not have the option of a car.

Observational Study

On the ground research was imperative to supplement this study as there is not much readily available sources that share information about the day-to-day experience within the public bus transportation system on island. Findings from this exercise were based around two journeys along route number two, one of three routes that service the western most part of the island called 'West Bay'. Parameters behind these bus journeys revolved around timing and environment.

	Start Time	**Departure Time**	**Passengers on Arrival**	**Passengers on Departure**	**Atmosphere**	**Traffic**	**Trip end Time**	**# of stops**	**Avg. time Between Stops**
Trip 1	13:55	13:58	4	6	Cool/warm, no music	Moderate /Light	14:17	9	2.25 mins
Trip 2	15:14	15:18	6	5	Cool, music	Moderate /Heavy	15:42	11	2.50 mins

Table 1: Observational Study Findings

In addition to the information in the table, it is important to note the following qualitative observations:

- Out of a combined twenty stops between both journeys, only two of those stops, one per journey, happened at one of the eighty-one bus shelters provided by Rotary Cayman on island (*Rotary_Bus_Availability*).
- The first bus was in poor condition in terms of temperature, smell, and upholstery, whereas the conditions of the second bus was significantly higher in quality.

- Passengers told the driver when to stop by saying ‘one stop driver’. This was average on both journeys.
- Drivers on both journeys blew their horn to get pedestrians attention, this is how they could see if they needed to stop to give the pedestrian a ride.

Conclusion

The above information was not only imperative to understanding the travel landscape of the island, but also to inform the motivation for the design, the design process and outcome. The expert interviews shed insight on various perspectives and practices on public transportation around the world. This information aids in the system development and helps with the filtration process of what is needed for a system to thrive in this environment.

Understanding the local perspective helps the researcher to understand who needs to be involved and what procedures need to take place for the plan to have success.

The survey and observational study impact the design and design process of planning out the new route and helps form an approach to building a service that can positively impact user needs and improve travel behaviour on island.

Chapter 5: System Design Plan

System Design Plan

This section of the document, the initial system design plan, will encompass research findings, design purpose, and highlight three major components: The Main Rapid Transit Line (MRTL), the zoned dynamic transportation lines (ZDTL), and the element of communication.

Main Rapid Transit Line

The MRTL is the first element of my system design. It is conceived as a standard, scheduled large bus that runs on a routine schedule. The MRTL provides an efficient vehicle for large groups of people to travel from rural areas of the island, through the center in hopes of reducing traffic congestion and reducing the need for personal automobiles. This method of transportation provides sustainability, because it can manage large groups, and a growing population and is a widely used in transportation systems around the world, as demonstrated by Hester et al. The decision to include a mass method of transportation was inspired through expert interviews in which managing large groups of travellers and having a capability for high bus capacities were mentioned as pain points within the current travel landscape of Cayman. The MRTL is designed to offer frequent stopping points in densely populated and commercialised areas including clusters of office buildings (e.g., Governors Square, Camana Bay, the CIG building, Maples and Cricket Square) and surrounding restaurants or shops. Results from the thesis survey show that most travelers in Cayman drive to work. The route for the MRTL will utilize the current highways that are typically connected by roundabouts. It is the larger faster people mover of the overall transit system that operates island wide to reach further into the densely commercialised area of Cayman. The MRTL is intentionally designed with a loop within the town center based on the positioning of commercial clusters within the capital. The two options provided are outlined in Figure 16 where option A and option B account for reachability and to respond to:

- the current road layout with consideration for potential development solutions that can be implemented seamlessly.
- weather elements including heat and heavy rain.

- distance and the walking paths that currently exist, while leaving room for a more pedestrian friendly road layout in the future (*Wright).*

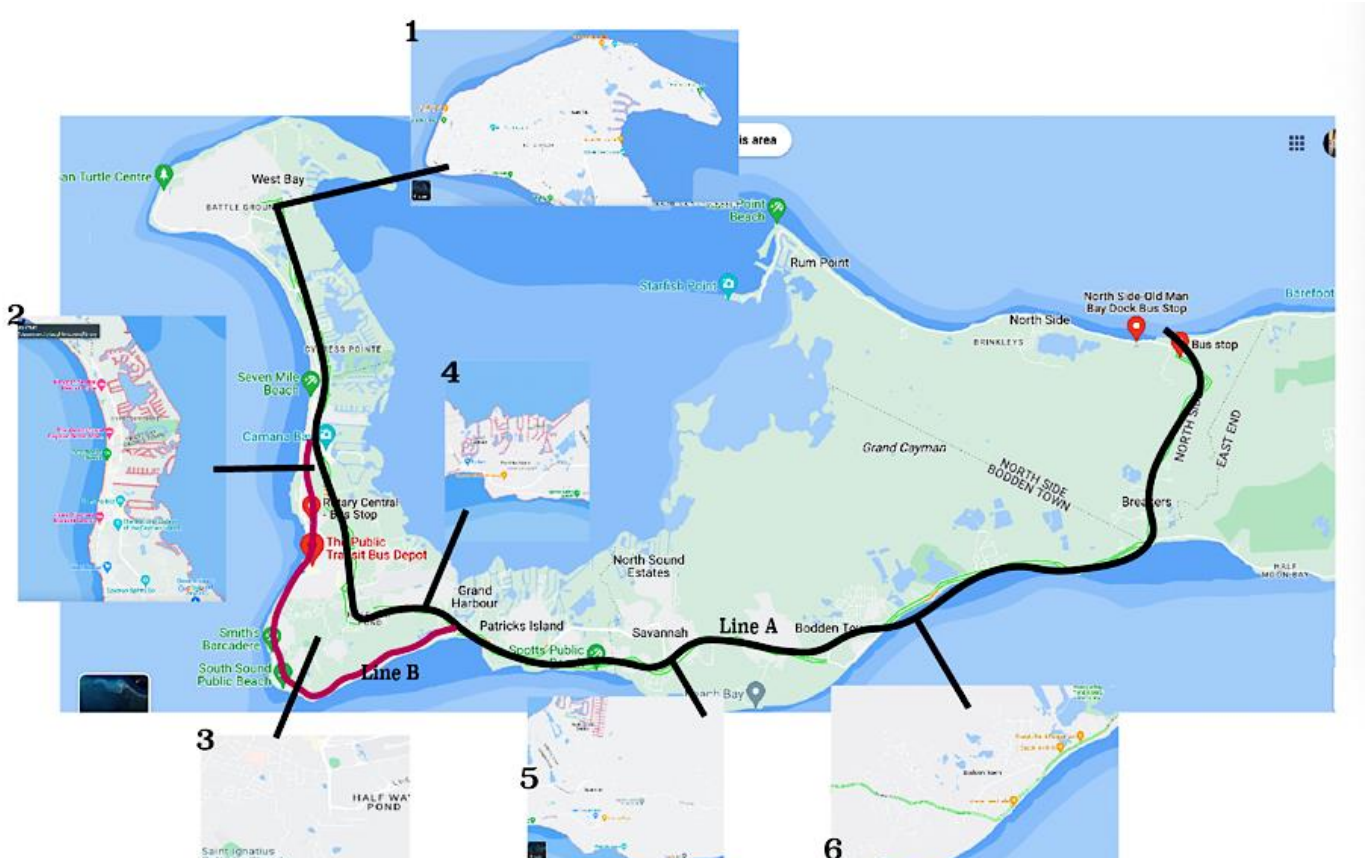


Figure 16: Transit Route Design Showing Route A and B

Zoned Dynamic Transportation Lines

The second part of the system will be built in an on-demand, dynamic format to account for the tightly spaced neighbourhoods and intertwined roads typically found in rural areas of Grand Cayman as described in the contextual review in earlier chapters of this paper. The key difference between the MRTL and ZDTL is that one is scheduled, and one provides service based on request. The routes for the MRTL are fixed, whereas the routes for the ZDTL are dynamic and adaptive. Most importantly, the largest difference is the component of communication. For the ZDTL, users let bus drivers know that they need to be collected by

interacting with the bus stop, drawing from concepts provided by Tzventarny and Minelli who highlight the process and definition behind on-demand transit. On-demand as the second element of the transit design works best in areas with less demand for transit. The need for expedient service is seen in industry trends, hence the push to a call system was developed. The 'how' comes from the ITS, ITC and systems integration mentioned in the literature review where communication, GPS tracking and user interface combine to create one cohesive system (Tzventarny and Minelli*).*

As with many systems, the proposal for Cayman transportation system is also built will rely on tiered user facing functions. It will draw upon Intelligent Transit Systems best practices discussed in the literature review, The preferential algorithms of the system mimic the preferences reflected in user-facing public transit systems found around the world, adapted to the Cayman context in order to ensure adoption. Users have the option to use a transportation app which offers daily top ups, monthly and yearly payment plans and users can also purchase tickets at the bus stop. For the ZDTL, once a customer arrives at their desired bus stop, they will scan their proof of payment at this bus stop. In the back end, this action will send a signal to schedulers to see where the signal is coming from, the number of people that are waiting, what time the signal was sent, what traffic conditions are like etc., to help make the decision of which bus needs to go to that stop. Most of the decision-making process will be automated through a series of Machine Learning capabilities. Subsequently, the nearest bus to the stop that the signal came from is the one that will collect the passengers. Should the nearest bus be full or exceed maximum capacity for the number of users needed at that stop it will not be scheduled to pick riders up at that bus stop. This feature is designed to increase efficiency and reduce the risk of overly crowded busses sustaining a more comfortable environment for users.

