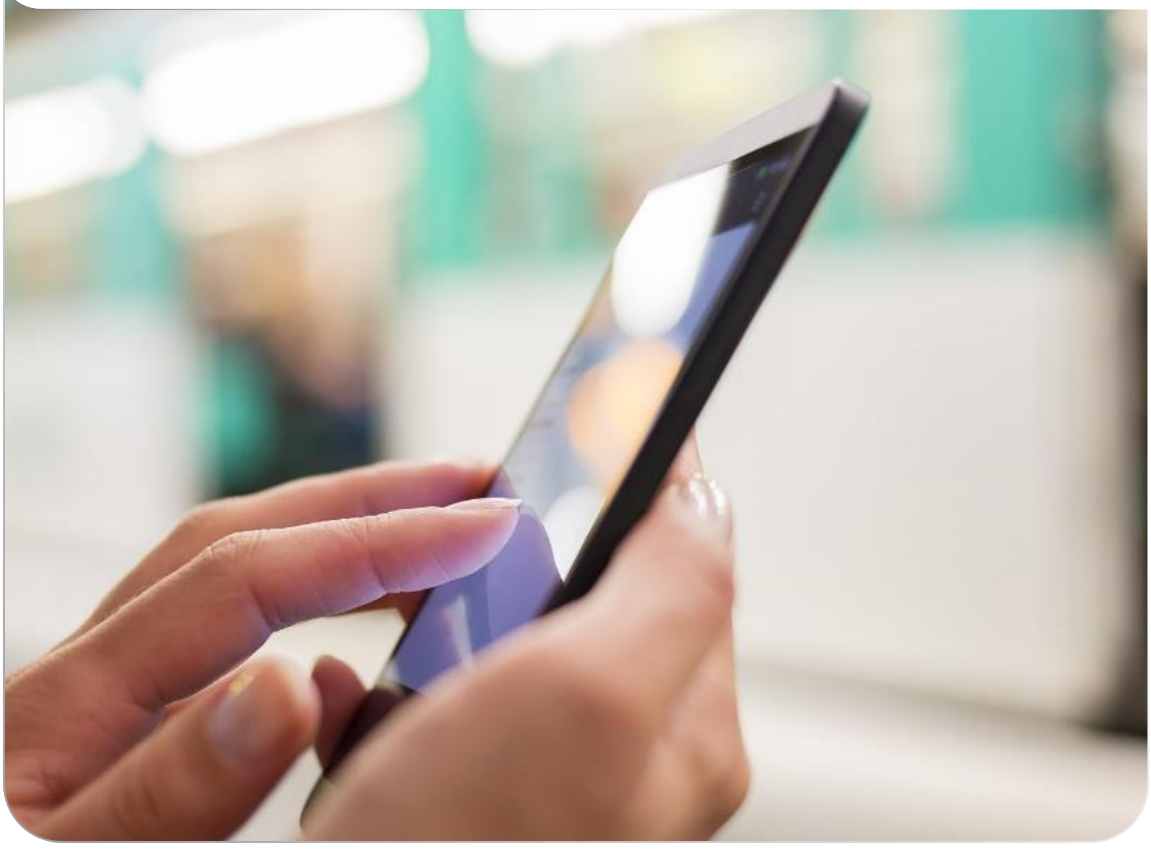
DILLON CONSULTING

BURLINGTON TRANSIT

Burlington Transit Business Plan

Appendix A-Dynamic On-Demand Transit Strategy



September 2019 – 19-9087

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1.0 Introduction

Strategic Direction 2 (Mobility Management) in the Burlington Transit Business Plan outlines a number of strategies to position Burlington Transit to deliver multi-modal and integrated sustainable mobility services. One of the key strategies in this Strategic Direction is to assess and pilot a dynamic, on-demand service. It is envisaged that such a service would utilize a mobile app to optimize shared-ride demand-responsive services and to allow customers to easily book, track and pay for their ride.

The purpose of this appendix to the business plan is to:

1. Define dynamic on-demand transit
2. Undertake an industry scan to understand common service features and review case studies that are in place in Canada today
3. Assess the applicability of a dynamic on-demand solution in Burlington
4. Evaluate dynamic on-demand transit models in the Burlington context
5. Identify next steps to piloting a dynamic on-demand transit model in Burlington

2.0 Defining Dynamic On-Demand Transit

2.1 What is Dynamic On-Demand Transit?

Dynamic on-demand transit is a traditional form of mobility that is experiencing a resurgence with the help of technology. Dynamic on-demand transit is sometimes referred to as micro-transit, demand-responsive transit or alternative service delivery. These are all specific types of dynamic on-demand transit, which is a larger umbrella term encompassing several different service models. Dynamic on-demand transit has three components that differentiate it from conventional fixed-route transit:

1. Flexible routing and/or scheduling designed based on customer demand;
2. Newly-emerged "mobility brokers" who use mobile apps to connect supply and demand; and
3. Use of smaller, more flexible vehicles.

In certain cases, there is a fourth component to a dynamic on-demand model:

4. Connecting multiple transportation services to complete a trip (using a mobile app).

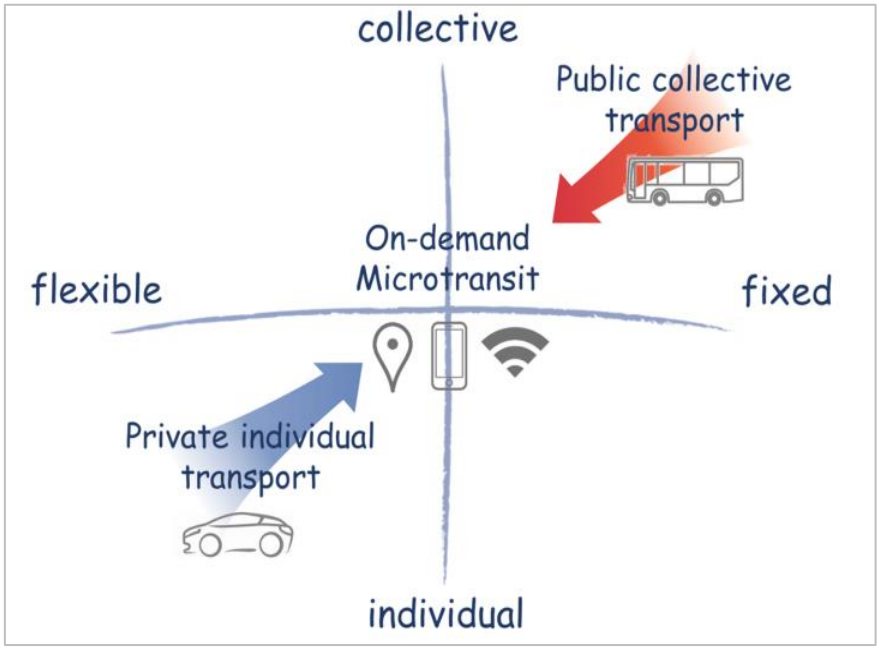
This fourth component connects dynamic on-demand services to fixed transit routes, or in certain cases, can combine multiple sustainable services (e.g., bike-sharing and car-sharing) to one mobility platform.

Dynamic on-demand transit can be differentiated from conventional fixed-route transit in the way that it caters to individual needs.

In a dynamic on-demand transit model, the transit service adapts to its customers, while in conventional fixed-route transit service model, transit customers must adapt to the service offered.

In many cases, this provides greater convenience and customization – moving towards some of the

Figure 1: Attributes of Dynamic On-Demand Transit



Source: http://www.smart-circle.org/blog/microtransit/

favourable characteristics of private automobile travel. As illustrated in **Figure 1** above, dynamic on-demand transit (referred to as "on-demand microtransit" in the figure) offers a level of flexibility, convenience, and individualism somewhere between regular fixed-route transit ("public collective transport") and private individual transport.

3.0 Industry Scan

An industry scan was conducted of various dynamic on-demand transit services in place or planned to be in place across North America (with a focus on Canada). The purpose of this industry scan was to provide a broader understanding of the existing application and to fully understand the variations of dynamic on-demand services in terms of service delivery structure, use of technology, operating structure and customer experience.

3.1 Defining Characteristics

For each example included in the industry scan, a brief summary is provided, along with key defining characteristics. These include the following.

3.1.1 Booking and Scheduling Interface

The interface used to book and schedule rides can vary widely between various models. Certain models use call centres and manual scheduling, while other models have mobile apps as a customer interface to optimize trips. Some typical trip booking and scheduling interfaces include:

1. **Mobile App -** Customers use a mobile app to book rides while a back-end processor optimizes trips in real time, balancing customer convenience with ridesharing. The customer interface allows customers to use their mobile phone to book their ride, track their ride and pay for their ride in real-time. The driver uses a mobile phone or tablet in their vehicle to receive trip instructions. The driver only sees one trip at time, as the mobile app continuously optimizes in real-time to add trip requests. A call centre option is typically provided for customers that do not have access to a smart phone, however, customers are typically still required to register an account for the dynamic on-demand service.

