

Reawakening Wayne State University's Street Parking for a Better Midtown



Prepared For:

Detroit City Council Public Health and Safety Committee
Wayne State Community

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Executive Summary

Broken parking meters have been a major issue in Detroit for many years. Set to roll out this year, a new electronic parking meter system is on its way to replace 90% of the parking meters (Guillen, 2015). This feasibility study evaluates the different options for implementing the best parking system as well as the most viable and practical features for a parking application targeted towards the Wayne State University (WSU) community. The alternatives we looked at are the following:

Alternative Parking Systems for Wayne State University Community

- Solely use Detroit's new parking system
- Use an already proven parking application
- Partner with WSU to develop a student-centric experimental parking application

Parking Application Features

- Easy Ticket Fine Payments
- QR Code Parking Meter
- Parking Notifications
- One Tap Payments
- Extended Time Parking Rates
- Real-Time Parking Map

Primary and secondary research was conducted to develop a thorough view of the alternatives. Primary research included a survey that targeted WSU students and an observation of Birmingham's existing parking application and parking system. Secondary research included discovering and analyzing competitors' products, services, and mobile application features as well as understanding Detroit's current plan. To propose an effective recommendation and a just evaluation for each alternative, we tested each alternative based on the following list of criteria:

Criteria for Parking Systems

1. Cost-Effectiveness
2. Practicality
3. Quality

Criteria for Application Features

- Cost-Effectiveness
- Simplicity
- Security
- Reliability
- Sustainability
- Desirability

After a comprehensive analysis of each alternative, we have concluded that creating a WSU specific parking application that works in tandem with Detroit's proposed electronic parking system is the best solution to create an efficient way for frequent Midtown and Wayne State visitors to park.

Introduction

Parking: A Problem Worth Fixing

Parking on the streets surrounding the Wayne State University campus presents a unique problem for the evolving midtown community in Detroit. The midtown area is very congested throughout the year, especially during college semesters. Due to the congestion, the parking system and the availability of parking affects local businesses and other entities in the area, the willingness of consumers to interact with entities in the area, and it affects the revenue that Detroit can collect from the meters. Our expanding city, in its efforts to reestablish Detroit as one of the most influential cities in America, through business and transportation initiatives, seems to only have recently recognized the defective parking meter problem in the downtown and midtown areas. Detroit will be rolling out a brand new electronic parking system throughout the city beginning this month, but Wayne State and the midtown area offers an opportunity for a more progressive and area specific parking system. It is crucial to create an efficient parking system that will create a sustainable parking situation for the WSU campus and Detroit. We, the students of Wayne State are lobbying for a major change in the way parking is done on campus streets, and want to offer an effective solution to the unique problem. We offer this feasibility study to discuss the best parking and application alternatives for creating a better parking system for Wayne State with collaboration from the city of Detroit.

A Brief Overview Of This Study

In this feasibility study, we will:

1. Present background information regarding why parking meters exist and the unique problems they have tried to solve.
2. Show you how and why we chose the alternatives to implementing an effective parking system at Wayne State. Third, we will
3. Explain the feasible alternatives in depth for potential features and implementation methods by presenting the unique solution they offer to the parking problems around Wayne State.
4. Show you our methods and strategies for gathering primary and secondary research about our alternatives.
5. Summarize of all of our research which was gathered using our research methods in an effort to gain the necessary support to argue the validity of our alternatives.
6. Explain our evaluation of the alternatives in light of our gained knowledge, offer our conclusions, and give our recommendation for the best solution in our concluding sections (last three sections).

Depending on circumstances related to the progress of parking meter implementation, the most desirable solution would use the meters that Detroit is already planning on placing in midtown and would test a parking application at WSU which has features specifically tailored towards the student's needs.

Background

Why Do Parking Meters Exist?

“Parking Meters Yield \$50,000,000 a Year” is a vintage article from November of 1951 which offers a window into the thinking and lives of the early adopters of the city parking meters. Truly, in the days before parking meters, congestion in downtown areas became nearly unbearable. In a desperate effort to overcome the problem of people over-parking, city leaders decided to adopt parking meters to motivate people to share the parking and to park further away from their destinations. Parking meters offered a unique solution to a growing problem in expanding cities across North America.

When parking meters first were introduced, the companies contracted to install them offered to add them to only certain sections of the city on a trial-run basis. After the trial period, if the city then decided against them, the installing company would remove them at no charge. Also, from the earliest parking meters, the city has always paid a percent of the earnings to the installing company until the price of the parking meter was paid off. This means that any revenue after the meter was paid off would be wholly for the city and any repairs or replacements they decide to purchase. This article, additionally, produces some insight into why cities decided to implement parking meters in the first place. Ultimately, parking meters were put in the city to encourage people to use parking further away from downtown to reduce the congestion of traffic and cars parked downtown (Reddick, 1951).

Since the enforcement of parking meters began, circumstances have changed. The parking meter industry has grown to a \$3 billion dollar industry with large corporations changing policies to respond to consumer parking needs by providing accessible parking (Janacek & Dejong, 2007). However most parking systems have not been able to keep up with the test of time and competition. Currently, technological advancements can change the functionality of parking meters to help meet Detroit's needs to promote parking accessibility and competitiveness.

What Are Detroit's Unique Parking Problems?