The on-demand system uses communicative technology to bridge the gap between customer and bus driver. For this to happen, technologies such as GPS and smart phones will be adapted (Deka et al.). Although dynamic, there will be a single route that a series of 4-5 busses will follow, depending on the zone capacity. Along this route, there will be multiple bus stops strategically placed throughout the zoned areas. The bus stops will serve two intentional purposes; one, to allow customers to call the bus and two, to provide bus drivers with information on demand. The idea is to create agile functions aimed at route optimization to adapt to the current habits and behaviours of bus riders as discussed earlier in the observational study. The transportation method of a flex route combines fixed and on-demand route to reduce wait times. The ZDTL acts as the second piece to a flex route (University of Virginia et al.).

Layers of Communication in the Back End System

The most important part of the system operation are the many layers of communication. The term ‘layers’ applies to the back-end system and its operators, user to system and system to user. While there are elements of global public transportation systems found in the design, a system of this magnitude will be new to the Grand Cayman travel landscape, with the push to call feature being an added layer to that newness. Cognitive semiotics is used in this design to clearly articulate layers of communication by paying attention to diverse types of sign recognition. User centric cognitive navigation will be essential, adapting to culture and current practices, so that new behaviours will be intuitive.

User to System

The point of action is unique to the Zoned Dynamic Transit Line; it is the user to system interaction of calling the bus. Given the current operation of the bus system in Cayman, the action of calling public transportation is new. The technology to support this design is mentioned earlier in the literature review, where the Intelligent Transport System is explained.

To recap, this system combines communication, processing, and application layers together to communicate data and information at high speeds. Riders begin by either purchasing a bus ticket from their phone, using their bus pass (which would also be on their phone), or purchasing a ticket from a kiosk at the bus stop. These three methods will produce a ticket that will be scanned at a device situated at the bus stop. Figure 17 shown below demonstrates communication within the system. Yellow represents the control room, green represents the bus driver and blue represents the bus stop/users' interactions.

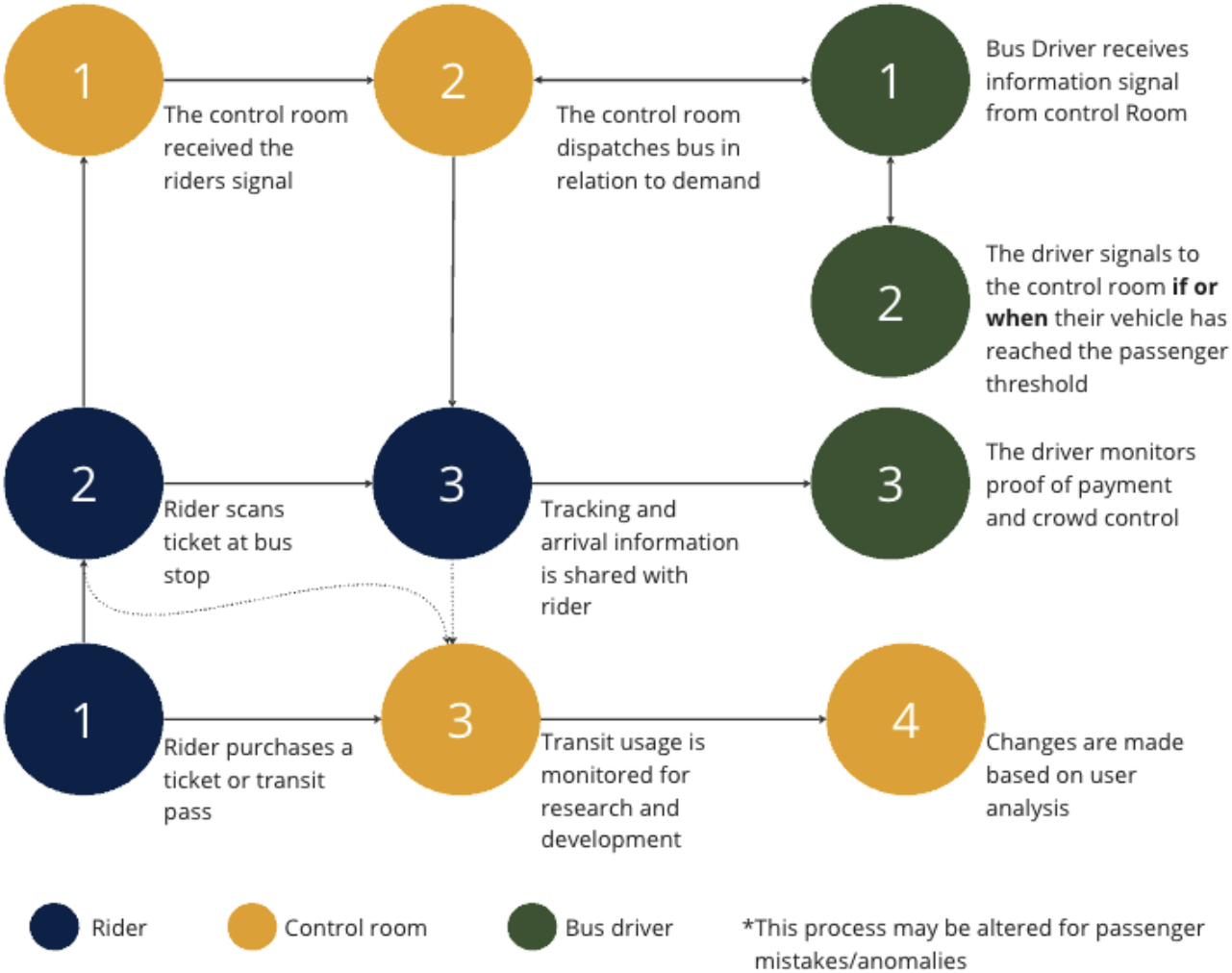


Figure 17: Communication Process of Transit System

Here is the step by step procedure:

- The user purchases a ticket, scans in at the bus stop and can see live arrival time and location of their bus.
- This information is shared with the control room for research, development, analysis, and dispatch.
- The bus driver receives information from dispatch where they monitor proof of payment and crowd control.

The scanning device will read the information produced by the ticket to register two things; that a passenger is waiting at this bus stop, and the destination of this passenger. The privacy policy in the Cayman Islands accounts for personal information being used including location where necessary (*Public Transport Unit Privacy Policy - Cayman Islands*). This research takes these policies into consideration for future development of the system if the law changes. The user's end destination will be filled out during the purchasing or reservation process of single ticket or pass holders. Once scanned, this information is passed on to the control room for overseeing and scheduling purposes. Then a signal from that stop will be wirelessly transmitted to the nearest bus driver letting them know that a rider is, or riders are waiting. Monitors within the bus will register once the bus has reached its destination. Payment will be withdrawn once the passenger walks through the bus door with valid proof of purchase. To signify this, there will use of light and sound from the reaction of a door sized scanning device to register the presence of a paid customer. If the customer has not paid, the bus driver will, to the best of their ability ask the rider to leave the bus or pay before the next stop.

System to User

At this point, the layer of system to user is introduced. Riders will be able to see when a bus is coming by using GPS tracking through the transportation system that will be accessible from their phone. For further transparency and support access for those without smart phones, the bus stop will have a screen that tracks the bus movement. This screen will also have an idle mode where riders will be able to access more information about the system, the main transit line schedule, how it works and stops available in that area. The purpose of the screen at the bus stop is to provide a more accurate representation of the nearest bus location without every customer needing to download multiple apps, reducing the mystery of "where is my bus?" and increasing overall efficiency of the service.

This is also where the study of cognitive semiotics becomes relevant. Humans have different forms of receptors that cause them to react through six distinct levels of agency (Mendoza-Collazos and Zlatev). Those relevant to this study are level one: operative; level five: sign mediated and level six: mediated by language and other symbolic media. The outcome of actions from these are to be studied in the testing phases of riders interacting with the bus stop and drivers interacting with the layout of prompts in the back-end system. Results from these observations will be used alongside industry best practices to inform final design decisions. Operative agency describes action without conscious thinking. Given that the system works on demand, it shares similar features to ride share companies like Uber and Lyft where customers select their destination, pay, track where the driver is and then proceed to use the service (Orosz). While an on-demand system shares comparable properties to ride share, the difference is that the journey is not as intimately personalized given that it is public, and the numbers of users is likely to be higher due to the size of the vehicle.

A major component of the design process was to ensure that the user can quickly understand and act in a productive way without prior knowledge of ride share and without having to rely on their individual mobile devices. Mendoza-Collazos and Zlatev, uses the example of someone running after a bus to describe operative agency, the rider knows the bus is gone, but the impulsive act of running happens without thought. Even though the act of running requires a collection of movements and thoughts to come together to create this action, the natural urge takes over. This analogy is what is meant to happen at the bus stop. There will be new technology, new infrastructure, a new route. However, the design is intended to remove the 'noise' of "how does this work?" "what am I meant to do?' and replace it with functions that work together seamlessly. Some of these include the positioning and function of the scanner, to eliminate the question of "how will the bus know if I'm here", the GPS tracking mentioned earlier, to eliminate worry of "where is the bus", the idle mode on the screen, to help users feel comforted through sharing of information about the system. The goal is the ensure users are comfortable and confident in the system design and function at the bus stop.

As previously mentioned, the method of payment will vary between users. Below is an explanation of the differentiation between the pass and the ticket.

The pass

The pass is a pre-loaded ticket that riders can purchase on a monthly or annual basis. This form of payment would typically work for residents of the Island, or individuals who plan to stay for a longer period. Riders using the pass will have unlimited journeys during their payment period. Users who hold the pass will be required to activate each journey by logging into their profile, choosing an end location and scanning the pass at the bus stop. The scanning function for pass users is in place for consistency in communication between the bus driver and the bus stop.