2. **Manual Scheduling -** Customers call a call centre to book a ride. Trips are scheduled manually or by using a specialized transit scheduling software package. This approach typically requires more advanced notice to book a ride, with less ability to optimize rides in real-time. As manual scheduling is booked and dispatched in advance, it is not possible to greatly alter operations in real-time. This means that manual operations are less able to respond to changing demands and must be scheduled with greater contingency in order to accommodate daily variation. Trips that cannot be booked far in advance can generally not be accommodated, even if they are similar to other pre-booked trips. As such, manual scheduling is generally less efficient and the scheduling less optimized than real-time options.

3.1.1.1 Service Delivery Model

Dynamic on-demand transit service can be structured in a number of different ways, depending on the goals of the municipality and the market in which the service operates in. Some typical service delivery models include:

1. **Origin-to-Hub (First-Mile/Last-Mile) -** Dynamic on-demand transit provides mobility to customers in lower demand areas to/from the nearest fixed-route transit stop. In this way, this service model provides first-mile/last-mile connectivity to the rest of the transit network, with the majority of a passenger's overall journey undertaken on fixed-route transit. Where possible, the connecting stop is typically a major hub/terminal, transfer point or stop that allows customers to complete their trips from a safe and accessible transfer point, connecting to multiple routes. The model is typically implemented in low density areas where fixed-route transit is uneconomical, is not offered, or to supplement an existing low-frequency fixed-route service.

2. **Origin-to-Destination -** Dynamic on-demand transit vehicles provide a one-seat ride to connect any origin with any destination in the service area. This means that transfers are not required to a fixed-route service. This model is typically implemented in larger low-density geographic areas where there is no fixed-route service. This model can be combined with an Origin-to-Hub model, where Origin-to-Destination is used for internal trips within an on-demand zone and Origin-to-Hub is used to connect customers outside of the on-demand zone.

3. **Origin-to-Hub-to-Destination -** This model is an extension of the Origin-to-Hub model, where the customer has the ability to plan, book and pay for their entire trip from origin to destination using the same software. In this scenario, a mobile app or a customer service agent would identify the entire trip, which could involve a dynamic on-demand service connecting to a fixed-route bus, then ending with a second dynamic on-demand service (to connect to the destination). This model requires real-time data of the entire transit network connected to a mobile app, and the ability to optimize the full trip and communication steps to complete the trip for the customer. To date, there are very few mobile app mobility providers that have this capability.

4. **Flex-Route -** This is a simple form of dynamic on-demand transit which is typically implemented in low-demand areas and allows transit agencies to provide additional coverage using a limited resource. Flex routes operate on a fixed-route and fixed schedule for certain portions of the route. At the request of a passenger, the driver has the ability to 'flex' off the route to pre-designated areas to pick up or drop off a passenger. The benefit of flex routes is that it allows the resource to provide coverage to a larger area that may have limited demand without the need to invest in additional service.

5. **Ridesharing Partnership -** This involves entering into an agreement with a transportation network company or taxi company to better integrate these services with fixed-route transit. This partnership typically involves marketing of the service or the municipality providing a fare discount to the ridesharing service if transferring to/from the fixed-route transit service. This service does not always replace the first-mile/last-mile of a transit service, but can be used to supplement the transit service for customers that want a better level of service and are willing to pay a higher fare premium. There are also examples where it can be used to operate the entire transit service in a municipality.

3.1.1.2 Operating Model

The operations of dynamic on-demand transit services can also vary. The variation comes from who operates the service, and if the operator is guaranteed compensation during the allocated service hours or whether the operator only gets compensated based on trips delivered. Some typical operating models include:

1. **Dedicated Vehicles – Municipal -** The municipality supplies the vehicles and drivers to operate the service. Drivers are compensated based on the hours they work, no matter how many customers they provide service to. Typically, specialized transit vehicles or smaller cutaway buses are used to provide the service. The operation of the service can be integrated with specialized transit services or be a stand-alone service.

2. **Dedicated Vehicles – Contracted -** The municipality contracts the supply of vehicles and drivers to a third-party operator. The vehicles and drivers used are dedicated to the service during the hours of service they are scheduled (drivers are not permitted to take on other trip requests that are not municipally operated public transit). Contractors are typically compensated by hour of service or service kilometer (with a minimum number of hours/kilometres guaranteed).

3. **Non-Dedicated Vehicles – Contracted -** The municipality contracts the supply of vehicles and drivers to a third-party operator. The vehicles and drivers used are not dedicated to the service during the hours of service and are permitted to take on other trips outside of the municipal transit function. Examples of these include trans-cab services with local taxi companies or partnerships with transportation network companies. For ridesharing services, citizens with their own automobiles set their own schedules and provide rides to other citizens. They have the opportunity to accept or decline a ride request. Therefore, to ensure availability of vehicles at a high level of service, pricing strategies are typically in place to ensure supply meets demand. Riders pay for the trip and the driver profits from a percent of this revenue. This model is useful if demand for a service in a particular area is too low to warrant a dedicated vehicle and if there is a supply of drivers to guarantee a trip request is delivered.

3.1.1.3 Proximity of Service

Dynamic on-demand transit service can be structured based on the traditional proximity targets of a transit system (requiring customers to walk up to 400m to the closest transit stop), or to provide more convenient service right to the curb of the customer's origin and/or destination. Some typical pick-up/drop-off models include:

1. **Bus Stop** - The dynamic on-demand service picks-up and drops-off customers at predesignated transit stops only. It is common to use pre-existing fixed-route stops (e.g. when fixed-route service is replaced by on-demand service during certain periods of the day), or to designated on-demand stops. Stops are placed so that the majority of residents are within a 400m walking distance of a stop.

2. **Corner** - Customers must walk a short distance to a street corner within 100 metres of their origin/destination to get picked-up and dropped-off by a dynamic on-demand service. This type of pick-up/drop-off point is only used by technology-based ride hailing services as stops are

virtual and only visible on the mobile app. This is because the location of a corner stop can change with each trip request, as the stop is selected to minimize the travel time of the vehicle that is destined to pick-up or drop-off the next customer (e.g. the location of a corner stop may be the north-east corner of an intersection for an inbound vehicle coming from the south, or the south-west corner for an inbound vehicle coming from the north). Customers are asked to walk a short-distance to optimize the service.

3. **Curb** - Customers are picked up/dropped off directly at the curb of their origin and/or destination. This model is typically used in more rural or low-density areas with limited ridership, where consolidating pick-up and drop-off points at a common stop would not significantly increase the efficiency of the service. For origin-to-hub service models, the curb is only used for one end of the journey.

3.1.1.4 Trip Booking

Dynamic on-demand service models can also differ in the degree of spontaneity in which customers can book trips. Models that focus on ridership growth generally offer more convenience, while those that focus on maximizing vehicle occupancy in low demand areas/periods require more pre-planning when booking rides. Some typical trip booking models include:

1. **On-Demand -** No pre-planning is required to book a trip. Customers can book a trip on-demand (within ten minutes of when they want to be picked up). This model typically works with a mobile app, when there is a higher supply of vehicles to accommodate the trip request. When there is low ridership servicing a large service area, the ability to share rides in this model is limited.

2. **Scheduled On-Demand -** Customers can book trips on-demand, but must select from a pre-defined list of arrival times or departure times (similar to a headway used for a fixed-route service). While the route is still dynamic, creating a schedule for pick-up or drop-off times can help group rides when customers originate or are destined to the same location or transfer point. This type of model is typical when a dynamic on-demand service is provided to connect to a transfer point which operates on a fixed headway (e.g. every half hour).

3. **Scheduled -** Customers can pre-book rides in advance (typically between two hours and one week of their requested trip). This model is typically used in lower demand areas/periods or in large geographic areas where the supply of vehicles is limited and providing more notice helps to promote an increase in average vehicle occupancy. Customers can also use this model to book important trips, such as medical appointments. This model is typically used when there is no mobile app in place to book rides, as more notice is required to share rides when completed manually or using a traditional scheduling software package.

4. **Subscription -** Customers have the ability to book repeat trips for travel that they make on a consistent basis (e.g. trips to work). In a dynamic on-demand service, the exact time of the pick-up may vary slightly each day depending on other trips that are booked around the trip.

3.1.1.5 Accessibility

While each model must comply with the Accessibility for Ontarians with Disabilities Act (AODA), the approach each dynamic on-demand transit model takes to provide accessible trips can vary. Two typical approaches to accessibility are:

1. **Integrated -** The integrated model involves co-mingling conventional dynamic on-demand customers with registered specialized transit customers (using the same booking/scheduling platform and being transported in the same vehicle). The only difference between the two customer groups is that a registered specialized transit customer may require a full origin-to-destination trip whereas a conventional customer may only be permitted an origin-to-hub trip (picked up at a stop instead of the curb). In this model, a registered specialized transit customer booking a trip would follow the same process as a customer that does not have a disability (whether booking through a mobile app or a call centre). The requirements of the person with a disability would be included in the customer's profile and identify trip characteristics such as the type of trip (e.g. origin-to-destination), whether the person is travelling with an attendant, whether an accessible vehicle is required, etc. A vehicle would be dispatched that meets the customer's requirements. The software or scheduler that optimizes trips would continue to do so, including optimizing trips with conventional transit customers.