Over time, problems such as the increasing number of dysfunctional parking meters, the city not being able to collect revenue from the meters, and the city receiving a bad reputation for accessible parking due to the dysfunctional meters. In 2014, approximately half of Detroit's parking meters weren't operational according to Bill Nowling who is the spokesman for Detroit's Emergency Manager (Badger, 2014). Recently, the city has taken steps towards fixing the parking meters, however only time can tell if this solution will be effective, sustainable, and if it will create a better Detroit. In recent years new parking technologies, innovations, and strategies have been developed to enhance current parking systems to promote efficiency, effectiveness, and sustainability. By implementing certain new features and systems Detroit can stay competitive, fix its parking meters, and improve Detroit's reputation in terms of easy accessible parking.

Criteria: Our “Filter”

Our goal, as earlier mentioned, is to find the *best* way to implement a parking system throughout Wayne State University and the city of Detroit, the *best* way to combine a mobile application with physical parking meters, and the *best* features for this parking application. In order to accomplish these goals, we have established multiple criterion with which we will evaluate our alternatives.

Criteria for Determining Feasible Parking Systems

Our first three criteria are focused on evaluating different aspects of potential parking systems for WSU. First, any parking system idea will need to be cost-effective. Ideally, anything discussed will provide a good opportunity to increase revenue gained from parking. Second, any parking system idea discussed here will focus on practicality. For instance, if a solution would not be realistic, functional, and useful, we will be a bit wary of discussing it here as it would not be likely to improve the current parking system in place. Lastly, any parking system idea discussed here must be able to provide a quality solution, which reflects a clear understanding of the problem at Wayne State University and throughout the city of Detroit.

1. **Cost-effectiveness**
2. **Practicality**
3. **Quality**

Criteria for Determining Feasible Features

Our next six criteria, in no particular order, are focused on evaluating feasible features for the Wayne State University community to implement within a parking application. First, any feature discussed will be simple, so that a broad range of ages and technologically skilled people can use it. Second, the feature must be reliable because reliability is essential and fundamental to establishing a functional parking system. Our third criteria for determining feasible features is cost-effectiveness. Features offered should be able to realistically offer financial benefits to the city of Detroit and WSU. Fourth, the ideas discussed here will be sustainable. To clarify, they will be features that will be able to be used for a long time and the need for them will not be eliminated quickly. It would be pointless to discuss an application feature that would only last a couple years before becoming obsolete. Our fifth concern when determining application features will be its security. In other words, we would not be interested in discussing features that would be easily exploited resulting in monetary loss for either the customer or the city. Finally, our last consideration when choosing the application features to discuss in this study is desirability. If the desire and demand is not there for a certain feature, implementing it would be a waste of time and resources.

1. **Simplicity**
2. **Reliability**
3. **Cost-effectiveness**
4. **Sustainability**
5. **Security**
6. **Demand**

Overview of Alternatives

When we first discussed the parking situation around Wayne State University, we began to formulate ways that different parking systems and possible mobile application features could improve the parking situation at Wayne State and throughout Detroit. The first section outlines what we have found to be the best ideas for implementing a parking system around WSU. All the implementation ideas discussed here will match our criterion earlier discussed. In other words, the “filter” for any idea outlined here will be that it is cost-effective, practical, and demonstrates quality.

The second section will discuss the different features that could be considered for a mobile application. All the features outlined here will conform to our earlier discussed criterion. To re-iterate, all the ideas here have met our criterion of being simple, reliable, sustainable, secure, cost-effective, and desirable. Each of these ideas cohesively establish an understanding of the current parking problems and atmosphere throughout Midtown Detroit.

Feasible Parking System Alternatives

Alternative One: Use Detroit’s New Parking System

It is worth mentioning that the simplest solution to tackling the defective parking meter issue surrounding Wayne State University is to have city-wide adoption of Detroit’s plan for replacing the parking meters. According to a Detroit Free Press article by Joe Guillen (2015), Detroit is planning on implementing a similar parking system to the one in place in Pittsburgh which would include electronic parking meters and a pay-by-license plate system.

Alternative Two: Use an Already Proven Parking App

A potential alternative would be to utilize and implement an existing mobile parking service on campus, which would be different from the service of Detroit’s current plans. This option would make use of other existing mobile parking services, which are available for implementation, such as Parkmobile or Passport’s Private Label Mobile Pay service.

Implementing Parkmobile

Parkmobile (2015) is an established parking mobile application and implementing Parkmobile would offer many options when parking at WSU. Parkmobile is currently implemented in 500 cities, which include over 600 locations in 37 states throughout the United States, and is still growing. Parkmobile is currently available on iOS, Android, Windows, Blackberry, and Amazon is on the way. It is currently offered in newer Ford and Volvo vehicles, and can be integrated into a wide selection of motor vehicles in the near future. Parkmobile is the leading parking application provider to universities in the United States and they are also partnered with PayPal, Visa, Chase, and Siemens. Parkmobile charges a convenience fee to the user for each transaction, which allows for Parkmobile to be implemented within cities at no cost to the city. The Parkmobile system works with existing parking meters through the addition of Parkmobile stickers, which assigns a unique number and QR code to each individual parking space. The parking meters do not display when a Parkmobile session is active, and people who using Parkmobile must trust that the application is reliable. Parkmobile allows for continued use of the coin operated meters as well.