The ticket

The ticket would be used for stop-over visitors or short-term visitors. Tickets will be dispensed at the bus stops ticketing machine. This will be designed in the form of a recyclable paper purchased from a kiosk at the bus stop. There will also be an option to purchase a more water-resistant single use ticket for users who may be doing water sports or on days where it may be raining. To purchase a ticket, riders use the kiosk to enter their end location and process payment. The ticket will stay active for 2 hours allowing riders to hop on and off without further payment, during this time. The two-hour grace period is a function used in many mass transit systems, the idea to use it in this project based on information derived from researchers frequent use of the Toronto Transit Commission (*About the TTC*).

System and Operators

The next layer of communication is between the back-end system and its operators. The only passenger information that the bus driver has access to is the starting and end point of a rider's journey. Once a rider arrives at a bus stop and scans their pass, an alert is sent to the nearest bus driver and the control room signaling that a potential passenger is waiting. This information is displayed on a device installed within the bus. This device holds and operates a multipurpose platform where the driver also has the capability to log in to their company profile. Upon beginning a shift, the profile allows drivers to clock in for their shift, see alerts of the vehicle including speed, charge/gas usage, traffic congestion, and other standard platform information. Once the bus is running, and a user has scanned in at a bus stop, the driver will receive an alert notification on their platform, the control room will determine whether this is a viable stop for this bus based on the bus's vicinity in comparison with other buses operating in that zone. If it is most viable for this bus to collect that passenger, the platform will display the most efficient

route for the driver to get there, they will notify the system controllers that they have received this command and that they will head in that direction, where they will proceed to collect the passenger. The bus driver will see the end point of riders journey end point as the only information that the driver will see. That end point will be one of a series of numbers that have been used to identify stops along the routes in that zone.

Efficiency

Route Optimization

Algorithms will run using information from statistics to anticipate demand for riding hours, traffic congestion, on-going or planned construction, speed limits and drive time. Another important aspect of the system is the capacity monitor. As one of the most important objectives of this system is efficiency, the bus will not be called to any bus stops once they have a certain number of riders on board. For clarification purposes, this will be called the 'maximum threshold.' For example, let's say the maximum threshold for a bus in zone one is 20 passengers. If a passenger calls for a bus within that zone and the nearest bus is at capacity with 20 passengers, and no one on that bus needs to get off at this stop, the system will not allow the signal to reach that bus but will send it to another bus that is operating within threshold for that zone, at that time. The goal is to move people from A-B in the most efficient way possible. This feature avoids the bus making too many stops and avoids the bus from falling into a more standard style of bus routing which typically has a structured schedule with specific stops to make. This feature allows the bus drivers to avoid roads where a bus has not been called further optimizing the drivers route. The threshold number differs depending on the zone that the bus is currently operating in, as the maximum threshold is not only based on the number of seats in the bus, but also the demand within the zone that the bus is operating in. This allows for agility in bus sizes as each bus is assigned to one zone and will only operate in that zone for a

given time. However, that same vehicle is occasionally allowed to be scheduled to operate in different zones.

Chapter 6: Project Development, Prototyping and Exhibition

Introduction

The research questions in this study seek solutions for the transportation industry in Cayman through the design of a new public transit system. The literature review, qualitative and quantitative research are used to inform the prototypes leading toward the final design. Key findings that directly informed the prototyping include:

- The survey where it was revealed that most people would use public transportation on island if it were more efficient and convenient with more advanced technology.
- Interviews that revealed a lack of a cohesive structure within the travel landscape of Cayman and the need for a designated space for information processing and analysis.
- The observational study that highlighted of the current layout, structure, and user habits revealing large gaps in communication and information.

Elements of Design

The design uses communication in technology to encourage efficient bus boarding. Some examples of the technology included are ride share, wireless transmitters, receivers, and GPS tracking.

Prototype Expectations

While the system design includes two components, the prototypes outlined in this thesis focus on the working elements of the Zoned Dynamic Transportation Line. The system will operate on an as need basis, much like ridesharing to provide a flexible system able to pivot by change, activity, or progress. Thinking Through Making was applied to create an iterative series of four prototypes where critique and refinement could lead to a plan for an exhibition of design outcomes.

Prototype One

Design Concept

Prototype One is a functional bus shelter within the dynamic system. For situational purposes, the prototype was created within zone one of the systems. The design includes a surface with small scale roads, three buses, and a bus shelter, an example can be seen below in Figure 19. The idea is to create an environment where users can experience what it will be like to use the bus stop. This is a tabletop version of an ideal life size structure that simulates the process of purchasing a ticket, scanning into the bus stop, and boarding the bus. During the bus journey, users will have the ability to visualize information and statistics that support the reason behind the research and design.

The Materials

The bus shelter was built with translucent materials to illustrate the light airy feel intended for the life size design. Inside, there were three bollards that functioned as safety barriers and by extension, three ticketing systems. The tickets for the system were placed on the display table

for ease of access to users. The ticket design is derived from a Seagrape leaf, found in coastal countries near the Caribbean Sea. The leaf's intricate, structured yet free design was inspiration to look from within and design for the island. The tickets' design process is seen below in figure 19. The scanning device is located on the inner side of the bus stop. The hardware and software for this prototype included programming running through an Arduino, LDR sensors and LED lights.

Further Iterations

The intent behind the design was for users to gain a visual experience of how a 'push-to-call' system would work by having them scan in at the bus stop and seeing that the nearest most convenient bus has been alerted. Further iterations of this prototype will have the scanning device prompt a miniature bus to move from point A-B on the physical display; Point B being the actual bus stop. While the bus is moving, users can interact with technology at the bus stop to see live tracking and how long the bus will take to arrive.

Evaluation

The table-top prototype was the first time that the project was created in a tangible format. Feedback from the prototype presentation concluded that the prototype was a good visual representation of the idea.

Positives	• The process of how the push to call system was clear and understood. • The intent behind design was clearly communicated.
Hesitations	• Given the multiple layers of the topics surrounding the topic, the audience and designer had hesitation regarding choosing the design

	idea that could be best translated into a prototype due to the many working pieces involved in a public transportation system.
Questions	• What system characteristics should be highlighted vs what should be left alone? • Which section of the system would be the most important to realize? • How will the overall system look and is this prototype representative of the entire system?
Interests	• Users wanted more experiential design; they were interested in physically seeing the reason behind the design. • Physically seeing intricacies of how the system works from a technological standpoint.

Table 2: Prototype 1 Evaluation

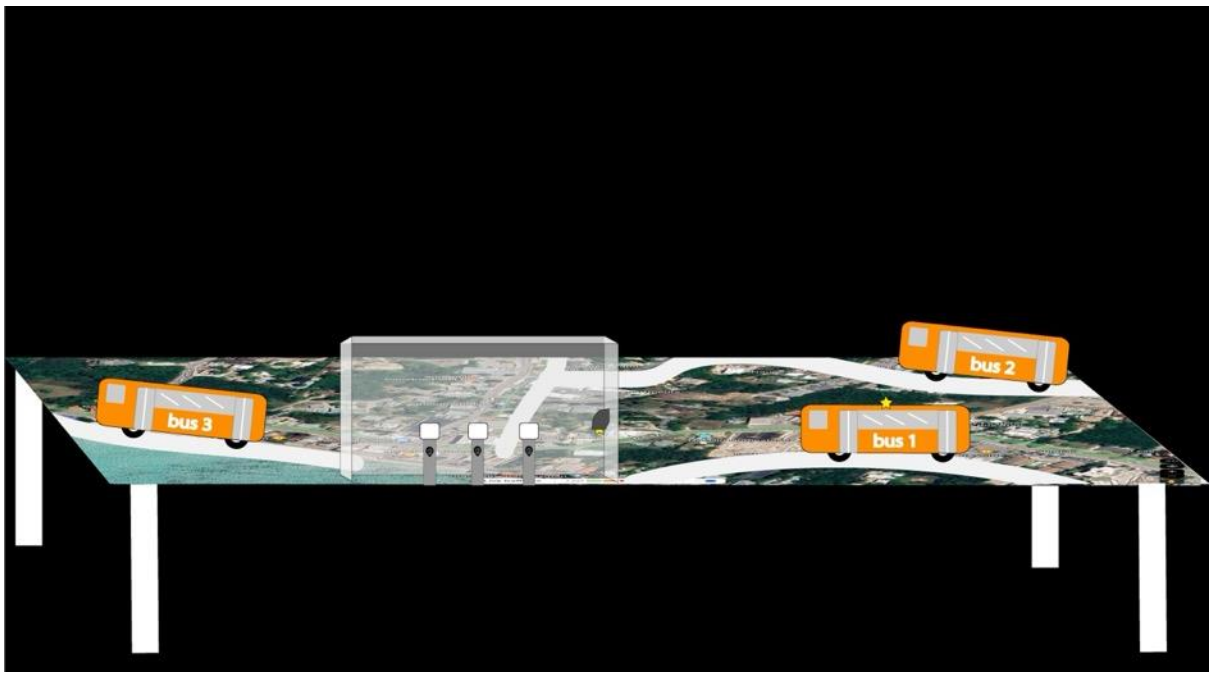


Figure 18: Prototype 1: Tabletop Depiction of Bus Stop in the ZDTL

Figure 19: Payment Ticket Design Inspiration and Concepts

Figure 20: Final Ticket Design

Prototype Two

Design Concept

Prototype Two responded to feedback regarding the tabletop prototype where users were interested in learning more about the intricacies of the system from an interaction perspective. The second prototype pivoted to approach the research from a digital platform perspective.

