

# Developing a mobile app for the Corvallis Transit System: Public policy intervention, programming solution

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## Problem Statement

Driven by their mission to preserve the environment and enhance neighborhood livability, the City of Corvallis Transit System (CTS) actively seeks to increase ridership on its public bus system. These efforts reflect in the sustained growth in ridership, which gained considerable momentum in 2011 with the implementation of a fare-less bus program. Though the bus system remains a popular alternative for residents, growth of Oregon State University, parking shortages, and traffic congestion are a continuing challenge for Corvallis.

Despite the economic, energy, and environmental benefits of public transportation, increasing ridership beyond the small fraction of regular users is an ongoing challenge for policymakers and transit officials across the country. Urban form and existing infrastructure largely predetermine the extent of coverage and practicality of transit use. Where public transportation is an option, most still opt for the convenience and control provided by the automobile. Further complicating efforts to increase ridership are macro level influences, like fluctuating fuel prices and socio-economic conditions that cause an intractable rise and decline of public transportation use.

Nevertheless, strategies to alter fare prices, improve service quantity and quality, and expand marketing have proven successful. This paper begins with a brief review of the literature discussing the internal factors determining ridership, focusing on the promising developments in information technology. Next, the authors review common features and services offered by current transit applications on the mobile phone market. We then present findings from a survey of 153 residents from the City of Corvallis, which aimed to identify areas where public transportation in Corvallis could be improved and how a mobile phone application may address these needs. The paper concludes with a discussion of the early developments of Transport (IOS) and Transit (Android), Corvallis' first mobile phone applications that provide real-time bus information.

## Literature Review

Although a region's economy, population, and geography are the primary factors determining public transportation ridership (Taylor et al., 2009), transit officials do

possess a number of direct strategies to expand their customer base. Research suggests ridership is sensitive to fare prices, especially within student populations. Discounted fares and “fare-free” experiments generally exhibit sustained increases in ridership after implementation (Brown et al. 2003; Litman, 2004). However, lower costs cannot overcome a general resistance to using public transportation if the service is infrequent or unavailable, or if the overall quality of service is poor.

Frequency and coverage of transit service displays strong evidence of attracting new customers, while encouraging existing riders to use public options more frequently (Taylor & Fink, 2009). Despite findings that increased service supply expands ridership, a lack of infrastructure often limits service expansion as an immediate policy option. Other direct strategies include improvements in the quality of service, which is often an undervalued method for increasing ridership and reducing automobile travel (Lutman, 2008). Exploring the determinants of public transit ridership, Syed and Khan (2000) found bus information, on-street service, station safety, customer service, and safety en-route were the five most influential factors determining ridership.

Advances in technology have opened an entirely new area for transit officials to deliver route information, connection schedules, and expected arrival and departure times. In fact, recent literature suggests real-time information is one of the strongest determinants of ridership and may encourage a mode-shift to public transportation (Multisystems, Inc, 2003). Early forms of real-time information using signs at transit stops revealed uninspiring results. Although perceived wait time declined in some areas (Schweiger, 2003), general satisfaction with transit and overall ridership did not increase at stops displaying real-time information (Science Applications International, 2003; Mehndiratta, 2000). Signs were helpful, but customers wanted access to real-time data from their homes, businesses, and areas nearby transit stops (Mehndiratta, 2000).

Rapid growth in Automatic Vehicle Location (AVL) on transit vehicles, widespread internet deployment, and improvements to smartphone technology provided the infrastructure to meet this customer demand. Development of mobile applications (apps) with access to real-time transit information is encouraging, yet research on its impact on ridership is sparse. Early studies showed positive results, yet most simply compared results before and after implementation, without controlling for the endogenous factors affecting ridership (Tang & Thakuriah, 2012).

As more transit systems have introduced mobile phone applications, a growing body of literature is investigating its effectiveness. Watkins et al. (2011) provided one of the first analyses, which determined both perceived and actual wait time decreased for users accessing real-time information from the “OneBusAway” application. Riders using the mobile phone application averaged a wait time two minutes less than others accessing traditional schedule information. The Chicago Transit Authority was an early adopter of real-time information, first providing route information on their website and later implementing the mobile application, “Bus Tracker.” Tang and Thakuriah (2012) used longitudinal ridership data beginning with the rollout of Bus Tracker and found the service provided “modest” increases in ridership. The researchers included a number of

control variables for unemployment, gas prices, socio-economic characteristics, and service factors, yet still found an increase of 126 riders per week on routes that used the Bus Tracker service compared to others without access to real-time information.