Implementing PayByPhone

PayByPhone (2015) was created by the payment company PayPoint, which originally offered users the option to call to pay for parking. Now, it offers options to text and use their mobile application as well. PayByPhone is offered in over 180 cities across the globe, including Ann Arbor, New York City, Miami, San Francisco, London, and Paris. Similar to Parkmobile, PayByPhone is implemented within cities at no cost to the city, because the company profits from the convenience fees from parking payment transactions. Implementing PayByPhone is similar to the implementation process of Parkmobile. Stickers with a unique location number are assigned to each parking space, and the user enters the location number into the mobile application. PayByPhone is currently available for devices running iOS, Android, and Blackberry operating systems. The PayByPhone application will also soon be able to interact with the Apple Watch.

Implementing Passport's Private Label Mobile Pay Service

Passport's Private Label Mobile Pay (2015) service offers custom software development for applications. Since parking processes are unique in every city, this option allows for building an application that is designed to include features that the city deems essential to economic growth, successful integration, and long-term sustainability. ParkChicago is the parking mobile application implemented throughout the city of Chicago, which was developed through Passport. This option would allow for creation of a custom application, possibly named ParkDetroit, which would be designed precisely based around the needs of the city. ParkChicago is one of the highest rated parking mobile applications in the Apple App Store and the Google Play Store.

Alternative Three: Partner with Wayne State University to Develop a Student-Centric Experimental Parking Application

Under this option, Detroit will continue with its plan on implementing its own parking system. However, WSU will be designated as a testing area for a mobile parking application tailored to the needs of students. This option would involve proposing a project to the Information Technology Steering Committee of WSU, which may spark collaboration between WSU and the city of Detroit to design and develop an original parking application developed and maintained by WSU. The aim of this approach is to create an application that will help solve the parking congestion around Wayne and encourage visitors to midtown to use the parking system.

Finally, in respect to cost, half of the money received from parking fees using the application would go towards Wayne State's expenses for creating, developing, maintaining, and improving the application, and the other half will go to the city.

Feasible Mobile Parking Application Features

Feature One: One Tap Payment

Convenience currently holds the power over the consumer of our day and age. It is becoming more and more clear that most merchants who want to be successful must offer the convenience of paying with a credit card. An option for mobile payments that could be implemented is as follows: you would input your desired method(s) of payment once and you will never have to input that information again (unless the payment method expires). With your payment method in place on the application, you then would have the

power to pay for parking with a single tap. The application must support a wide variety of payment methods such as Visa, MasterCard, Discover, American Express, Warrior Dollars, OneCard Dollars, and PayPal.

Feature Two: Easy Ticket Fine Payments

Paying for a parking ticket from one's mobile phone is another possible alternative. A person given a parking violation can pay their ticket within the application, by the same method as they would pay for a normal parking charge. This feature will include a way for the city to input tickets into the parking application and for the recipients of the tickets to view charges, deadlines, proof/pictures regarding the violation, and an option for recipients to dispute the parking violations within the parking application.

Feature Three: Extended Parking Time Rates

Another payment based feature would be to have the ability to pay a premium price to extend parking time past the maximum limit. This option would potentially save the user from receiving a ticket by allowing them to extend their parking time by an additional fifteen minutes. If the meters allow for a maximum of 2 hours, but if the consumer is running late, they would have the ability to extend the time by an additional 15 minutes for a premium price. The premium price will be determined by the city and proper authorities.

Feature Four: QR Code Parking Meter

For this feature idea, each parking spot would be tagged with a unique QR code. Users would then scan the meter with their phone to select the spot they are occupying and pay their parking dues. In the unlikely case that the QR Code does not work or is vandalized, the parking spot would have its unique number etched onto its surface for the user to enter into their phone.

Feature Five: Real-Time Parking Map

Using advancements in technology such as ultrasonic transducers and sensors (discussed in depth in results) opens up the possibility of implementing a real-time map. This map will include the locations of available parking spots and how soon those spots will become available if they are occupied. Not only would this feature let people know where they can find a parking spot, but it would also enable heightened enforcement. The advancement in technology can allow for parking meters to detect if a car is still parked in a certain spot which will allow enforcing officers to identify and check streets that have clear parking violators. In other words, users can find parking spots quickly on busy days and city officials can ticket cars parked over the limit just by checking the app.

Feature Six: Parking Notifications

It is commonly known that people tend to hate to be ticketed. To assist users in avoiding tickets, the application would also have the capability of displaying a notification on the phone telling the user how much time is left on their meter, giving them the option to add a small amount of time at a premium price, or just letting them know that they need to get back to their car.

Research Methods

In this feasibility study, our methods of research were broken down into primary and secondary research. In order to discover the most effective, efficient, and viable implementation alternatives and features for a mobile parking application, it was essential that we used refined research questions that helped us generate effective, practical, and most importantly reliable research. As we moved forward, the research we generated ensured that we were able to provide logical, trustworthy, realistic, and persuasive solutions in this report.

Primary Research Methods

One of our primary research methods included conducting a survey that targeted at 100 Wayne State University students and a field test of Parkmobile, the parking mobile application implemented in Birmingham, Michigan.