This design highlights the front (figure 22) and back end of the dynamic bus platform (figures 23 and 24). The outline shows the process of a customer purchasing their journey, and the journey of a bus driver setting up their online platform that would be used in a typical bus route, then seeing the driver dashboard. Visualizing this information helped gain clarity on the types of information needed for a seamless understanding of the system structure.

The Materials

Figma design prototyping was used to create the framework of the back-end system. Using theory from Stephen Wendel, the prototype highlighted pain points and then adjusted enhance the user experience. Wendel mentioned that this approach increases user confidence in the design and helps users adapt to changes more quickly by eliminating confusing or steps that may, on average be too difficult to complete given the design context of time, atmosphere, and demographic. The goal was to make the process smooth and seamless as well as easy to understand by both driver and user.

Further Iterations

To progress this prototype, the back-end of the system would undergo further development and a working system would be displayed. User testing would be conducted to monitor usability to help understand what could be added or removed to increase efficiency.

Evaluation

Positives	• The framework provided understanding of the design approach to the system back end. • The system back-end vs user facing platform was defined through this process.

	• The back-end was shown, and the intricacies of the design became more apparent that previous iterations.
Hesitations	• There was a one-sided approach to the design of this prototype. • It lacked the visuals of data gathering and information design.
Questions	• How does this communicate the dynamic approach to the proposed system?
Interests	• Visualizing more of the system layout from a user point of view

Table 3: Prototype 2 Evaluation

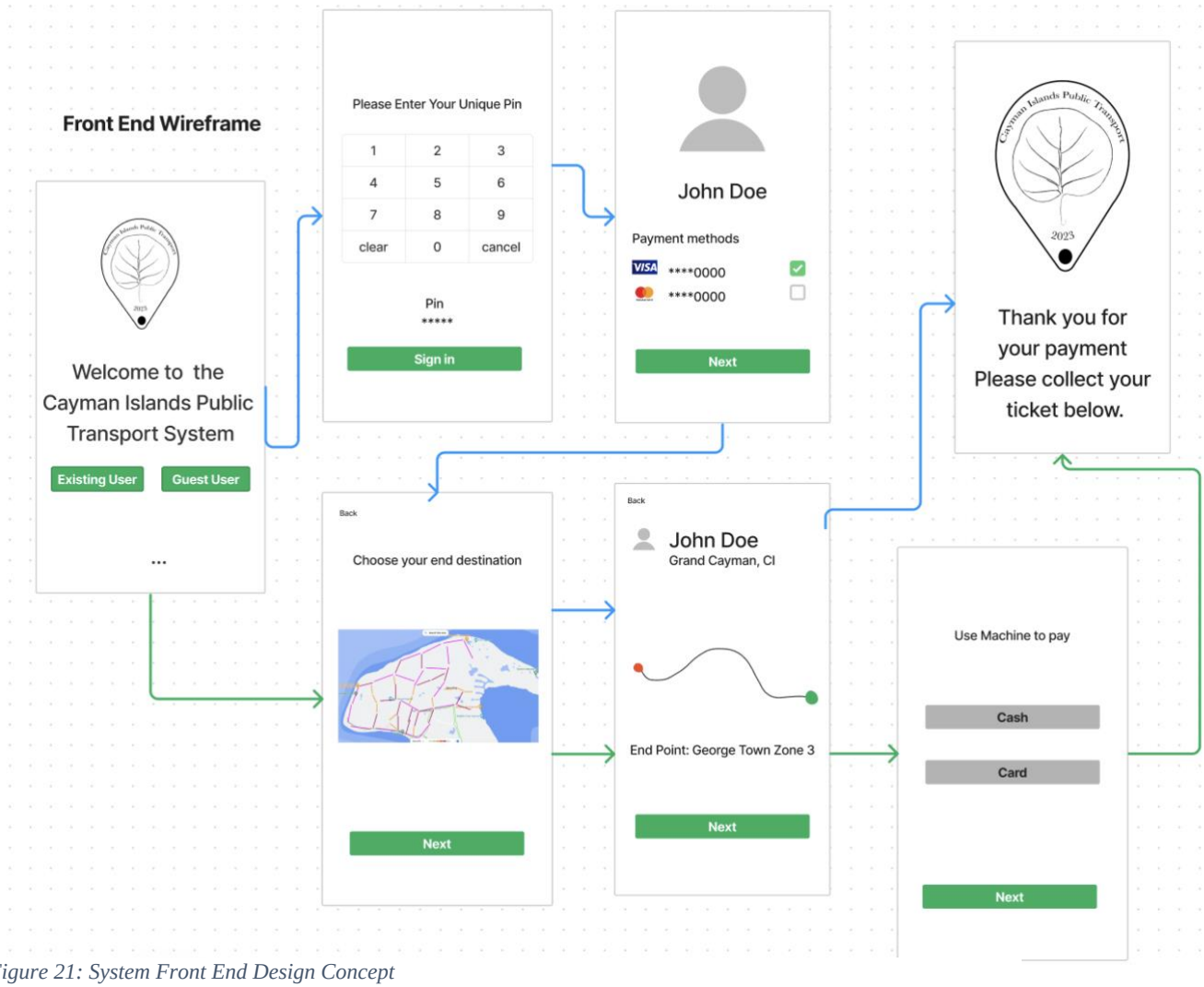


Figure 21: System Front End Design Concept

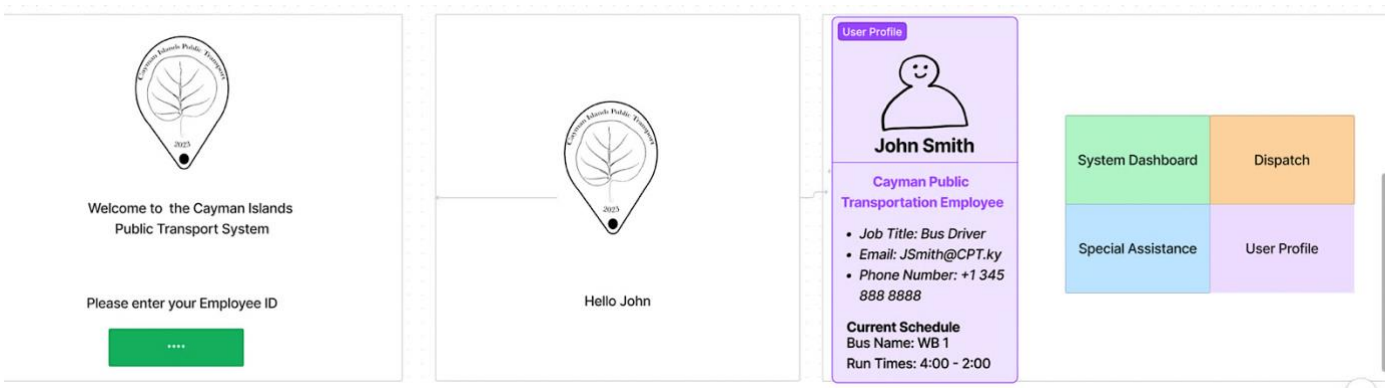


Figure 22: System Back End Design Concept Part 1

Figure 23: System Back End Design Concept Part 2

Prototype Three

Design Prototype Three

Concept

The intention behind Prototype Three was to lay out the pathway in which information would be shared between networks within the back-end system, accompanied by a visual of the system layout shown in figure 27. The idea was to conceptualize the passing of information within the on-demand section of the transportation scheduling platform as a demonstration of the 'how' aspect of the thesis.

The Materials

The prototype used Touch Designer to create a series of network and a visual component to illustrate and offer visibility to the information processing.

Evaluation

This iteration works best in the later stages of design and product development. Using a series of network connection nodes in touch designer visualised the process of connecting data sets to a live visual. This prototype speaks to the network mapping of the proposed transit system, see figures 25 and 26. This program and approach help the team visualize the idea, process and spot pain points in the design that should be addressed.

Positives	• The technical layer of the thesis was visible. • The abstract visual of the system was intriguing.
Hesitations	• The prototype was too one sided given the many layers of the project. • This prototype took away from the illustration of designing the system.

Questions	• How will the research and project scope be displayed through this prototype? • Is this the right area to focus on for this stage of the project?
Interests	• Create a cohesive design that tells a story, exposes research answers, and illustrates the system design. • To exhibit the things that invite or answer people's questions about the project. • Showing how users engage with the dynamic system communicates the uniqueness more than showing the data communication in the background network.

Table 4: Prototype 3 Evaluation

Figure 24: Touch Designer Part 1: Connecting Data to form a Shape.

Figure 25: Touch Designer Part 2: Connected Datasets Transmitted Across Two Networks.

Figure 26: Overall Transit System Map Highlighting Zone 1

Prototype Four

Design Concept

Pivoting from all previous variations, this prototype encompassed demonstration, information, and experience. The idea borrows from the first iteration of the project where the process of scanning to enter the bus was utilized. It encompassed the need to know more information about the purpose and reasoning behind the design, and it allowed for an abstract view of information processing, see Figure 28. It included:

- Step 1: The push to call element of the system. This was represented by the miniature structure of the bus stop shown in prototype one where, there was a paper ticket and an Arduino that was attached to an LDR sensor and an LED light. Once the paper was placed over the LDR, the LED lit up. This was to signal to the user that an action had taken place. This action was symbolic to calling the bus.
- Step 2: Once there is a trigger for the bus, users proceed to the seats provided at the installation, as though they are sitting on the bus, about to begin their journey.
- Step 3: This is where the user watches a video. That video highlights information on how the system works, statistics that make it relevant, and a visualization of the dynamic transportation map.

The demonstration of this prototype was conceptual where the physical display was on the desk, but the ideas were illustrated through the presentation slides shown below.