While the research on real-time information delivered by mobile applications is promising, evidence to suggest it attracts new riders to shift from private to public transportation modes remains limited. Nonetheless, one early study found real-time bus arrival information systems do assist in the maintenance of ridership (Multisystems, Inc, 2003), and this assessment of real-time information technology remains mostly true a decade later. Several studies suggest future efforts should focus on complementary marketing campaigns and the development of feature-rich applications (Schweiger, 2011; Tang and Thakuriah 2011). Tang and Thakuriah (2011) note marketing efforts are imperative to reach non-riders and encourage them to “try” public transportation. Software recommendation systems represent a new a form of advertisement for applications, which targets users most likely to adapt mobile phone software (Tang and Thakuriah 2012). Applications may also attract more users by incorporating multiple features, such as trip planners and route maps in addition to real-time information. Zhang et al. (2011) recommend future development focus on “multimodal” applications that appeal to all commuters regardless of transportation type. A multipurpose application will expand the user base and may encourage commuters using cars or other forms of private transportation to experiment with public options.

### *Existing transit applications*

A quick search in either the Play Store for Android devices or the App Store for iOS devices shows multiple apps that help users navigate public transit. Most of the apps are limited to specific geographic areas or transit systems. For example, the app “NYC Bus and Subway Maps” provides data specific to New York City. While the majority of apps are location limited there are still quite a few that are not. Google Maps has a transit feature, which has data on 475 transit agencies around the world. Other apps are created by third parties and contain information from various locations, like “Where’s My Bus.” All of these apps have common elements or tools that should be considered when creating an app for the Corvallis Transit System. Below are common elements of the various transit apps

#### Real-time Map and Schedule

- A 2-D map with routes overlaid displaying the real-time or estimated location of the desired bus.

#### Route Schedules

- This feature allows users to look up detailed information about a specific route. This information is usually a static table with stops and estimated times of specific bus lines. This information is no different from the data typically posted at bus stops.

## Trip Planner

- This feature predicts the shortest paths between any two points in the transit network using real-time information provided by a bus arrival prediction system, relying on GPS equipped transit vehicles. Typically the user can see multiple route options and receive details on a route or multiple routes including estimated time of travel, number of transfers required, and estimated walking distance.

## Notifications

- The ability to enable “push notifications” that make the user aware Bus A’s location and estimated time of arrival to User A’s location. Routine notifications help regular commuters. For example, if user A always rides the Blue Line Bus at 5:00pm the app will notify the user that the Blue Line Bus’ status and location a few minutes before.

For additional more specific information about the user interface we suggest looking at the following apps as models.

- Where is My Bus?
- One Bus Away.
- Moovit
- Transit

## Methods

In an effort to develop a real-time transit application for the Corvallis Transit System, researchers conducted a survey of Corvallis residents to determine areas where the current system could improve and what features would be most useful in an application. These results served to inform app developers of where early efforts in application design should focus. Due to strict time constraints, we utilized a convenience sample by emailing students and faculty at Oregon State University and asking for participants in-person at high foot-traffic areas. 153 members of the Corvallis community participated in and completed the survey. Participants were informed that the survey was designed to help improve the Corvallis Transit System. Upon agreeing to take part in the survey, participants were asked to answer 12 questions regarding their usage and knowledge of the Corvallis Transit System as well as their opinions on what could be improved. For the full survey, see Appendix A.

## Survey findings

The first two graphs display the percentage of our sample population that uses the Corvallis Transit System, and how often they ride. This is a preliminary view into the usefulness of a smartphone app. A large proportion are riding at least once a week to every day (57%), meaning that an app would allow them to efficiently view and use the bus system in conjunction with their daily schedule.