Wayne State Parking Application Survey

We used a survey (see Appendix A1 & A2) as our primary way of assessing the current frustrations and needs of the Wayne State community. The survey we constructed targeted 100 WSU students who contributed to this report. Doing this gave us valuable information about how many students have smartphones, if they have used a mobile parking application before, if they would be willing to use a parking application, and most importantly what features would they like most in a mobile parking application. In order to get a good sample of students at Wayne State University, we published the survey on social-networking sites and wiki pages. Because we used SurveyMonkey to conduct online surveys, we were able to easily attain, organize, and analyze our results.

Field Research in Birmingham

We, additionally, determined strengths and weaknesses of existing applications through field research. We visited Birmingham, Michigan to analyze Parkmobile, which is the parking mobile application that is currently implemented in the city. We tested and evaluated Birmingham's Parkmobile system to identify the advantages and disadvantages of the service.

Secondary Research Methods

Our secondary research methods included discovering and analyzing competitors' services and mobile application features as well as delving into things like cost.

How Did We Learn About Competing Apps?

We found that the types of research questions that yielded the most significant information were those that identified and analyzed the strengths, weaknesses, and effectiveness of available products and services. With the help of our research questions we have discovered major companies that have developed mobile parking applications and have identified the strengths and weaknesses of their parking applications, features, and services.

We searched many websites for established mobile parking service providers. These websites gave us better understanding of a parking service providers' mobile parking application features and services. However,

we took caution and considered advertising and marketing techniques used to promote these products, which seemed to exaggerate services and features offered by the creator. In order to distinguish between actual services and features from the ones advertised, we used digital media (Android and iOS app stores) to examine reviews of existing parking service providers and their mobile parking applications.

How Did We Discover Research Cost?

Cost of implementation and Detroit's budget are also factors that we considered. Through research we discovered public city information such as The Detroit Municipal Parking Agency Plan (2013), which provided us a summary of the missions, goals, and the budget of the department. This source helped us to further understand the current plans that the city has in place and it allowed us to make an educated judgment regarding the feasibility of certain alternatives and features. If our research involved any discussion of cost, we spent quite a bit of time researching vendors that provide the goods that can solve our dilemma.

How Did We Get a Working Knowledge?

We used digital media to generate a potential list of websites that contained working knowledge, general resources, news, academic journals, books, and professional organizations. This preliminary secondary research helped us conduct primary research and refine our research questions, which helped us generate reliable results that were later filtered through our criteria and used in this report. This allowed us to present parking services and mobile parking application features that were worth discussing in this report.

Results: The Data We Mined

Our research outlines primary and secondary research that was conducted specifically to discover mobile parking application features and implementation options for Detroit's parking situation.

What Is Detroit Doing?

A Detroit Free Press article by Joe Guillen (2015) offers great insight into what Detroit's new parking system, set to roll out this month, will include. The system will cover around 90% of all parking spaces in Detroit and boasts an entirely electronic pay system. The \$3 million contract for the system has already been approved. The new system will be based on the license plate of the user and will allow the user to park in any space for the duration of the payment. The pay stations will also sell tickets for existing local public transportation systems to promote using alternative ways to get around Detroit. A proposal to implement dynamic pricing for special events is also in motion so that revenue can be increased when there is an increased amount visitors in Detroit for special events. A strong parallel can be drawn between Detroit's plan and what the city of Pittsburgh has already implemented and seen success with. Pittsburgh Parking Authority's executive director David Onorato states that after implementing their new parking system, the daily revenue of meters in the city more than doubled, up to \$47,000 from \$22,000 per day on the old style machines. Three-fourths of this revenue is due to the electronic payment option with credit cards. This massive increase in revenue would likely be seen in Detroit as well, especially since Detroit is not able to collect money from the defective parking meters. Pittsburgh also raised their parking prices for parking to help pay for millions of dollars in pension costs (Cato, 2014). After seeing strong precedence for use of an electronic parking system, Detroit will finally be able to move into the future.

What do Students at Wayne State Want?

A survey was conducted on 100 WSU students via SurveyMonkey in which students were asked various questions regarding mobile parking application features that they wanted to be implemented near WSU. These application features were aimed to help overcome obstacles and problems specific to the WSU community. In addition, these application features can eventually help solve larger problems in other areas of Detroit.

A Brief View of Wayne State University Student's Parking Obstacles

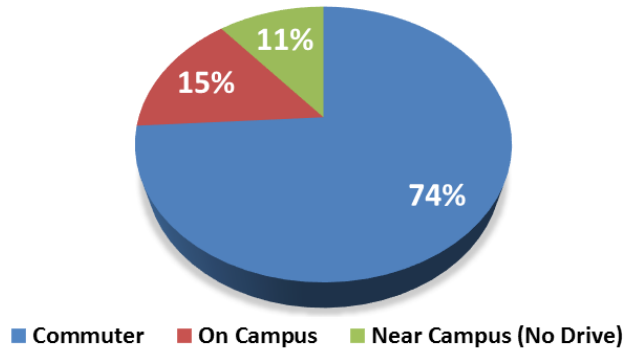
From the 100 WSU students surveyed:

- 74% of students reported that they commute to WSU
- 69% of students have reported that they have used parking meters near WSU
- 64% of students have reported that they rarely or never have change to pay for parking
- 83% have reported that they have encountered a broken parking meter near WSU