Evaluation

The feedback was collected in a conversational format from peers, instructors, and the supervisory team. Results included the following:

Positives	• The design represented the project cohesively by capturing the main points while telling a story. • The research elements were clearly visible. • The element of experience was present. • The design shows process, flow, and user engagement. • The amount of data collected has its opportunity to be shown here.
Hesitations	• That the added step of interacting with the bus stop was not necessary.
Questions	• What if the push to call section of the installation was abandoned and instead the exhibition was only a video to explain the process and show the design?
Interests	• To develop the experience in a way that users can track their hypothetical journey on their phones while 'riding' the bus.

Table 5: Prototype 4 Evaluation

The push to call element was retained, allowing users to learn through experience which will help them get a feel for what is meant to happen at a bus stop and how the push to call works as a key element of the system design. Interactive experiences within an installation increase user interest and engagement, allowing them to further connect with the concept.

The idea of having customers track the journey while seated is even more conducive to understanding how a dynamic system works. However, for the purpose of this installation, it also distracts from the informational aspect pertaining to the 'why' of the thesis that will be displayed in the video while users are on their bus journey.

The Exhibition

The final exhibition was a combination of an informational video with an element of user interaction. It draws critical lessons from the Thinking Through Making process. The exhibition took place in an exhibition hall. It provides an environment that mimics the process of using a bus stop situated along the Zoned Dynamic Public Transportation Line. The video visualizes a bus journey through Grand Cayman and is programmed to play when users interact with the miniature bus stop on display.

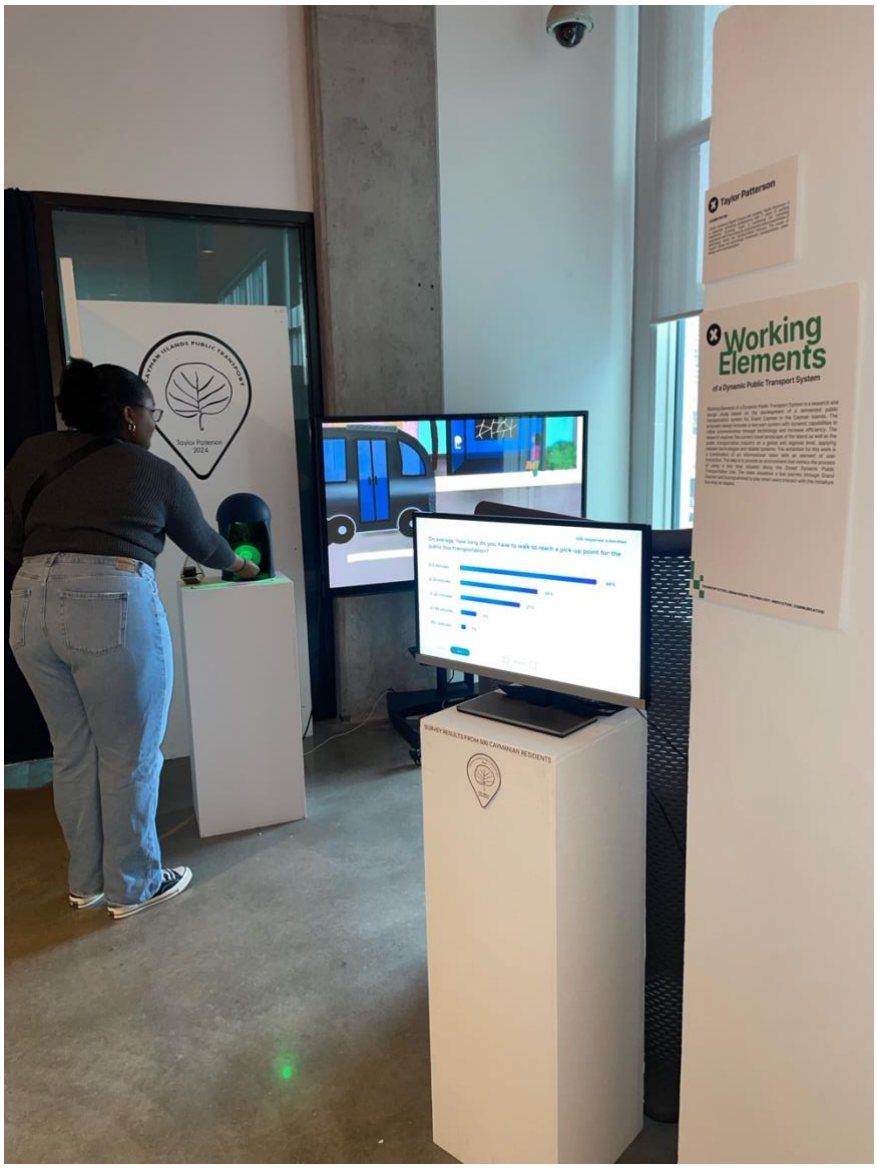
Below is a walk-through of the exhibition:

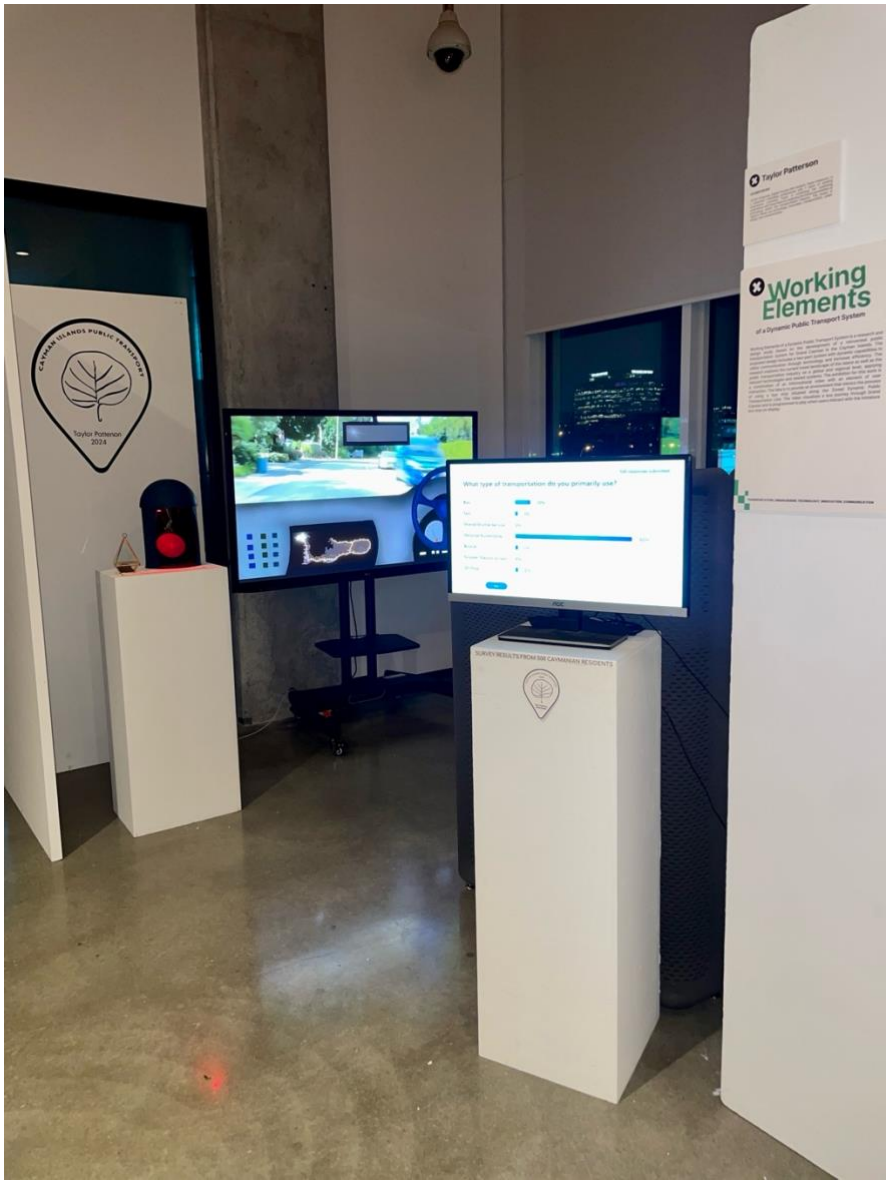
- There is a version of the scanning device created in prototype one.
- The user picks up a bus ticket from the display and use that device to scan in at the bus stop.
- This action of scanning in prompts the sound of a bus arriving and then welcomes users to the bus.
- The 'bus' is a seated area within the exhibition space where users will sit in front of a screen to watch the informational video.
- This video is from the perspective of a rider. The overhead announcement is communicating with the riders thoughts on the system to share information behind the system design supported by the study.
- There will be a waiting area before the scanning device that displays information gathered from the survey mentioned above.

The audience understood how to interact with the exhibition and found it intriguing to learn about how the system works. Below is a summary of some of the feedback given from the exhibition.

Positives	• The audience loved the fact that the overhead voice and the riders voice were done in a Caymanian accent; This helped situate the system. • The use of video footage from Cayman helped to give context as to what road in Cayman currently look like. • The system was well explained. • The design seemed like a feasible, well thought out plan for the travel landscape and transportation concerns shown from the survey. • Users felt immersed and enjoyed the feeling of riding in a hypothetical bus. • The concept of scanning to call the bus was clearly portrayed.
Hesitations	• There was quite a bit of information in the video, some users had to watch it twice to understand the narrative, and then to understand the concept and the system functions.
Questions	A. From a user facing point of view, how the system would work if there was an app? B. What does a user do if they scanned in at the bus stop and changed their mind, will they be charged? C. How was the idea for the system developed?
Responses	• The system would work the same, the information used would just be displayed on a smartphone. Ticket purchasing, journey tracking, delays, account information, would all be visible from within the app. • Should a user scan in a change their mind, the bus would still be deployed. However, the user does not get charged until they pass

	thorough the bus and is registered by the scanners surrounding the bus doors. • The research study was referred to where issues within the travel landscape and the shape of the island were highlighted. This with a combination of international travel trends lead to the idea of a two-part system with zoned dynamic transport.