2. **Separated -** Some dynamic on-demand services use non-accessible vehicles (e.g. sedans or minivans) to provide service. This is typical of certain models (e.g. partnerships with ridesharing organizations) or when there are no accessible vehicles available in the existing fleet. To book an accessible ride, a registered specialized transit customer must call into the customer call centre to request a ride. The transportation coordinator would then find an available accessible vehicle to provide the ride. In most cases, accessible vehicles are not used in the dynamic on-demand transit service, and may be a different vehicle operator (e.g. contract with a taxi company to use an accessible taxi vehicle). Typically, more advanced notice is required to book an accessible ride, depending on the availability of accessible fleet. This model can be more cost effective if the cost of operating a non-accessible fleet is higher than an accessible vehicle. The challenge with this model is that the customer with a disability may not have the same experience using the dynamic on-demand service as a conventional passenger (e.g. may require more notice to book a ride or may not be able to use a mobile app).

3.1.1.6 Costing Model

Different dynamic on-demand transit service and software providers offer different costing models. This may depend upon the types of services that they offer and their business structure. Different costing models are better suited to different types of services, depending on hours of service and anticipated levels of ridership.

1. **Per Hour -** This is the most typical costing model for when the service is dedicated and operated by municipal operators. The model provides more cost control as it is set by the agency's decision of how many service hours to provide. It incentivises the fastest routing, rather than

the shortest routing. This model becomes more cost effective as ridership increases (as the cost is fixed no matter how many people use the service).

2. **Per Kilometer -** This model is similar to the per hour option and is typically used for contracted services (dedicated or non-dedicated models). A pre-defined cost is charged for each revenue service kilometer planned and provided. This model is less predictable than per hour because the number of kilometres will change depending upon service usage and therefore routing. It incentivises the shortest routing, rather than the fastest routing. This model becomes more cost effective as vehicle occupancy (ride sharing) increases.

3. **Per Trip -** This model is typically used for non-dedicated contracted services. A pre-defined cost per trip is established with the service provider. The model is effective when there is low ridership, as there is no fee charged to the municipality when no trip is delivered. As ridership grows, this model can increase operating costs, particularly when there are no financial incentives to encourage ridesharing.

3.2 Dynamic On-Demand Service Case Studies

The following provides a description of a number of dynamic on-demand transit services already in place or scheduled to be implemented in the near future. The purpose of these case studies is to provide some examples that may be applicable in Burlington Transit's context.

3.2.1 Arlington, Texas – Arlington On-Demand

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Destination	Transit Agency	City of Arlington
Booking / Scheduling	On-Demand	Municipality	Arlington, Texas
Operating	Dedicated Vehicles Contracted	Land Use Context	Suburban
Trip Booking	Mobile App	Technology Provider	Via
Accessibility	Integrated	Service Provider	Private
Proximity of Service	Corner (virtual stops)	Status	Operating
Costing	Per kilometre (app) Per hour (operator)	Fare Payment	Mobile App

Description

Ten years ago, Arlington was the largest municipality in the United States with no public transportation system. In 2013, fixed-route bus service was added by Dallas Area Rapid Transit, however, it was replaced by Arlington On-Demand (operated by Via) in 2017. The goal of this change was to provide a better level of service to grow ridership.

The City of Arlington has a population of 500,000, and the on-demand service provides coverage in select areas of the City. There are no fixed-route services outside of a connecting inter-regional light-rail service (which the on-demand service connects to). Customers pay a flat $3.00 fare per person per trip within the service zone (select areas of the city) from 6:00 a.m. to 9:00 p.m. Monday through Friday, and from 9:00 a.m. to 9:00 p.m. on Saturday. The shared service uses 6-passenger wheelchair accessible vehicles, integrating it with the City's specialized transit service, Handitran.

The entire service provides 500 to 750 daily boardings (which roughly translates to 4 boardings per revenue vehicle hour).

Additional Information

https://platform.ridewithvia.com/

3.2.2 Belleville Transit – Bus On-Demand

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Destination	Transit Agency	Belleville Transit
Booking / Scheduling	On-Demand, Scheduled, Subscription	Municipality	Belleville, Ontario
Operating	Dedicated Vehicles	Land Use Context	Urban/Suburban
Trip Booking	Mobile App	Technology Provider	Pantonium
Accessibility	Separated	Service Provider	Municipal
Proximity of Service	Bus stop	Status	Operating
Costing	Per Hour	Fare Payment	Cash, passes, tickets (On Vehicle)

Description

In September 2018, Belleville Transit replaced its evening fixed-route service with an on-demand pilot (scheduled to run to the end of 2019). The on-demand pilot uses a ride hailing platform called Pantonium to provide demand-responsive real-time origin-to-destination services. Unlike most on-demand service, the Belleville model uses existing 40-foot buses, as these vehicles were available during the evening period and could be used for the pilot without incurring any capital expense. Once the pilot is concluded, a more detailed assessment will be completed about procuring smaller vehicles to operate the service.

Customers must download and register on the mobile app to use the service. When booking a trip, the customer selects their closest bus stops in relation to their origin and destination. The app then creates journeys based on passenger demand. The goal of this pilot project was to allow public transit to reliably cover large, low-density areas more efficiently.

Since the start of the pilot, ridership has increased by 300% (250 passengers/day) and vehicle mileage has decreased by 30%. To date, the service carries approximately 250 daily rides. Due to this early success, the pilot was made a permanent service in January 2019. Pantonium is compensated for use of the mobile app via a flat fee per vehicle and per year.

A child car seat is not required, since the service uses standard city buses. Bus drivers/operators are hired by Belleville Transit and are required to wear a uniform, provide checks (police, vulnerable sector check, driver's abstract), and receive training. Maintenance of the buses is done internally. While Belleville buses are fully accessible, registered specialized transit customers would continue to use the specialized transit service for curb-to-curb service.

Additional Information

https://pantonium.com/initial-results-from-belleville-on-demand-transit/
https://www.pr.com/press-release/775682

3.2.3 Grand River Transit – Route 901 Flex Trinity-Freeport

Characteristic	Description	Characteristic	Description
Service Delivery	Flex Route	Transit Agency	Grand River Transit
Booking / Scheduling	Scheduled On-Demand	Municipality	Waterloo Region, Ontario
Operating	Dedicated Vehicles Contracted	Land Use Context	Suburban
Trip Booking	Call-In/Online	Technology Provider	None
Accessibility	Integrated	Service Provider	Private
Proximity of Service	Bus Stop	Status	Operating
Costing	Hourly per Vehicle (operations)	Fare Payment	On Vehicle

Description

Route 901 operates on a fixed schedule with three fixed stops, but also has three 'flex stops' in the middle of the route where customers can request a ride for the same day or the next day by calling dispatch or booking online. The route connects to a light rail transit station, the hospital and a seniors centre, while the flex-stops are locations that have a high number of seniors or at medical facilities (where there is a desire to minimize walking distance). If no passengers request a stop at the flex stops, that part of the route is bypassed.

The service is contracted to a third-party operator, using a dedicated smaller accessible vehicle to operate the service. Trip booking is a scheduled on-demand service, meaning passengers at flex-stops are provided key set pick-up and drop-off times at flex stops that they can select from. The goal of the pilot is to maximize coverage using a limited resource and reduce walking distance, targeted to a vulnerable population.

Service is provided weekdays from 11:15 a.m. to 6:15 p.m. (the target market for the service is discretionary trips and for medical appointments).

Additional Information

https://www.grt.ca/en/schedules-maps/901-flex-trinity-freeport.aspx

3.2.4 Grand River Transit – Route 902 Flex Hespeler Village

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Hub Origin-to-Destination	Transit Agency	Grand River Transit
Booking / Scheduling	Scheduled On-Demand	Municipality	Waterloo Region, Ontario
Operating	Non-Dedicated Vehicles Contracted	Land Use Context	Suburban
Trip Booking	Dial-in	Technology Provider	N/A
Accessibility	Separated	Service Provider	Triangle Taxi
Proximity of Service	Curb	Status	Pilot
Costing	Per Trip	Fare Payment	Cash, paper transfer, fare card, ticket, student card

Description

Route 902 Flex was created to improve transit access to/from a seniors residence (Jacob Hespler Lodge). As part of GRT's service review, a number of the local routes were streamlined, which resulted in an increased walking distance for seniors from this lodge to the closest transit stop.