#### 4. Do you use the bus?

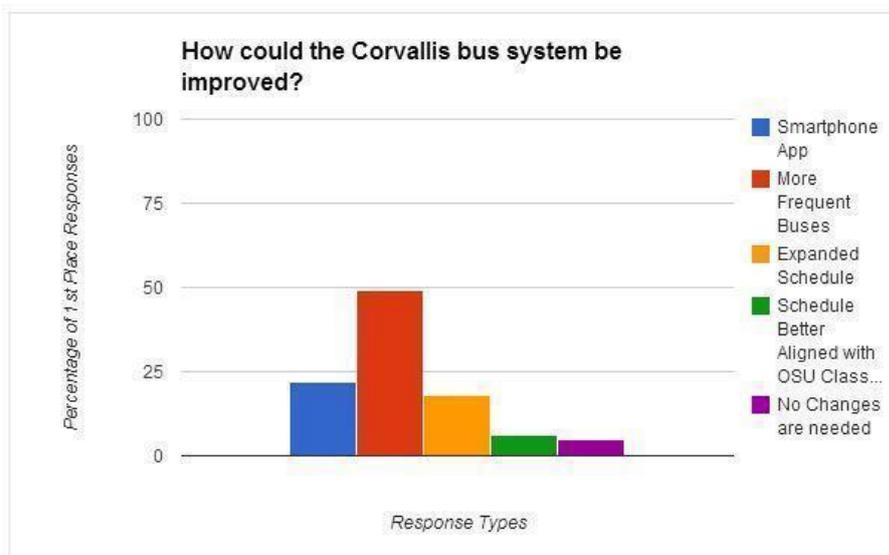
#	Answer	Response	%
1	Yes	80	52%
2	No	73	48%
	Total	153	100%

#### 5. How often do you ride the bus?

#	Answer	Response	%
1	Every day	17	21%
2	At least once a week	29	36%
3	At least once a month	19	24%
4	Less than once a month	15	19%

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It appears that at this time most riders utilize the CTS website, Google Maps, and the schedules posted at bus stops to guide their usage. This suggests that the CTS website is likely the most popular because it offers, “Where’s My Bus?,” a real time bus information system that allows users to determine the current location of the next available bus on their route.



Although the top response to this survey question determining bus system improvement focuses on the frequency of buses, a smartphone app is the second most popular option. In addition, the availability of an app that displays accessible, real time bus information may ease the desire for more buses, as riders will be able to fit their schedule more easily around the bus system if they are aware that a particular bus will be arriving late or on time.

## 12. What would you want to see in a Corvallis bus app? Check all that apply.

#	Answer	Response	%
1	Closest routes	96	70%
2	Bus stop locations	105	76%
3	Bus arrival time for my stop	123	89%
4	Real time bus location information	116	84%
5	Access to schedule	86	62%
6	Trip planner	67	49%
7	Bus system map	86	62%

The final question directly addresses what users would prefer in a CTS app. Bus arrival time for each stop, and real time bus location information top the list, again showing that users most want real time information about the current location of their bus. The rest of the responses are evenly distributed between closest routes, access to schedules, and a bus system map. All of these options seem to be valued but perhaps as peripheral parts of the CTS app. Trip planner received the least votes, possibly due to respondents' lack of knowledge about what a "trip planner" is or what service it would perform.

Respondents were asked to comment at the end of the survey with any additional notes or suggestions to inform CTS about their preferences. Selected representative quotes are presented below:

"My biggest impediment to riding the bus is a combination of the bus's tardiness and how it runs related to class start times--I want to ride it more than I do, but sometimes it's too much of a hassle. Also, a real-time function on the app would be so helpful, to know when to keep waiting and when to give up."

"The 'Where's my bus' (WMB) site isn't very mobile friendly....most of us riders are always interested in the ETA to stops outside of home and work so we don't waste time getting to a stop early or having to repeatedly look up common stop numbers."

"It is difficult to know when exactly a bus should arrive. It is one thing to be a few minutes late here and there, it is another to be unable to tell where and when the bus is actually going to stop. As a full time student with 2 jobs and 2 internships, I HAVE to have reliable transportation."

In terms of responses relating to app development, and in reviewing the ending statements of survey respondents, it seemed that the overall focus was directed towards the availability of real time bus information. Respondents also seemed interested in peripheral functions, such as bus schedules and route maps, but were focused on an app

that allowed them to be able to determine and guide their transit use to fit their personal schedule.

### *Appathon*

Twenty-five student app developers and seven policy students came together during the "Appathon," an all-day event in which the electric engineering and computer science (EECS) students worked to produce a feasible Corvallis transit app. On Friday, April 18th, the survey results were presented to the Appathon team, led by student and president of the App Development Club Chris Vanderschuere. The data from the graphs above was used to inform developers of the valued components of a proposed CTS app. Therefore, the key focus was access to real time bus information in conjunction with bus arrival times for each stop location. The addition of closest routes, bus stop locations, and a route map were deemed as secondary objectives but still necessary as additional features that would only add to the apps user friendliness and utility. The Appathon moved forward with development on the IOS and Android operating systems with these priorities. Early efforts resulted in beta versions of Transit for the IOS operating system and Transport for Android.