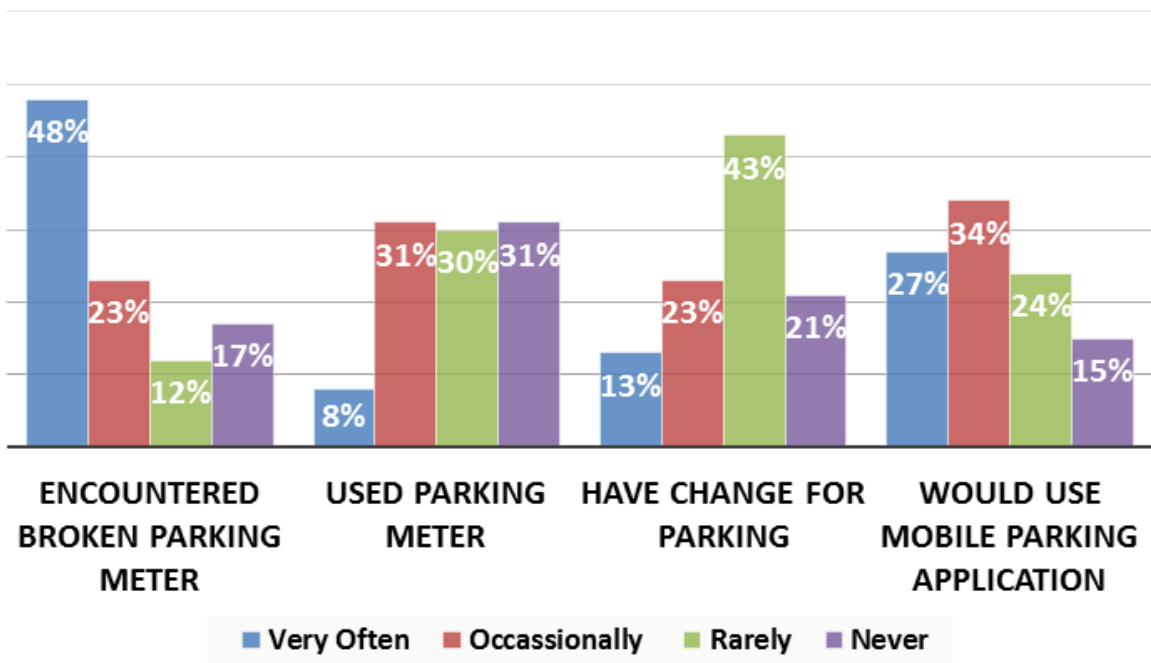
Both WSU students and the city of Detroit have experienced many inconveniences caused by the dysfunctional parking meters. This data presents a unique perspective to the parking problem near WSU. This suggests that approximately 7 out of 10 students drive to campus and nearly 6 out of 10 students very often, occasionally, or rarely use parking meters near WSU. However, roughly 8 out of 10 students have encountered broken parking meters very often, occasionally, or rarely near WSU. This indicates that when students tried to pay for parking near WSU, almost 8 times out of 10 they were not able to pay due to the

dysfunctional parking meters. The results also presented us information that about 6 out of 10 students rarely or never have change to pay for parking. This indicates that even if we fixed the parking meters, nearly 6 out of 10 times students won't be able to pay their parking fees due to the fact that they don't have change (see Appendix A1 for original tables).

WSU Student Profile



WSU Student Background Information



Parking Application Features Wayne State University Students Want

In order to overcome current parking obstacles that WSU students face, there was a series of questions asked to determine the best solution for the parking problem. Of the students surveyed:

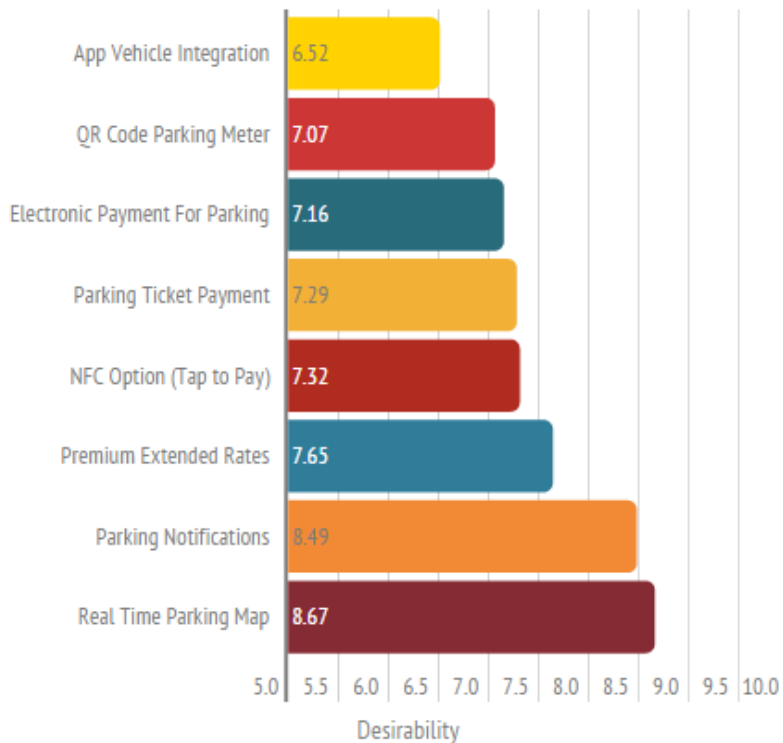
- 100% owned a smartphone
- 85% of students reported that they would use a mobile parking application to pay for parking
 - 27% would use the parking application very often
 - 34% would use the parking application occasionally
 - 24% would use the parking application rarely
 - 15% would never use the parking application