The purpose of the pilot is to provide a cost-effective option to connect residents more directly to the fixed-route transit service or key destinations frequented by seniors in Hespeler Village. The service operates as an origin-to-hub service (902 Flex – taxi to bus) or an origin-to-destination service (902 Flex – taxi-to-destination) based on a fixed schedule that was created in partnership with residents of the facility. Routes are dynamic and vehicle is only dispatched based on a passenger trip request. Since vehicles are not dedicated to the service, there is no fee charge if no trip request is made.

There is a partnership with Golden Triangle Taxi, which delivers a subsidized taxi service using sedans and accessible taxi vehicles to two or three fixed bus stops in downtown Hespeler as well as other key destinations in the area. The 902 Flex runs every day on a schedule, and is available to anyone residing in Waterloo Region. Customers booking trips must be picked up at a 902 Flex Stop. Bookings are accepted Monday to Sunday between 8:30 a.m. and 10:15 p.m. based on a pre-set schedule.

Additional Information

https://www.grt.ca/en/schedules-maps/902-flex-hespeler-village.aspx

3.2.5 Grand River Transit – Route 903 Flex Northwest Waterloo

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Destination Origin-to-Hub	Transit Agency	Grand River Transit
Booking / Scheduling	On-Demand	Municipality	Waterloo Region, Ontario
Operating	Non-Dedicated Vehicles Contracted	Land Use Context	Suburban
Trip Booking	Website/Mobile App	Technology Provider	RideCo
Accessibility	Separated	Service Provider	Private (RideCo)
Proximity of Service	Bus stop (virtual)	Status	Pilot
Costing	Hourly per vehicle (mobile app and operations)	Fare Payment	Mobile App, smart card, U-Pass, transfer

Description

Route 903 is an on-demand model being piloted by GRT in Northwest Waterloo. This service was placed in an area where a number of local routes were removed to streamline service onto the arterial network. This resulted in a number of areas that were outside of a 400m walking distance of a fixed-route service. To improve coverage, the on-demand service provides origin-to-destination service within the on-demand zone and to connecting fixed-route stops to allow them to complete their trip anywhere in the GRT network.

The service is provided weekdays between 7:30 a.m. and 10:00 p.m. Customers can book a trip using a mobile app, online or over the phone providing on-demand service. The same mobile app is used to optimize the service. Trips can go between two stops in the service area, including those where riders can transfer to a fixed-route service at no additional cost. Passengers can pay using the mobile app, or their smartcard.

The service is contracted to a third-party operator (RideCo), which uses two to four dedicated sedans to provide service. The service is not currently accessible and is separate from specialized transit service.

Additional Information

https://www.grt.ca/en/schedules-maps/903-flex-northwest-waterloo.aspx

3.2.6 Grand River Transit – Route 77 Wilmot Flex Route

Characteristic	Description	Characteristic	Description
Service Delivery	Flex Route	Transit Agency	Grand River Transit
Booking / Scheduling	Scheduled On-Demand	Municipality	Waterloo Region, Ontario
Operating	Dedicated Vehicles – Municipal	Land Use Context	Rural
Trip Booking	Dial-in	Technology Provider	N/A
Accessibility	Separated	Service Provider	Contracted
Proximity of Service	Stop / Flex Stop	Status	Permanent
Costing	Hourly	Fare Payment	Pass, ticket or cash

Description

GRT operates a flex route service between Wilmot Township and a transit terminal in Kitchener (where passengers connect to other GRT routes to complete their trip). The service was implemented to supply transit in an area that did not have it.

The route operates on a 60-minute round trip travel time to facilitate timed-transfers at the Boardwalk bus terminal. The flex route model was implemented to extend the service area on a low-demand route while maintaining the 60-minute round-trip travel time. The route includes four fixed stops and 13 flex stops that can be made on request. Passengers looking to access one of the flex stops must call the customer service agent between 8:00 a.m. and 5:00 p.m. on the same day of service and request the stop be made. The customer service agent would then inform the customer whether the driver is able to accommodate the request and inform the driver. If no request is made, the bus will not stop or detour to the flex stop. This allows GRT to extend the service area without increasing resources. It is estimated that 80 - 90 passengers use the service daily. All vehicles are accessible.

Additional Information

https://www.grt.ca/en/schedules-maps/flexible-transit.aspx

3.2.7 Milton Transit – GO Connect

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Hub	Transit Agency	Milton Transit
Booking / Scheduling	Scheduled On-Demand	Municipality	Milton, Ontario
Operating	Dedicated Vehicles – Municipal Non-dedicated Vehicles - Contracted	Land Use Context	Suburban
Trip Booking	Mobile App	Technology Provider	RideCo
Accessibility	Integrated into app upon request	Service Provider	Local taxis, Milton Transit
Proximity of Service	Stop Curb (premium fee)	Status	Terminated (pilot project)
Costing	Per trip and Per km	Fare Payment	Mobile App

Description

Milton's GO Connect service model used dynamic transit to provide enhanced connections to the Milton GO Train Station for GO Train arrivals and departures that did not have a direct local transit connection. The goal of this pilot was to put transit service where there was none and to provide a better level of service. The challenge in Milton was that a number of local transit services were not timed with GO Train arrivals/departures due to the variability of GO Train schedules. As a result, a number of customers would need to wait up to 20 minutes at the station for a connection between services. With Milton's GO Connect service model, customers could use a smartphone app to arrange for a local transit pick-up based on the GO Train arrival or departure time. Customers were charged a small fare premium for the direct connection to the GO Train and an additional fare premium if they wanted a pick-up or drop-off directly in front of their house instead of at a communal stop.

Additional Information

https://www.milton.ca/MeetingDocuments/Council/agendas2016/rpts2016/ENG-003-16%20Dynamic%20Transit%20Pilot%20Project%20final.pdf

3.2.8 Translink (Greater Vancouver, BC) – Bowen Island On-Demand Pilot

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Hub (Weekdays)/ Origin-to-Destination (Weekend)	Transit Agency	Translink
Booking / Scheduling	Scheduled On-Demand	Municipality	Bowen Island, British Columbia
Operating	Dedicated Vehicles – Municipal	Land Use Context	Suburban/Rural
Trip Booking	Call-In/Mobile App	Technology Provider	TapRide
Accessibility	Separated	Service Provider	Public
Proximity of Service	Curb	Status	Pilot
Costing	Unknown	Fare Payment	On Vehicle

Description

Translink (the regional transit authority in Greater Vancouver, BC) is piloting an app-based, on-demand transit program on Bowen Island, a suburban and rural municipality accessible by ferry from the rest of the region. The pilot is scheduled to be in operation between July 15th and September 15th, 2019.

The goals of the on-demand service are to put transit service where there is none, introduce service to growing area as a first phase, and provide a better level of service to grow ridership.

The service is being offered in addition to the regularly scheduled, fixed-route service on Bowen Island and does not replace existing service.

On weekday evenings (4:30 p.m. to 9:30 p.m.), the service operates with scheduled departures from the ferry terminal to any point in the service area. On weekends, the service provides flexible pick-up and drop-off to/from any stop in the service area from 10:00 a.m. to 5:30 p.m.

Trips can be booked on-demand and up to two weeks in advance using a mobile app provider called TapRide.

The service is operated using two shuttle buses that provide dedicated service in the service area. Customers can book their ride using the mobile app, but fare payment is made on-board the vehicle using cash or the smartcard. Passengers that don't have a smartphone can book a trip using the call centre during regular operating hours.

Additional Information

https://www.translink.ca/bowen

3.2.9 Calgary Transit – On-Demand Pilot

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Hub / Origin-to-Destination	Transit Agency	Calgary Transit
Booking / Scheduling	Scheduled On-Demand	Municipality	Calgary, Alberta
Operating	Dedicated Vehicles – Contracted	Land Use Context	Suburban
Trip Booking	Mobile App	Technology Provider	RideCo
Accessibility	Integrated	Service Provider	Third-Party Contract
Proximity of Service	Corner/ Stop (virtual)	Status	Operating
Costing	Service hour but monthly minimum	Fare Payment	Mobile App, Passes, Tickets (On Vehicle), No Cash

Description

In August 2019, Calgary Transit began a one-year pilot project offering on-demand transit service in the low density suburbs of Carrington and Livingston. Calgary Transit partnered with RideCo to provide a mobile-app for the service, and contracted operations to a third-party operator.

Customers book a ride through the RideCo app or call in. A single $3.40 fare is charged for the service, which passengers can pay using a mobile app or on the vehicles. Customers are able to take origin-to-destination trips within Carrington and Livingston or origin-to-hub trips to the North Pointe shopping area and transit terminal. Virtual stops are identified through the mobile app and customers are expected to walk a short distance to access stops. At North Pointe, drivers offer transfers to customers who can continue their trip elsewhere in Calgary.

Trips can be booked up to three days in advance or on-demand when the trip is required. The on-demand service aims to arrive within 15-30 minutes of ordering a vehicle.