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## **Analysis and conclusion**

The findings from the survey of Corvallis residents suggest that a real-time transit application will provide a valuable service for both current and potential bus riders. A majority of riders already consult various services for bus information, yet it appears existing options lack the reliability and accessibility users desire. Multiple respondents indicate that they would ride the bus more often, but simply cannot trust what they perceive as unreliable bus service. While an app does not address bus reliability, it does give riders more control of their commute and may alleviate the concerns of those hesitant to use the bus system

Whereas a mobile phone application was a highly ranked area for improving the bus experience in Corvallis, respondents overwhelmingly felt increasing the frequency of service was most important. Evidence from previous research finds that real-time transit information reduces both perceived and actual wait time, which may also influence an individual's perception of service frequency. It is possible that reduced wait time for the bus will make frequency of service less important for some individuals. Although current research does not address a possible relationship between real-time information and perceived service frequency, it should be an area of future investigation.

Despite the relatively small sample size, the results clearly indicate that an opportunity exists to expand bus ridership in Corvallis. Approximately 11% of respondents ride the bus every day and only about half ride the bus at all. The literature provides evidence to suggest that Transport and Transit will provide a modest increase in the frequency of bus use for current riders, which is about half of our sample population. The challenge for the Corvallis transit officials will be educating the occasional and non-rider of the new transit

service. The public release of both apps should coincide with a strong and ongoing marketing effort to reach these populations. Advertisements at bus stops and on vehicles should accompany efforts to reach students at Oregon State University and others likely to utilize mobile phone applications. One strategy to expand the use of the apps may be to gradually add features that make it useful for other types of commuters. If individuals use Transport and Transit for their automobile travel or other trip planning services, they may decide to experiment with other features of the application and try the bus system. Moving forward, the key for sustained increases in ridership will be getting Transport and Transit on the mobile phones of Corvallis residents and ensuring their experience on the bus remains positive.

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Appendix A: Survey

Corvallis Transportation System Questionnaire

OPAL project

The City of Corvallis wants to make the bus system more convenient and accessible. One way to do this is by developing a mobile app for users. For this purpose they'd like your input on the Corvallis bus system and how they can improve the service. Please take 5 minutes to let us know what you think.

1. What is your zip code?

\_\_\_\_\_

2. How old are you? (circle age range)

16-24 years

56-70 years

25-40 years

70+ years

41-55 years

3. Do you identify yourself as:

Male

Female

Prefer not to answer

4. Do you use the bus?

Yes

No

If YES, please answer the following questions:  
questions:

If NO, please answer the following questions:

How often do you ride the bus?

a) Every day

- b) At least once a week
- c) At least once a month
- d) Less than once a month

What's your primary method of transportation?

- a) Car/truck
- b) Bicycle
- c) Carpooling
- d) Walking
- e) Other:

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What resources do you use to find out bus information? (Circle as many as apply)

- a) Google Maps / Transit
- b) CTS website
- c) QR codes posted at bus stops
- d) Schedules posted at bus stops
- e) None of the above
- f) Other: Are you aware that the Corvallis bus system is fareless (free to ride)?
  - o Yes
  - o No

What are some reasons you ride the bus?

- a) Convenience
- b) Gas prices
- c) Environmental reasons
- d) Parking issues
- e) I don't have another method of transportation

What's preventing you from riding the bus?

- a) Infrequency of service

- b) It doesn't go where I want to go
- c) Route systems/schedules are hard to understand
- d) I don't have a need
- e) I find the experience sometimes unpleasant

5. How could the Corvallis bus system be improved? Please rank your choices in order of preference.

- a. Smartphone App
- b. More Frequent Buses
- c. Expanded Schedule
- d. Schedule better aligned with OSU class times
- e. No changes are needed

6. What would you want to see in a Corvallis bus app? Check all that apply.

- a. Closest routes
- b. Bus stop locations
- c. Bus arrival time for my stop
- d. Real time bus location information
- e. Access to schedule
- f. Trip planner
- g. Bus system map

7. What type of mobile device are you using?

- a. iPhone
- b. Android
- c. Other:



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8. Would you like to see a Park and Ride service?

- a. Yes
- b. No
- c. Don't know

9. If you would like a Park and Ride service, what locations would be most convenient for you?

Thank you for taking the time to complete this survey. The results will be compiled and reported to the City of Corvallis to aid in the improvement of the Corvallis Transit System. Please feel free to add any additional information or comments on the back of this sheet