This data shows that roughly 8 out of 10 students would use the mobile parking application. However, the parking application must provide a pleasant experience and reduce inconveniences that students have encountered while trying to park (see Appendix A1 for original table). The survey presented students with a list of application features, which could help make the mobile parking application and the experience with parking near WSU more enjoyable, efficient, and beneficial. The students were asked to rate how desirable the following features were to have the ability to:

- Integrate parking application into vehicle navigation systems
- Scan a QR code to pay for parking from the parking application
- Make parking fee payments by credit card/PayPal from the parking application
- Pay parking violation fees from parking application
- Use NFC to tap and pay (Apple Pay) parking fees from within the application
- Pay a premium price from the parking application to extend parking time past the maximum limit
- Receive notifications from parking application to your smartphone alerting the user that parking time is expiring
- Identify available parking spaces on a map from the parking application

A real time map that includes locations of available parking spaces was the most desirable feature by WSU students. This indicates that students would like to be able to locate available parking efficiently, which could in turn save students time and money. The second most desired feature by WSU students was a smartphone notification that warns students when time is expiring for their meter. The third most desired feature by WSU students was an option to pay a premium price to extend the parking time past the maximum time limit. The least desired features were integration of the parking application into vehicle navigation systems and an option to scan a QR code that links the parking application to a parking spot. The data below represents the results of the survey (see Appendix A2 for original table).

Mobile Parking App Features



100 WSU students were asked to rate mobile parking application features that they desired most on a scale of 1-10. 1 being least desired, 5 neutral, and 10 being most desired.

What Do Existing Mobile Parking Applications Offer?

Parkmobile

Parkmobile was one of the first parking mobile applications to ever be implemented throughout cities in the United States. The Parkmobile application offers many notable features, including payment options directly from a smartphone, QR code scanning, available option to extend a parking session from a smartphone, and directions navigating a user back to their parked vehicle. In Michigan, Parkmobile is implemented throughout the city of Birmingham. When paying for 24 minutes of parking, the cost for parking was \$0.40 with an additional \$0.43 transaction fee, making the total cost for 24 minutes of parking equal to \$0.83. Each time a person extends a parking session, the person is charged a transaction fee again (Parkmobile, 2015). A considerable amount of iOS reviewers claimed that they have received parking violations, despite the fact that they paid through the Parkmobile application. Many reviewers also noted that the Parkmobile application does not deliver accurate notifications of the time parking expires (Apple, 2015).

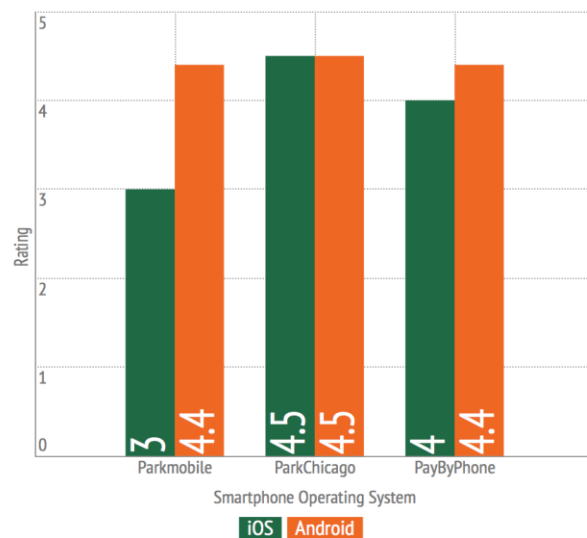
PayByPhone

PayByPhone offers secure payments by credit card, text message reminders to alert users before parking expires, the option to extend parking remotely, and receipts of transactions can be accessed via email. In San Francisco, a \$0.45 fee is added to the cost of parking for each transaction. San Francisco was the first city to offer a NFC payment option at each meter. The NFC technology prompts users to launch the application and identifies the location of the meter (PayByPhone, 2015). Many iOS reviewers have complained that the application was slow or unresponsive, with frequent crashes. A considerable amount of iOS reviewers also have mentioned that they have received a ticket, even though having paid for the time that they had parked their vehicle (Apple, 2015).

ParkChicago

ParkChicago (2015) is a unique parking mobile application implemented throughout the city of Chicago, Illinois. The ParkChicago application is exclusively for parking in Chicago and the application was published by Passport Parking. ParkChicago and Passport Parking Mobile Pay are unified via Passport's Private Label Mobile Pay (2015) service. Passport's Private Label Mobile Pay service allows cities to create custom software to implement unique features into an application, which are tailored to the needs and desires the city. ParkChicago also allows users to pay for a parking session by dialing a number from a cell phone or using a desktop or mobile browser to pay. In order to use ParkChicago, users must create an account and the user's account must be pre-funded with \$20.00 or more. If the purchase of parking will reduce a user's account to below \$10.00, it is required to authorize replenishing of the account. When parking for less than 2 hours, a \$0.35 convenience fee is applied for each transaction. There is no convenience fee when parking is purchased for 2 hours or more. The ParkChicago application also delivers notification alerts of expiring parking and offers the option to remotely extend a parking session.