Chapter 7: Project Analysis

The project goals have shifted from the initial idea of providing a service aimed at alleviating traffic, to providing a technologically advanced dynamic transportation public bus system that focusses on convenience with further goals of a user-centred design. To begin the project analysis, the initial question of “How can research inform the reconstructed design of public transportation in the Cayman Islands through the proposal of a dynamic public bus system?” resurfaces.

As mentioned in the contextual review, and alongside the information shown in previous chapters of this thesis, further research was supplemented through an independent study. This study provided insight on how information systems for transit uses real time data, modular platforms, and route optimization, along with examples of how they have been used around the world to enhance public transportation. This study looked at system with GPS like the information shown in chapter 2, but also investigated the role of map-based systems. Some examples included planning and optimization during high traffic times and flexible route planning, both of which have been considered in the design thinking process of creating a framework for the system plan. (*Map Based Systems*, *independent study*, Taylor Patterson).

Understanding the current needs of travelers within Grand Cayman shed light on important statistics that shape the travel landscape of Cayman. This research led to a trend analysis of the current context which resulted in a better understanding of current user habits. Demographic, technical and population trend analysis supported the vision for a transportation system. (*Understanding the current needs of travels in Grand Cayman*, Taylor Patterson).

In addition to the travel landscape and map-based systems, other aspects such as social, economic and land use factors were researched. This secondary research provided insights on what rush hour looks like in Cayman, where most of the population reside, information on electric vehicles, their charging stations, positioning of building clusters including schools, businesses, restaurants etc. There was also information on the demography of Cayman in terms of standard work life, the number of visitors to the island and what school routines look like for islanders. (*What is needed to build an on-demand Transit in Cayman*, Taylor Patterson).

Analysing and processing this information led to the realization that not only does the system need to be displayed, but a map to display first-hand how the route would work, was also a crucial element to visualizing the design process and desired outcome. See map design below in Figure 32.

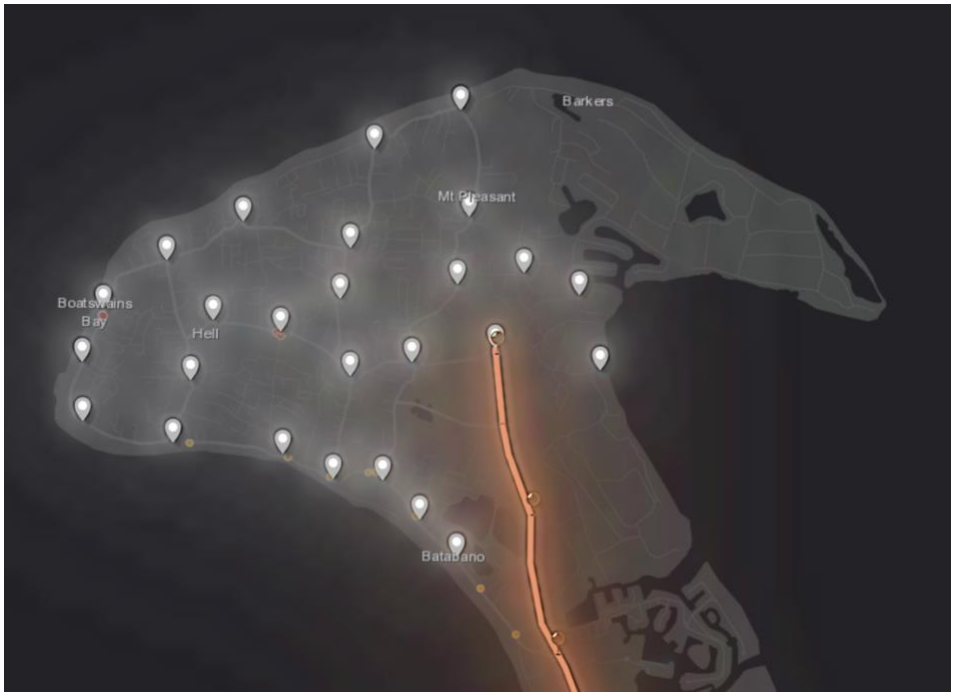


Figure 27: ZDTL 1 Map

Figure 28: MRTL Design

Chapter 8: Conclusion

Working Elements of a Dynamic Public Transport System applied a design thinking methodology and cognitive semiotics and incorporated a spectrum of insights including interviews with industry experts from different around the globe, a survey from the current users of the current travel landscape and on the ground research through observational study. The strategy was developed after extensive research on the public transportation industry, systems in technology, systems integration, communication in transportation, strategic design in transportation to build a foundation to support the reason behind design and to provide insight on elements that will be used within the system operation. These topics also aided in the exploration of elements that will be combined through technology and design to influence design decisions for this user centric service.

The aim is to provide the framework for a solution that seamlessly introduce a

layered and integrated framework to provide a new responsive, human centred mobility experience that responds to the needs of the Cayman, increases efficiency, and reduces the overall travel time within the island's travel landscape.

Future Work

Future research would include:

- Continued research of transportation and cognitive semiotics among public bus users in Cayman.

- Continued research on what types of information should be included and what angle would be best to approach a campaign tailored towards encouraging the population to use public transportation and unlearn current transit habits.
- Detailed Development of the user centred digital platform
- Facility design to integrate control admin centre functions, fleet charging stations, and overall technical and system maintenance.
- User centred design of interfaces, tickets, and customer support.

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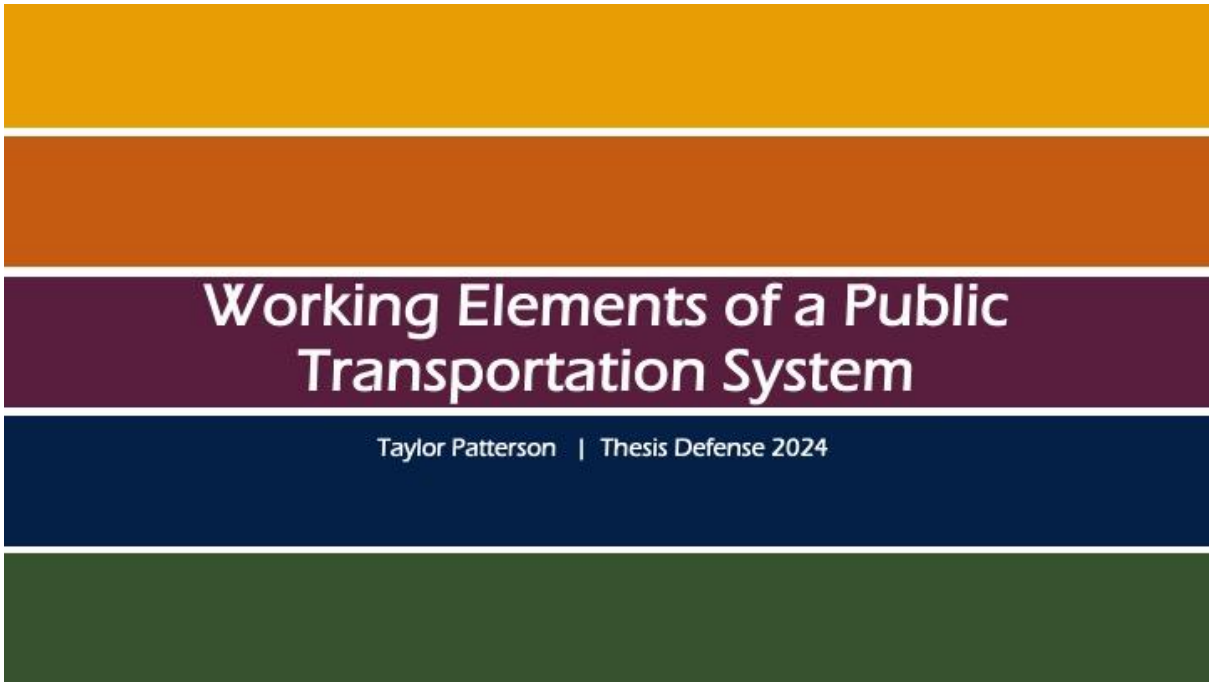


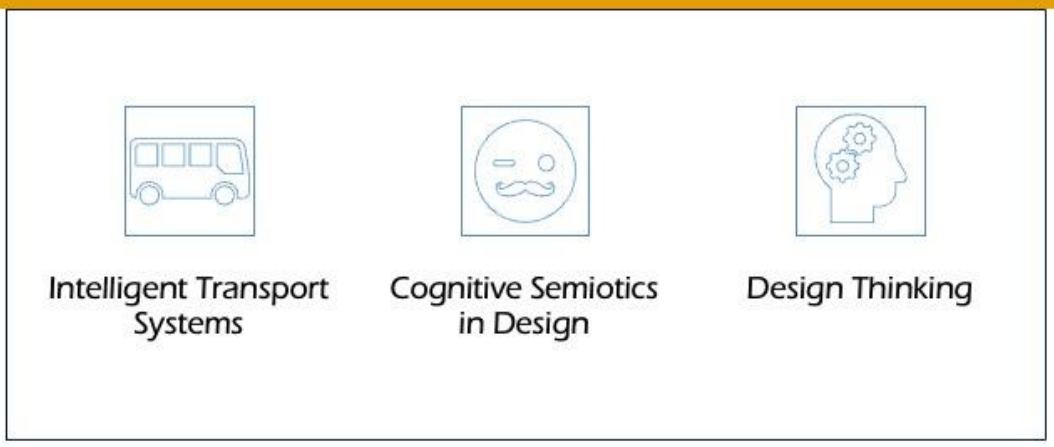
The Foundation

Motivation

- Family Background
- Global Influences
- Geographical Landscape
- Gaps in Current System