The average daily ridership is 70 passengers or five boardings per revenue vehicle hour.

Trips are delivered using a dedicated fleet of mini-vans. A third-party operator provides the vehicles and drivers. Maintenance to the vehicles is performed by an external service provider. Calgary Transit is the primary brand on the vehicles but RideCo has a small decal on the back. Drivers are not required to wear a uniform, but require onboarding checks (police, vulnerable sector check, driver's abstract), and training (customer service, sensitivity) through the technology provider. RideCo is compensated for use of their mobile app via flat fee per vehicle per month. Customers are required to bring their own car seat for children, and children under 12 must be accompanied by an adult. There have been minor difficulties with cellular coverage in a new community, but a larger problem is up-to-date mapping from turn-by-turn navigation providers. The mapping has since been updated manually by the provider.

Additional Information

https://www.calgarytransit.com/news/calgary-transit-demand

3.2.10 Cochrane Transit – COLT (Cochrane On-Demand Local Transit)

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Destination	Transit Agency	Town of Cochrane
Booking / Scheduling	On-Demand	Municipality	Cochrane, Alberta
Operating	Dedicated Vehicles – Contracted	Land Use Context	Suburban
Trip Booking	Call-In/Mobile App	Technology Provider	RideCo
Accessibility	Separated	Service Provider	Southland Transportation (Private)
Proximity of Service	Bus Stop	Status	Planned Pilot
Costing	Pay hourly per vehicle	Fare Payment	Mobile App/On Vehicle (no cash)

Description

In October 2019, the Town of Cochrane, Alberta will introduce Cochrane On-Demand Local Transit (COLT). It will start with 126 unique bus stops across the town where customers can board and alight. The eight low-floor, 21-seat buses will be fully accessible with rides for $2.50. The goal of COLT is to increase coverage by adding transit to areas where there is none.

Additional Information

https://calgaryherald.com/news/local-news/cochranes-colt-buses-to-take-riders-in-new-directions

3.2.11 Winnipeg Transit – DART

Characteristic	Description	Characteristic	Description
Service Delivery	Hub to Stop	Transit Agency	Winnipeg Transit
Booking / Scheduling	Call-In	Municipality	Winnipeg, Manitoba
Operating	Dedicated Vehicles – Municipal	Land Use Context	Suburban
Trip Booking	Call-In/Driver	Technology Provider	N/A
Accessibility	Integrated	Service Provider	Municipal
Proximity of Service	Bus stop	Status	Operating
Costing	Hourly per Vehicle (operations)	Fare Payment	On-Vehicle

Description

Winnipeg Transit operates four on-demand "DART" services that are offered in low-density residential areas during periods of low demand. This includes weekday evenings and periods of weekend service. DART services start at a fixed route terminal and have scheduled departures. Passengers tell the operators which stop they wish to travel to and the operator determines a route to accommodate all requests. Passengers being picked up from the service area need to call in advance of when they are picked up. This low-tech solution works well for volumes up to ten boardings per bus hour. The goal of this service is to improve productivity of low performing routes and provide a better level of service to grow ridership.

Additional Information

https://winnipegtransit.com/en/service/dart/about-dart/

3.2.12 Innisfil Transit - Uber Partnership

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Destination Ridesharing Partnership	Transit Agency	Innisfil Transit
Booking / Scheduling	On-Demand	Municipality	Town of Innisfil, Ontario
Operating	Non-Dedicated Vehicles - Contracted	Land Use Context	Suburban/Rural
Trip Booking	Mobile App	Technology Provider	Uber
Accessibility	Separated	Service Provider	Uber
Proximity of Service	Curb	Status	Permanent
Costing	Per km	Fare Payment	Pay via app

Description

Innisfil did not have a local transit service and initiated a business case to implement one. Instead of implementing a fixed-route model, the municipality decided to partner with Uber in May 2017 to provide a public transit service pilot.

The partnership is based on subsidizing Uber Pool trips (shared-ride) for trips within the Town. Passengers pay a flat rate of $4 to $6 for trips to pre-defined locations (e.g. the GO Station) and receive $4 off the standard Uber fare for all other trips within the Town. Uber accepts payment from passengers directly and invoices the Town for the difference between the standard Uber Pool fare and the Innisfil Transit fare.

A uniquely branded mobile app is used as a customer interface and to optimize trip requests. Passengers can book on-demand within five minutes of their desired travel time. The estimated time of pick-up will appear once the passenger books the trip, along with the estimated arrival time. Uber drivers operating their own vehicles are used to provide the service. For persons with disabilities, the Town has an agreement with Barrie Taxi to provide accessible taxis upon request. To book an accessible taxi, a customer must call the day before the trip request and cannot use the Uber app. For persons that do not have access to a mobile phone, iPads are provided at rec centers and the town hall for convenient booking. Residents can also call into a call centre to book a ride.

One of the challenges with the service is cost control. As ridership increases, the cost of service increases (as the service focuses more on convenience rather than increasing vehicle occupancy). Ridership in the first eight months of 2017 was 27,000 and increased to 86,000 in 2018. Operating costs also increased from $150,000 (first four months of the pilot in 2017) to $640,000 in 2018. Based on anticipated increases in demand, the 2019 budget increased to $900,000. To maintain this budget and avoid further increases, the town has reduced the fare subsidy and limited the subsidy to 30 trips per month per individual (customers can request up to 50 trips per month based on application process).

Additional Information

https://www.uber.com/ca/en/u/innisfil/
https://innisfil.ca/transit/

3.2.13 York Region Transit – Mobility On-Request

Characteristic	Description	Characteristic	Description
Service Delivery	Origin-to-Hub-to-Destination	Transit Agency	York Region Transit
Booking / Scheduling	On Demand	Municipality	York Region
Operating	Dedicated Vehicles - Contracted	Land Use Context	Suburban/Rural
Trip Booking	Mobile App	Technology Provider	Routematch
Accessibility	Integrated	Service Provider	Contracted operators
Proximity of Service	Curb/Bus Stop	Status	Permanent
Costing	Per km	Fare Payment	Presto, YRT Pay App, cash

Description

York Region Transit began piloting a dial-a-ride service in 2016 with a Dial-a-Ride North service in the rural area of Georgina and East Gwillimbury. The service uses an on-demand mobile-app platform to optimize trips, connecting residents in the dial-a-ride zone to the closest fixed-route hub. The service is delivered by Mobility Plus, YRT's specialized transit service, which contracts out operations using a fleet of accessible Arboc vehicles, sedans and minivans.

The mobile app provider (Routematch) has been working with YRT over the past few years to customize an app that would allow co-mingling of trips between dial-a-ride customers and Mobility Plus riders. Once complete, it will also provide a complete origin-to-hub-to-destination solution where passengers can use the mobility app to plan their trip from origin to destination (including transfers to multiple on-demand zones). There are currently 15 dial-a-ride zones in York Region in both urban and rural areas.

The mobility app for the service was first piloted in the Fall of 2019 at the Aurora GO Station. With the success of the pilot, the mobile app will be made available in all 15 dial-a-ride zones. YRT has also undergone a rebranding, changing the Dial-a-Ride designation to "Mobility On-Request". Trips continue to be comingled with registered Mobility Plus clients and the Region is identifying new "Mobility On-Request" zones to expand the service.

Additional Information

https://www.yrt.ca/en/our-services/on-demand.aspx

3.2.14 Airdrie Transit

Characteristic	Description	Characteristic	Description
Service Delivery	Specialized transit: Origin-to-Destination Conventional: Origin-to-Hub	Transit Agency	Airdrie Transit
Booking / Scheduling	Call-in	Municipality	Airdrie, Alberta
Operating	Contracted	Land Use Context	Suburban
Trip Booking	Call-in	Technology Provider	N/A
Accessibility	Integrated	Service Provider	Airdrie Transit
Proximity of Service	Transfer point	Status	Permanent
Costing	Hourly cost per service hour	Fare Payment	Passes, tickets, cash

Description

Airdrie Transit on-demand service has been in place for two years. It services a population of about 70,000 people over an 85km^2 area. While the initial implementation of the service used a mobile app to plan and optimize trips, the mobile app provider chosen did not meet the expectations of the service, and therefore it was discontinued.

Today, customers are required to call in to book a ride for areas in Airdrie that are more than a five-minute walk to the nearest local transit stop. The On-Demand service will pick customers up from a stop in an on-demand zone and connect them to one of eight designated transfer points.

The service carries about 45 daily riders. The fare is the same as the regular local fare; transfers can also be issued.

Additional Information

https://www.airdrie.ca/index.cfm?serviceID=1353

3.3 Common Characteristics

Based on the above industry scan, a number of common characteristics can be noted.

1. **Technology** – Most new applications of on-demand service use mobile apps for booking and dispatch purposes. Of these, all offer a booking alternative for those without access to or comfort with smartphones.
2. **Integration with fixed-routes** – While there are origin-to-destination examples, most of the examples provide first-mile/last-mile service to fixed-routes (origin-to-hub).