Parking Application Ratings



Ratings obtained from Apple App Store and Google Play Store, based on a 5 star scale, with 5 being the highest possible rating.

What Are The Relevant Advances In Computerized Parking Meter Technology?

According to Joshua Mushell, his invention of a computerized parking meter is aimed at increasing parking revenues by 50% to a maximum of 200% by using ultrasonic transducers, programmable rates and advertisements, and low power consumption.

Local municipalities have requested a way to automatically reset a parking meter to zero when a vehicle departs from a parking spot to increase revenue. This parking meter utilizes ultrasonic transducers and sensors to calculate the distance of a parked vehicle from the meter in order to reset the meter to zero once the vehicle leaves. However, problems may occur due to human or animal interference, yet this computerized parking meter is capable of differentiating between vehicles and humans. This helps reduce the chance of resetting the parking meter due to human or animal movement.

To reduce costs and increase revenue, these computerized parking meters, also, have an expected battery life of seven years. The low power consumption, sleep mode, and solar recharger all make this possible. When traffic isn't enforced during the nighttime or during special holidays the parking meters could be set to sleep which saves power and it prevents any unnecessary usage of the meter.

By computerizing the parking meters, they can be programmed in many different ways. This computerized parking meter can be programmed to enforce different parking rates on select days. This would open up the possibility to increasing or decreasing the rates at certain times of the day and during certain events and holidays. In addition, advertisements can also be displayed on the LCD which can potentially increase revenue. The computerized parking meters have the ability to play audible messages. This opens it up to the possibility of having audible advertisements in addition to advertisements written on the LCD.

Lastly, the computerized parking meter features have the ability to use features that are used to bring in revenue to promote safety and awareness. Safety, traffic, and weather information could be displayed on the LCD screen of the parking meters. In addition, the information could be audible which can enhance consumer safety and awareness in the area (Mushell, 1995).

Evaluation: The Data's Voice

Feasible Parking Systems

Alternative One: Should We Use Detroit's New Parking System?

Our city has a budgeted plan that will attempt to revamp the parking system by implementing new electronic parking meters and a pay-by-license plate system. However, all details have not been revealed and the pay-by-license plate system of this alternative may not produce practical or cost-effective results that meet the needs of WSU students.

Cost-Effectiveness

From our research, the city has already approved a \$3 million contract to revamp the parking system (Guillen, 2015). However, with details still hidden, it may be worth investing more into a system that solves WSU student's problems with features that will make parking efficient, effective, and sustainable. This may in turn increase user satisfaction, which can correlate to an increase in parking use, which further translates into an increase in revenue.

Practicality

With details hidden, the pay-by-license plate system may not be functional or useful to solve some problems that WSU students face. For instance, the pay-by-license plate system allows users to pay for parking for their car and park at any space. In turn, this system may not allow for a real-time map of parking availability because this feature depends on the ability to track open parking spaces in order to present a map of available parking to the user. By not having this feature, which was voted as the most desirable feature by WSU students, it decreases the functionality and usefulness of this parking system for WSU students. In turn, this would decrease the usefulness and functionality of the alternative.

Quality

The quality of the solution, based on the information that was revealed, may not provide a complete solution that reflects the problems of WSU students. Problems such as locating and paying for parking efficiently may still be left unsolved, however, further information about the new system is required to assess which problems the system fails to address.

Alternative Two: Should We Use an Already Proven Parking Application?

Implementing Parkmobile

Parkmobile would be implemented at no cost to the city, which would initially make implementation of Parkmobile cost-effective. However, the transaction fees that accompany Parkmobile's service are considerably high for the consumer, and over an extended period of time, the city would be missing out on enormous revenue that the city could be receiving. In addition, the quality of the Parkmobile application is also questionable based on user reviews.

Cost-Effectiveness

The initial cost of implementing this service is zero, however the amount of money that can be earned is forfeited in the process. Parkmobile charges users a \$0.43 transaction fee and Detroit has 3,404 parking spaces. If all of those parking spaces are used, Parkmobile would receive \$1463.72 every two hours, which is money that could be going to the city to fund important projects that could help improve the city.

Practicality

This solution would be easy to implement throughout the city by adding Parkmobile stickers to existing parking meters. Parkmobile has been implemented in 500 cities, so the transition to using the service would be realistic and smooth based on the experience that the company has. In the Apple App Store the application received a 3/5 and its Android application received a 4.4/5. This reflects the functionality and the usefulness of the application based on user reviews. In the Apple ecosystem, there seems to be a major problem for functionality, which overlaps with our quality concerns.

Quality

There seems to be a quality issue with the Parkmobile application due to poor communication between the service and local parking enforcement agencies. From user reviews on iOS, this lack of communication has resulted in individuals receiving parking violations, despite having paid for their parking session. This has caused many users to become frustrated with the application, especially because under section 3.6 of Parkmobile's terms and conditions it states that Parkmobile is not responsible for any parking violation that a user receives (Parkmobile 2015). Based on the reviews and terms and conditions of Parkmobile, this alternative may not provide a solution that solves the problems that WSU students face, but it can potentially add to the problems that they face.