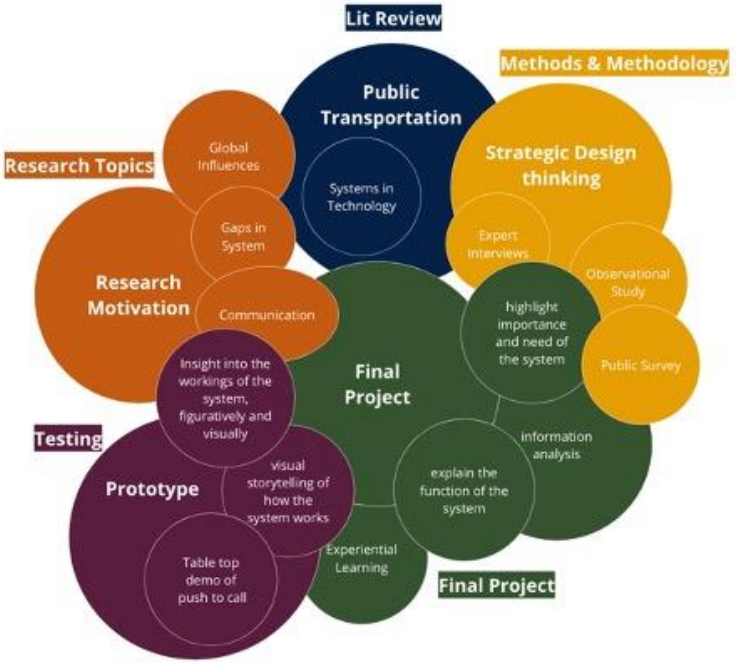
Thesis Structure Outline

Theoretical Tools



Existing Bus System

The Research



The Interviews

National

Eric Bush
Minister of Planning, Agriculture, Housing, infrastructure, transport and Development, Cayman Islands

Durk Banks
Director of Transportation, Cayman Islands

Regional

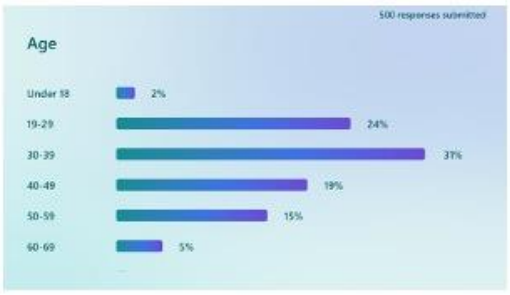
Khalil Bryan
Executive Director and Co-Founder of Caribbean Transit Solutions, Barbados

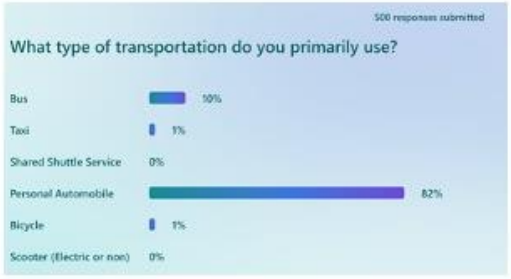
Global

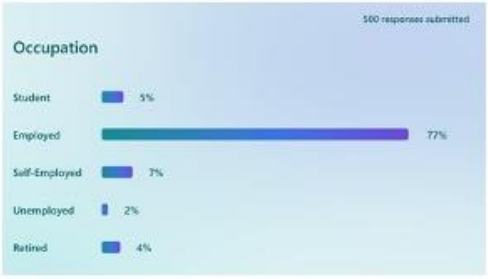
Anthony Diogini
Previous Senior Policy Advisor for Ontario Ministry of Transportation

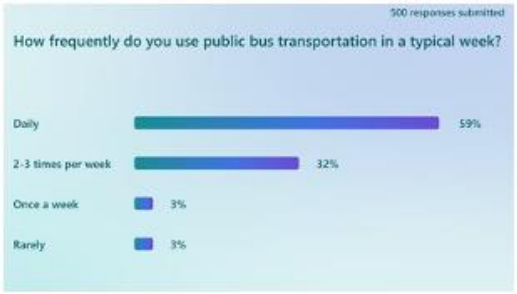
Interview Highlights

National	Cabinet will form a strategic head for all transportation to form one solitary public transportation unit. Plans for the next 50 years look to provide long term solutions that can accommodate for substantial growth in population in hopes of combating the issue of road fatalities and traffic bottle necks on island.
Regional	The purpose of EasyTrak was to provide high level tracking solutions for current public transportation companies operating in the Barbados. There was no need for new vehicles as the hardware for tracking was implemented into the diagnostic port of the vehicle, or hardwired and runs on the vehicle battery.
Global	Major differences noticed between countries is with technological advancement and the perception of transportation by country. The debate on strategic focus regarding moving people from cars to busses versus improving the current service for those who do not have the option of a car.

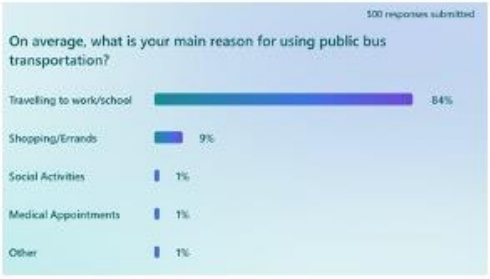






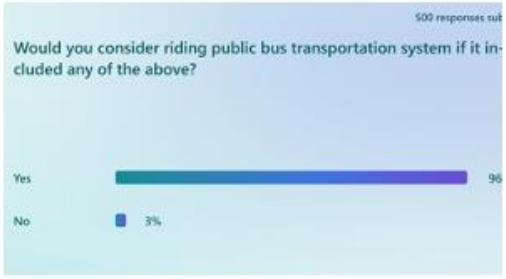

500 responses submitted
How frequently do you use public bus transportation in a typical week?
Daily
59%
2-3 times per week
32%
Once a week
3%
Rarely
3%


500 responses submitted
On average, how long do you have to walk to reach a pick-up point for the public bus transportation?
0-5 minutes
44%
6-10 minutes
26%
11-20 minutes
21%
21-30 minutes
5%
30+ minutes
1%


500 responses submitted
On average, what is your main reason for using public bus transportation?
Travelling to work/school
84%
Shopping/Errands
9%
Social Activities
1%
Medical Appointments
1%
Other
1%


On average, from point A to Point B, how long is your total commute?
10-29 minutes
48%
30-49 minutes
30%
50-59 minutes
5%
60+ minutes
15%


What features would you like to see in a reimagined public bus system? (Please select all that apply)
Real-time tracking of buses so I know when my bus will arrive
20%
Flexible routes based on passenger requests (on-demand public transit)
8%
Cashless payment options
15%
User-friendly mobile app to plan my travel and track my routes
16%


Would you consider riding public bus transportation system if it included any of the above?
Yes
No
3%


What factors influence your choice of transportation? (Please select all that apply)
Cost
9%
Convenience
25%
Frequency of Service
15%
Route Coverage
15%
Environmental Concerns
4%
Safety
13%

Observational Study

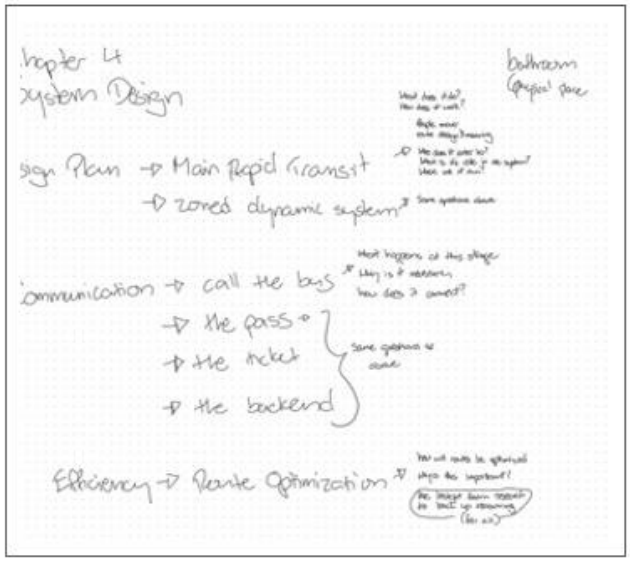
	Start Time	Departure Time	Passengers on Arrival	Passengers on Departure	Atmosphere	Traffic	Trip end Time	# of stops	Avg. time Between Stops
Trip 1	13:55	13:58	4	6	Cool/warm, no music	Moderate /Light	14:17	9	2.25 mins
Trip 2	15:14	15:18	6	5	Cool, music	Moderate /Heavy	15:42	11	2.50 mins

Main Rapid Transit Line (MRTL)

- Fixed routes
- Runs through middle of Island
- Larger vehicles

Zoned Dynamic Transit Line (ZDTL)