3. **Productivity** – Most dynamic on-demand services are implemented to achieve cost savings compared to conventional fixed-route transit. This is typically in the form of after-hours service, or to meet coverage targets in low-demand areas.
4. **Limited accessibility integration** – Most services are currently being provided separately from specialized transit operations.

3.4 When Dynamic On-Demand Transit is Applicable

It is important to note that the introduction of dynamic on-demand transit services is not a one-size fits all solution and is not applicable in all contexts. There are many situations where continuing to provide and enhance fixed-route service will provide the most convenient level of service for customers, and will be more cost effective.

To be successful, dynamic on-demand transit services should complement and be integrated with a fixed-route network. This first involves an assessment of where a fixed-route is more effective, and which areas of the City or periods of the day should be considered for a dynamic on-demand service. A summary of typical service level criteria is presented in **Table 1** below:

Table 1: Service Level Criteria for Fixed-Route versus Dynamic On-Demand Transit

	Fixed-Route	Dynamic On-Demand
Proximity to Service	Majority of residents in close proximity to transit stops (less than 400 m walking distance)	Residents are outside of 400m walking distance of a fixed-route service
Route Structure	The route is relatively direct with minimal deviations that increase travel times	The route is fairly circuitous or has large one-way loops
Headway	Route provides headways of 20 minutes or better	Route has low headway (30 minutes or greater)
Key Origins and Destinations	There is a high demand for service between similar origins and destinations along the route	There are minimal origin / destination pairs on the route that have a high demand (ridership is more scattered)
Productivity*	Ridership above 15 boardings per revenue vehicle hours	Ridership below 12 boardings per revenue vehicle hour

**Note: The exact productivity rate is dependent of the geographic area and the operating model and cost implemented for dynamic on-demand service and should be used as a guide.*

4.0 Application in Burlington

4.1 Guiding Principles

A working session was held with key Burlington Transit staff to help identify guiding principles in the development of a dynamic on-demand transit strategy. Staff were engaged in identifying their vision, which was used in the evaluation of different dynamic on-demand transit models. Based on this session, the following guiding principles were identified:

1. **Convenience:** The solution should emphasize customer convenience and reduction in travel time in order to encourage ridership growth.

2. **Adaptable and Scalable:** As technology evolves and new applications are found within the City, the solution selected should be adaptable and scalable to meet future needs.

3. **Accessible**: The solution should be accessible for all residents regardless of age or ability. This includes having a dial-in option available to book a ride if a mobile-app based on-demand model is selected and accessible vehicles available that can support persons with disabilities.

4. **Safety and Security:** The solution selected should emphasize customer and operator safety and security through appropriate driver training, use of safe vehicles, etc.

5. **Environmental Footprint:** The service model should be reflective of current environmental efforts and plans proposed by the City of Burlington.

6. **Congestion Reduction:** The service model selected should decrease overall vehicle kilometres and/or time travelled by placing emphasis on ridesharing.

7. **Branding:** The service should be branded as a part of the Burlington Transit system.

8. **Financial Sustainability:** The service should be financially sustainable and be implemented in areas/periods where it leads to an improved level of service at a lower cost.

9. **Fare Integration:** The service model should be integrated with the Presto card and follow the same fare structure as the fixed-route service.

10. **Reliability:** The service should be reliable in terms of on-time performance and vehicle availability.

11. **Ease of Use:** The service should be easy to use and simple to understand.

Of the eleven guiding principles identified above, emphasis was placed on “Convenience”; having a system solution that will be attractive and result in ridership growth.

4.2 Context

The identification of a dynamic on-demand transit service in Burlington must also consider the context in which it will operate. There are a number of opportunities and constraints that should be considered when selecting a model. These are highlighted below:

Presto Fare Card System
Burlington Transit uses the Presto fare card system for all discounted fare media. This includes monthly passes and discounted tickets. Any solution that is selected must ensure it is capable of being integrated with Presto. Currently, this would require every vehicle to have a mobile Presto Card reader.

Fare Policy
Burlington Transit currently offers discounted fares based on demographics (seniors, students and children) and frequency of use (monthly pass, tickets and cash). Any solution proposed should be integrated with and use the existing Burlington Transit fare system, including fare discounts. Cash fares are the exception. In a mobile-app based solution, single-ride fares should be paid for on the mobile app instead of cash exchanging hands with the operator. Higher fares may be considered for premium service, but only if a fixed-route option at the standard Burlington Transit fare is also available to the customer.

Accessibility
The Accessibility for Ontarians with Disabilities Act will need to be adhered to for any solution. This means that the solution should ensure:

- an accessible vehicle is available upon request;
- the ability to accommodate attendants at no fare;
- mobile apps (if used) are able to be read by screen readers (WCAG); and
- drivers receive sensitivity training for accommodating persons with disabilities.

Use of Specialized Transit Vehicles
Currently, Burlington Transit's specialized transit fleet of 14 vehicles are occupied during the daytime period, but do have some capacity to operate dynamic on-demand transit services during the evenings and early mornings. In order to offer a consistent and reliable service, the use of these vehicles would require the features of the dynamic on-demand vehicles to match those of the specialized transit fleet.

Potential to Use Existing Specialized Transit Scheduling Software
The potential to use the existing scheduling software used to book specialized transit trips for dynamic on-demand transit services was explored. Based on the review, it was determined that the existing software does not have the capability to achieve a number of the guiding principles noted by City staff. To ensure that this is possible in future, dynamic on-demand transit solutions for Burlington should be capable of supporting specialized transit scheduling functions in addition to dynamic on-demand services.

Hours of Operation of Existing Call Centre
Burlington Transit currently operates a customer call centre to book specialized transit trip requests and answer questions from customers and residents about the Burlington Transit service. The call centre is open from 8:00 a.m. to 5:00 p.m. on weekdays, with no service on weekends. Supervisors are available to handle specialized transit trip cancellations when the call centre is not open, but they do not book new trips. The call centre does have some capacity to book new dynamic on-demand trips, but this is limited. Any significant increase in ridership may warrant adding new staff. There is also no current capability to book trips outside of the customer call centre hours using existing Burlington Transit resources.

Collective Agreement
The existing collective agreement with current operators limits Burlington Transit's options with regards to the provision of transit services by other parties. As such, it is important that any dynamic on-demand service does not replace the role of current operators. If a contracted operating model is selected, it should augment the current municipal-run fixed-route system, resulting in no job loss.

Taxi Service By-Law
As taxis and Uber already operate in the City of Burlington, existing taxi service by-laws are expected to allow for dynamic on-demand transit services involving ridesharing. However, these by-laws should be reviewed to ensure that they do not preclude any vehicle types, service models or future innovations in the dynamic on-demand transit space.

Policies around Travelling with Young Children, Packages and Service Animals
Currently, Burlington Transit allows children, packages and service animals on all transit services, including Specialized Transit. As the carriage of packages, young children and service animals is expected to continue, some dynamic on-demand transit vehicles will need to accommodate this. Additionally, any booking system will need to allow passengers to identify these requirements to ensure that an appropriate vehicle is scheduled for their trip.

Risk Management
Like any transit service change, the introduction of dynamic on-demand services should be aware of and work to mitigate Burlington's identified enterprise risks. In helping to improve mobility within the City, dynamic on-demand transit is expected to help mitigate enterprise risks.

4.3 Service Objectives (applications of dynamic on-demand service)

Based on the industry scan of systems, the guiding principles and the understanding of the Burlington context, there are a number of general applications for dynamic on-demand transit services that should be considered in Burlington:

- **Replace Poor Performing Routes (or Route Segments):** Areas with boardings less than 12 boardings per revenue vehicle hour could be considered to improve productivity. This may not need to be a full route, as large route deviations could be considered for dynamic on-demand service if the removal of the fixed-route deviation improves the directness of the main route and reduces operating costs or vehicle requirements (or allows for a frequency improvement using existing fixed-route resources). In certain cases, dynamic on-demand service may replace existing routes during low demand periods of the day or days of the week (e.g. weekday late evenings or Sundays).

- **Introduce to Areas with Limited Proximity to Transit Service:** As certain routes are removed and focus shifts to the arterial roadway network, there will be certain residents that are no longer within a 400-metre walking distance of a fixed transit route. Dynamic on-demand transit offers a significant advantage in terms of proximity to service, as the dynamic on-demand route has more opportunity to access the entire service area based on customer trip requests. Since the vehicle is not tied to a fixed-route, this increases the number of residents within a five-minute walk of a dynamic on-demand transit stop. When assessing this, consideration should also be made to understanding the demographic of the community. Communities with a high senior population are more impacted by long walking distances, and these become good applications for dynamic on-demand transit service.

- **Early Introduction of Service:** Similarly to areas with limited proximity to transit service, dynamic on-demand service may be applicable to growing areas that do not yet have the population/employment to support a fixed-route service. Smaller vehicles operating only where needed offer the opportunity to provide greater coverage of developing areas, allowing people to use transit from the early days of a development area. This allows transit to be instilled as a mobility choice, reducing reliance on other modes. As these areas grow and road networks expand, the transit service can be converted to a larger fixed-route model.

- **Improve Connections to Rapid Transit Stations:** GO Transit schedules do not always align with local Burlington Transit schedules. This can result in long waiting times for customers transferring between the two services. Providing good transit access to GO stations is important. As space for parking is limited and congestion around major stations becomes problematic, tools to reduce the attractiveness of driving and parking are important to keep the station functional. When GO Train service is more frequent than fixed-route Burlington Transit connections, dynamic on-demand transit can be used to connect to GO Trains that do not have a seamless Burlington Transit fixed-route connection (e.g. early morning or late evening services). This ensures that customers using GO Train services have a seamless Burlington Transit connection for any train they take (either fixed-route or dynamic on-demand. These are similar benefits to the provision of high frequency transit services to stations, with the added convenience of more personalized routing.

- **Provide a Premium Level of Service to Supplement Existing Fixed-Route Service:** As a further development of improved connections to stations, dynamic on-demand transit can provide a more convenient and personalized transit experience across the entire network. By increasing rider convenience with on-demand services, overall ridership would grow and premium services could be a gateway, bringing in new customers who then go on to use the conventional system as well. This could be applicable in low demand periods where there are low-frequency fixed-routes, but passengers that do not want to wait could select a more frequent dynamic on-demand option at a premium fare.

5.0 Evaluation of Alternatives

In reviewing the many aspects and models currently available for dynamic on-demand transit, not all are the best fit for the Burlington context. This decision-focused evaluation aims to guide the selection of features that are most relevant to the Burlington Transit context and to select an appropriate option to pilot. The evaluation is based on:

- alignment with guiding principles;
- ease of implementation in the City of Burlington; and
- alignment with service objectives (purpose of the service).

The evaluation of alternatives includes the use of technology, service delivery models and operating models.

5.1 Booking and Scheduling Interface

One of the first steps in developing a dynamic on-demand model for Burlington is to confirm the booking and scheduling interface. As noted previously, there are two options to consider: manual scheduling and the use of a mobile app.

Manual scheduling for dynamic on-demand transit has a long history and has been used by a number of transit agencies to provide dial-a-ride service, trans-cab and zone bus service. The solution does not require a large investment in technology, but is not as effective in optimizing trips (to share rides and minimize vehicle kilometres traveled). It is also not seen as an attractive interface by many customers, as manual scheduling typically involves more notice and effort by the customer to book a ride. A mobile app, on the other hand, provides the opportunity for customers to book, track and pay for their trip in real-time.

Based on the assessment of guiding principles noted above, a mobile app-based solution was felt to be more convenient and easier to use and more effective at optimizing trips and thus reducing vehicle kilometres traveled over a manual scheduling solution. For these reasons, any dynamic on-demand service model piloted for Burlington should utilize a mobile app-based booking and scheduling platform.

Recommended Strategy:

1. Procure a mobile app-based platform to pilot a dynamic on-demand transit service in Burlington. The platform should be capable of supporting several service delivery and operating models, enabling the implementation of different service types at different times of the day and in different parts of the City.

5.2 Purpose (Service Objectives)

The purpose and role of a dynamic on-demand transit service must be determined. Each purpose has implications for service delivery and operating model choices, as well as, how the services would integrate with the rest of the transit network.

Table 2 below illustrates the five potential applications (service objectives) of dynamic on-demand transit and includes potential applications and suitability in the Burlington context as a pilot. Based on this assessment, an evaluation is made as to the suitability of potential service delivery objectives.

Table 2: Service Level Criteria for Fixed-Route versus Dynamic On-Demand Transit

Purpose	Poor Performance Routes	Limited Proximity Areas	Early Service Introduction	Rapid Transit Connectivity	Premium Transit Service
Burlington Example	Late night only routes (50, 51, 52) Late night services on local routes	Areas along Lakeshore Road Between arterial roads	New growth areas - Tyandaga	Aldershot GO Burlington GO Appleby GO	Network-wide
Implications	Reduce cost by providing less resources in areas of lower demand Specialized Transit fleet available during evening periods only App-based origin-to-destination or origin-to-hub	Improve coverage by providing service in fringe areas Service area(s) needs to be large enough or joined together to support service App-based origin-to-hub	Improve coverage by providing service in new areas Encourage early adoption of transit App-based origin-to-hub	Incremental benefit over existing transit services Duplicates fixed-route changes in Business Plan App-based origin-to-hub	Incremental benefit over existing transit Ridership growth App-based origin-to-destination Ridesharing Partnership
Suitability	**Yes**	**Yes**	**Yes**	**Yes**	**No**

Recommended Strategy:

1. Explore the suitability of dynamic on-demand transit services (via a pilot) for the trip purposes identified in **Table 2** above).

5.3 Service Delivery Model

The selection of a service delivery model is dependent both on the guiding principles for service as well as the service objectives (the reason for implementing a dynamic on-demand service). There are five service delivery models that were considered. The suitability of each service delivery model for each service objective in Burlington is assessed in **Table 3** and discussed further below.

Origin-to-Destination

The application of a origin-to-destination model in Burlington would be most applicable as a replacement of poor performing routes or routes in a large geographic area and/or where customers received a poor level of service (e.g. infrequent service with poor proximity and long travel times due to long, circuitous route design).

A potential application that could be considered would be the replacement of the late night service (Routes 50, 51 and 52) with an origin-to-destination dynamic on-demand service. In this example, the service model would utilize three to four smaller vehicles to provide a one-seat ride with connections to the GO Stations and key stops along Route 1.

Table 3: Application of Various Dynamic On-Demand Service Delivery Models

Purpose	Poor Performance Routes	Limited Proximity Areas	Early Service Introduction	Rapid Transit Connectivity	Premium Transit Service
Origin-to-Destination	✓	✓			
Origin-to-Hub	✓	✓	✓	✓	✓
Origin-to-Hub-to-Destination	✓	✓	✓	✓	✓
Flex Route	✓	✓	✓		
Ridesharing Partnership	✓	✓		✓	✓
Suitability	Yes	Yes	Yes	Yes	No

Origin-to-Hub

As noted in the industry scan, the majority of Canadian examples utilize an origin-to-hub approach, connecting passengers in low-demand areas to a fixed-route stop. This approach is also referred to as the first-mile/last-mile of service. An origin-to-hub model is typically used in smaller geographic areas

to accommodate various service objectives. It is important to note that the size of the geographic area planned for this service is dependent on the headway of the fixed-route service at the transfer point and the demand for service. For example, if the on-demand service connects to a GO Station with trains that operate every 30 minutes, the size of the zone should be based on the ability of the on-demand vehicle(s) to travel within the on-demand zone and get back to the GO Station to make the train connection. Some examples to consider include:

- **Rapid Transit Connectivity:** There are certain routes in the Burlington Transit network that could be modified or eliminated to improve the directness to major hubs such as GO Stations. Additionally, there are some conventional routes that may not meet early or late GO trains that could be supplemented by on-demand services. Specific dynamic on-demand zones could provide internal full origin-to-destination service and origin-to-hub connections to GO Stations or other major hubs. Identifying specific routes that may be applicable should only be recommended after careful analysis of customer data at least six to nine months following Burlington Transit's update to the route network in September 2019.

- **Improve Proximity to Service:** An origin-to-hub service model could also be used to connect residents in areas with limited access to transit to a fixed-route service. The area along Lakeshore Road provides a potential example of where this type of service could be piloted, with connections provided to key intersections on New Street (e.g. Guelph Line, Walkers Line and Appleby Line).

- **Poor Performing Routes:** Since most routes on the Burlington Transit network meet minimum productivity targets, there may be limited opportunities to replace entire routes with this model. Routes to be further explored include Route 87 and services to industrial areas (Routes 80 and 81). Route 87 is fairly short and operates through local streets and have some indirect one-way loops. The industrial routes can be very peak-oriented based on shift-times, with other periods attracting minimal ridership. These may be potential candidates to consider once the impacts of the new service change are better understood.

Origin-to-Hub-to-Destination

This model is an evolution of the origin-to-hub model, and allows customers to plan their entire trip using the dynamic on-demand software (instead of just the portion of their trip from origin to transfer point). The existing or future capability of mobile app providers to accommodate this should be explored, as it is seen as an evolution of the service.

Flex Route

The flex route model could be applicable on local routes that provide a linear service that deviates from the most direct path. Two examples may be Route 4 (which provides service on the local roadway network between North Shore Boulevard / New Street and Plains Road / Fairview Street) and Routes 80 and 81 (which provides service to a number of industrial employers and could be used to provide closer

service to the door of a large industrial employer when a flex stop is requested). Moving to a flex route should only be considered if a technology-based solution is applied.