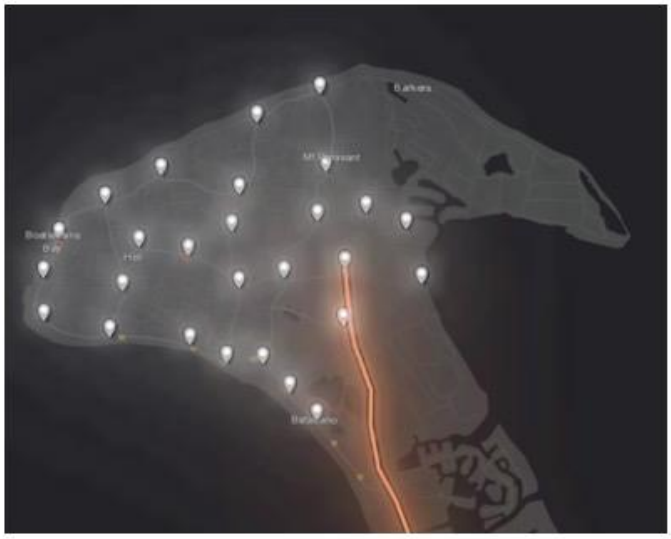
- Dynamic routes
- On-Demand Service
- Smaller vehicles

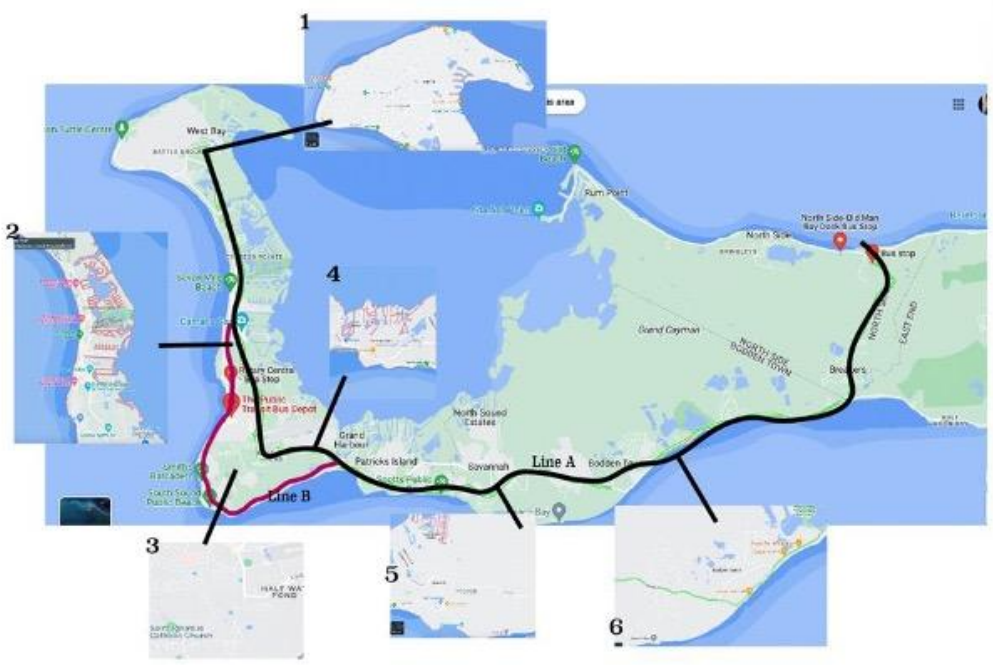



West Bay
Snug Harbor
Seven Mile Beach
George Town
Pond
Websters

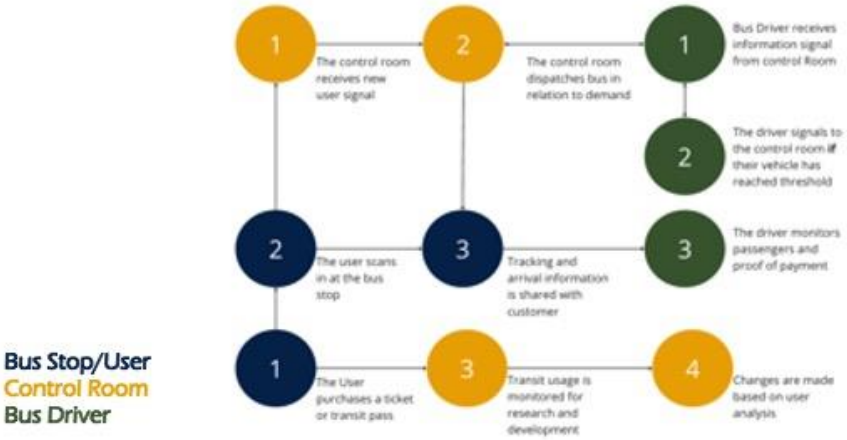
MRTL

ZDTL

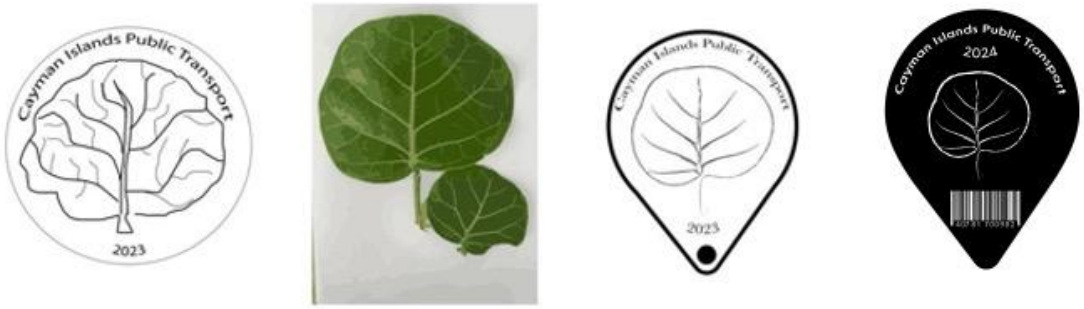




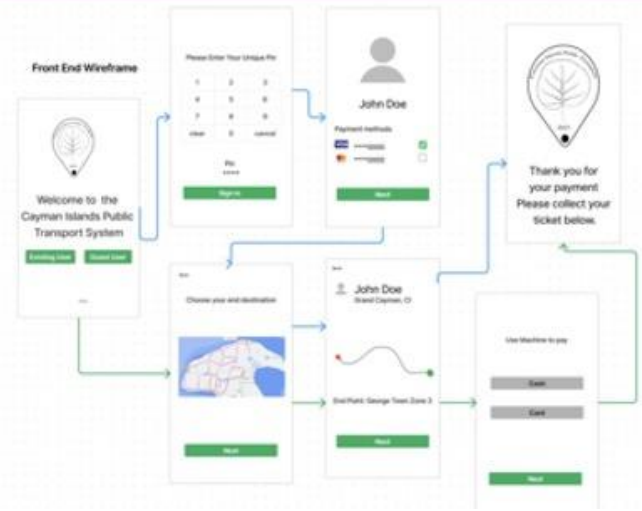
Chain of reaction



Ticket Design



System Front End – User view



System Backend – Driver view

The Installation

Purpose

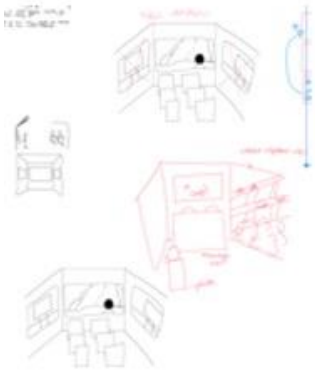
Designed to emulate the process of scanning into the bus stop to monitor the function of scanning in to enter a space and to highlight the design of the system through video.

Narrative

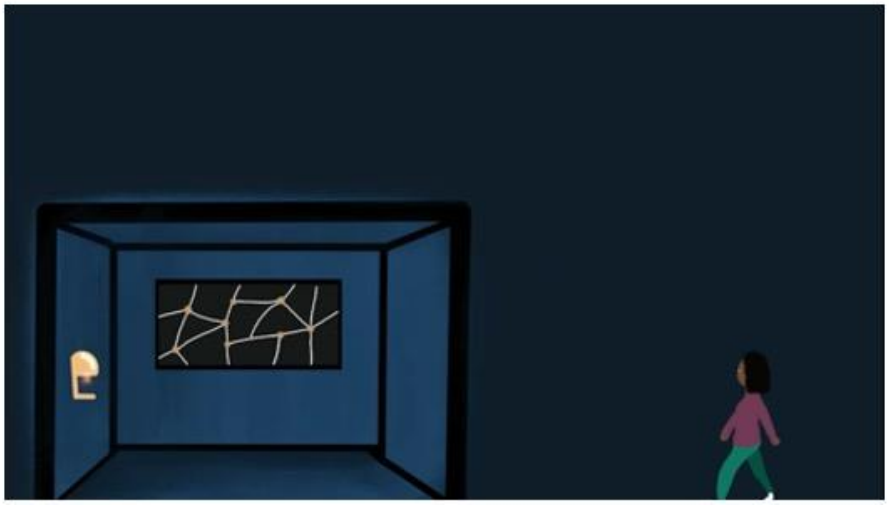
A specific customer journey using the public bus. The persona is based on findings from the December 2023 survey of transportation users found in GCM.

The descriptive video explains how the system works, the route, process of using the stop and bus stop selection.

Setup



The Video



Observations

Conclusion

Research Question

"How can research inform the reconstructed design of public transportation in the Cayman Islands through the proposal of a dynamic public bus system?,"

Findings

- Traffic to Technology
- Systems in Transit
- Understanding the current needs of travellers

Future Development

- Detailed Development of the user centred digital platform
- Facility design to integrate control admin centre functions, charging, and technical maintenance.
- User centred design of interfaces, tickets, and supports.
- Speak with government in hopes to inspire or implement change in perspective on public transportation
- Speak with investors who have vested interests