Ridesharing Partnership

Ridesharing partnerships can be beneficial in terms of providing a high level of service, but do not focus as much on optimizing vehicles to share rides. Because the service typically operates with non-dedicated contracted vehicles, issues of cost control and an increase in vehicle kilometres travelled can also arise. Where ridesharing partnerships are most effective are in areas of very low demand (e.g. less than five trips per revenue vehicle hour) or if the objective is to supplement existing low frequency service at a premium fare (e.g. providing customers a choice to pay more for a direct on-demand route rather than wait for a fixed-route service). When assessed against the guiding principles, this service delivery model is not suitable in the near term to replace existing services or to provide a premium service at a subsidized fare. However, consideration should be made to creating a more seamless experience between transit and ridesharing services to provide customers with more choice, particularly for the first/last mile of their trip.

Recommended Strategy:

1. Explore the use of an origin-to-destination service model during late night and early morning periods with the potential to start service earlier based on performance of existing fixed-routes and the pilot dynamic on-demand transit service.
2. Explore the use of a flex route on linear local routes where there are concerns over walking distance.
3. Explore the use of an origin-to-hub pilot to improve connections to the GO Station and other core routes in areas with poor performing routes.

5.4 Operating Model

The operating model is important to consider when identifying how to operate the dynamic on-demand transit pilot in Burlington. Each has its own benefits, depending on the purpose of the dynamic on-demand service. The implications of each operating model assessed in **Table 4** below are based on the potential service strategies stated in the Purpose (Service Objectives) and Service Delivery Model sections above.

Recommended Strategy:

1. Explore the use of a dedicated municipal model for any pilot focused during the off-peak periods only (based only on availability of specialized transit vehicles).
2. Utilize a dedicated contracted model for any pilot projects that are implemented during core operating hours to limit capital expense during the pilot project.
3. Assess the effectiveness of both operating models at the conclusion of the pilot before expanding.

Table 4: Assessment of Operating Models

Operating Model	Dedicated (Municipal)	Dedicated (Contract)	Non-Dedicated (Contracted)
Model	Vehicles and drivers procured by Burlington Transit	Vehicles and drivers procured by contractor	Vehicles and drivers procured and coordinated by contractor
Availability of Fleet	Use existing vehicles and drivers during off-peak periods. Need to purchase new vehicles and hire new drivers during peak periods	Vehicles can be supplied by the operator and included as part of the operating rate (no capital purchase)	Vehicles can be supplied by the operator and included as part of the operating rate (no capital purchase)
Cost Effectiveness	More cost effective as ridership grows (vehicle supply fixed, therefore goal to fill up capacity through ridesharing)	More cost effective as ridership grows (vehicle supply fixed, therefore goal to fill up capacity through ridesharing)	Cost effective for low demand areas (only pay when a trip is complete). Less cost effective when demand is higher
Cost Control	Certainty of cost based on hourly operating rate and fixed supply of drivers	Certainty of cost based on hourly operating rate and fixed supply of drivers determined in the contract	Less cost control if Burlington is not in charge of dispatching vehicles (supply is added to accommodate increasing demand)
Branding	Burlington Transit vehicles used	Vehicles can be branded with Burlington Transit logo	Vehicles may not be branded with Burlington logo
Fare Integration	Easy integration with Presto card and cash payment (fare equipment typically on vehicle)	Easy integration with Presto card and cash payment (may require purchase of a Presto card reader)	Integration with Presto card more difficult (each non-dedicated vehicle requires a Presto Card reader)
Reliability	Guarantee availability of a driver during low demand periods when it may be difficult to attract a non-dedicated driver	Guarantee availability of a driver during low demand periods when it may be difficult to attract a non-dedicated driver	Non-dedicated drivers may not accept short trips that may not generate income or may choose not to be available during certain periods
Integration with Specialized Transit	Ability to integrate dynamic on-demand trips with specialized transit services (utilize same fleet)	More difficult to integrate services if provided by two different operators	Services are not typically integrated unless there is a fleet of accessible non-dedicated vehicles to accommodate trips

Operating Model	Dedicated (Municipal)	Dedicated (Contract)	Non-Dedicated (Contracted)
Collective Agreement	Few collective agreement concerns	Potential collective agreement concerns	Potential collective agreement concerns
Suitability	Good solution for late night or other off-peak service models where specialized transit vehicles are available	May be a simpler/lower risk option for all-day operation options. Allows Burlington to pilot daytime service with limited capital expense	Good for very low-usage areas that don't warrant dedicated vehicles
Suitability	**Yes**	**Yes**	**No**

5.5 Other Considerations

There are a number of other factors to be considered when designing a dynamic on-demand service. Based on the guiding principles noted above, some preferences for each are noted below:

5.5.1 Proximity of Service

Service models should use existing bus stops or virtual stops to connect customers to the dynamic on-demand service. Requiring customers to converge to a common area can increase the effectiveness of the service (rather than picking up passengers from the curb of their home or destination).

Stops used as transfer points should be fully accessible (concrete pad, sidewalk), have passenger amenities (e.g. bench, shelter, trash receptacle), be safe (e.g. well-lit area) and connect to two or more fixed-routes.

5.5.2 Trip Booking

The trip booking model should promote on-demand service, with the ability to also book scheduled and subscription trips ahead of time. For on-demand trips, it will be important to identify the degree of spontaneity in which customers can book trips. During low demand periods where there are fewer vehicles operating in a large geographic area (e.g. potential replacement of late-night service), customers should be recommended to provide between half hour to one hour's notice when booking a ride. This increases the ability to optimize trips. The amount of notice required decreases as the geographic area covered by the on-demand service decreases.

5.5.3 Accessibility

For the pilot service, specialized transit and dynamic on-demand transit should continue to be separated, particularly if the service is contracted. The specialized transit service uses its own scheduling software program which may not be compatible with the dynamic on-demand mobile app. In

the process of selecting a mobile app provider, the ability to integrate dynamic on-demand service with specialized transit should be a key consideration.

5.5.4 Costing Model

If the service is contracted to a third-party operator, the costing model selected should encourage trip optimization. Costing models that pay the contractor by the hour or per kilometre can help maintain cost control by optimizing the number of passengers that share rides.

5.5.5 Level of Service and Customer Focus

In order to function as a viable part of the transit network, dynamic on-demand services needs to be able to provide service to customers without excessive wait times. Whether this is regulated by being a scheduled on-demand service, or there are maximum wait times specified for a fully dynamic service, these impact the cost and efficiency of the service. While lower wait time options provide greater customer benefits, the cost is higher as additional vehicles are required to ensure that they can provide the required coverage. As such, utilization time per vehicle will likely decrease.

If dynamic on-demand transit is feeding to other transit services, it is beneficial that the level of service matches that of the conventional fixed-route service it is connecting to. In this way, scheduled on-demand or flex services may be appropriate, particularly if the fixed-route service isn't operating at a high frequency.

Beyond customer convenience, service levels affect the overall capacity and attractiveness of the service. If demand and capacity are high, the cost of providing the service may exceed that of a fixed-route and therefore productivity gains are lost. If this is the case, a dynamic on-demand service may be the precursor to conventional fixed-route transit as demand grows.

5.6 Summary

Burlington Transit's dynamic on-demand transit pilot should target poor performance routes, areas with poor transit proximity and/or new service areas. The pilot should use an app-based system, with a non-app booking option, to allow for the greatest efficiency and passenger convenience. Technology providers can cater to different service purposes simultaneously and Burlington should consider whether a pilot would cater to one or multiple purposes initially.

To ensure vehicle availability, branding and consistency, the pilot should use a dedicated fleet, provided either in-house or through a contractor. Choosing a dedicated fleet means that new, potentially very low-ridership areas may not be viable for a pilot. Therefore, the pilot should target existing low-ridership services, such as after hours or low-ridership areas. If after hours services are targeted, then the Specialized Transit fleet and existing bus stops could be utilized, which would reduce upfront costs and

risk. Such a pilot would connect passengers in certain low-after-hours-ridership areas to fixed transit routes and hubs.

6.0 Next Steps

Based on the above information and summary, the next step is to work to finalize and document a dynamic on-demand transit service. Prioritizing potential purposes and areas will help to define and refine the characteristics of a potential pilot project.

With a fixed purpose, service delivery model and operating model identified, an RFP can be developed for a dynamic on-demand service pilot. This RFP should be specific in articulating Burlington's requirements and desires, but flexible enough to allow for innovation from potential bidders. Depending on the desired purpose, it is anticipated that Burlington's dynamic on-demand transit RFP will include the following specifications:

- Service hours and level of service;
- Service area(s);
- Service delivery model;
- Operating model;
- Length of pilot;
- Whether Burlington Transit is providing operators and vehicles;
- Accessibility requirements;
- Branding requirements; and
- If Specialized Transit integration is a current or future goal.