Implementing PayByPhone

Similarly to Parkmobile, PayByPhone is offered to cities free of cost, because PayByPhone receives profits through transaction fees, which brings up the same cost-effective issues as Parkmobile. In addition, based on user reviews the quality of the PayByPhone application is somewhat comparable to Parkmobile.

Cost-Effectiveness

Like Parkmobile, PayByPhone is offered to cities free of cost, because PayByPhone receives profits through transaction fees, which reduces the revenue that Detroit can possibly receive.

Practicality

This application offers similar realistic and smooth implementations as Parkmobile, however it has been implemented in fewer cities than Parkmobile. Furthermore PayByPhone has similar functionality and usefulness concerns as Parkmobile, which overlaps with our quality concerns.

Quality

Based on reviews, users have complained of experiencing significant glitches while using the application, and it was easy to identify individuals that have been wrongfully ticketed, regardless of the fact that they had paid for their parking. This quality concern reduces the functionality,

usefulness, and reliability of the service, which creates more problems rather than solving the problems that WSU students face.

Implementing Passport's Private Label Mobile Pay Service

Implementation of a custom application similar to ParkChicago via Passport's Private Label Mobile Pay Service offers one of the most practical, quality alternatives at a very high upfront cost that the city may not want to spend.

Cost-Effectiveness

The \$40 million upfront cost that Chicago has invested is approximately 13 times the amount that Detroit has approved for its new parking system. The cost of developing an application through Passport, if compared to Chicago, is currently out of Detroit's approved price range.

Practicality

Implementation of such an application would offer Detroit many reliable features that Parkmobile and PayByPhone do not offer. It would also improve functionality and usefulness of the application, which also overlaps with quality control.

Quality

ParkChicago outperforms in certain aspects where other services fail. This custom designed application allows enhanced communication between the city and the application which prevents ticketing individuals that have already paid for parking, a problem that individuals using other services have experienced. Passport also offers some of the most advanced technology available and also offers the highest level of payment processing security, according to the PCI Security Standards Council (Passport, 2015). However, there have been some troubles as well. A minority of users have stated that the application has crashed and that the convenience fee and the \$10 minimum account balance is unjustified. Furthermore, ParkChicago is different from other services in terms of convenience fees because they waive the fee when users park for a minimum of two hours. The reviews and ratings make it very apparent that such a large investment has led to a high quality application and effective parking system that meets the needs of Chicago. ParkChicago is the most well reviewed parking mobile applications on both the Google and Apple app stores at this time.

Alternative Three: Should We Create a Wayne State University Student-Centric Experimental Parking Application?

A collaboration between Wayne State University and the city of Detroit in the development of an original and homegrown application for Detroit parking would offer profuse benefits in terms of cost-effectiveness, practicality, and quality.

Cost-Effectiveness

The city of Chicago has spent \$40 million to create their parking application (Chicago Parking Meters, 2014), and outside companies such as Parkmobile and PayByPhone charge tremendously high convenience fees for each transaction. This implementation idea would offer a middle ground in terms of cost effectiveness. This alternative would allow the city to collect service fees that

would otherwise be collected by the other application solutions. More importantly, the city and Wayne State could work out a deal to fund the app's creation using the initial transaction fees and University's resources. Additionally, a homegrown application would direct the prices of such convenience fees back into the city of Detroit, rather than the pockets of outside companies, further funding the parking application project as it progresses.

Practicality

At the forefront, establishing a collaborative project would be quite a bit of work for the city and the university to plan and execute. The development process would take some time, but in terms of long-term sustainability, it would be extremely beneficial for both parties to allow Wayne State University to develop, maintain, and test the application and additional new features. WSU's unique, young, and tech-savvy audience may translate into shorter learning curves and an openness to change. This can enable researchers and application developers to rapidly implement new ideas, techniques, and systems without alienating its consumers in other areas of Detroit, who may not be as open to change. With these circumstances, WSU may be the most practical location to conduct tests to create a more sustainable parking meter system that is tailored to the needs of WSU students. The cutting edge technology and innovative staff at Wayne State University can contribute to producing astonishing advancements that will ensure reliability and sustainability of the parking system in Detroit.

Quality

Collaboration would offer solutions to some of the prominent quality concerns of utilizing existing parking alternatives such as Parkmobile and PayByPhone. This collaboration could enhance communication between the application and the parking enforcement agency, which will eliminate mistakenly ticketing vehicles, and it could create a stable and effective application that is tailored to the needs of WSU students.

Feasible Features: A Discussion of Features and Criterion

When we added these features to our discussion, we initially filtered them through the six criterion we devised: cost-effectiveness, simplicity, reliability, sustainability, demand, and security. In our research, we found it nearly impossible to discover actual costs for specific features. We also identified that all of the features were desirable based on our surveys and we, also, determined that these features were going to be secure if the application was to be published in the Google or Apple app stores. That said, we will highlight important evaluations for each feature, but may not talk about every criteria in-depth.

Feature One: One Tap Payment

As technology progresses in this busy society, it is more important than ever to enable consumers to pay for their services in a time effective manner.

Simplicity

The option to store payment information would allow users to quickly and easily process transactions from the parking application, making paying for parking a simple process, while saving users from the hassle of inserting coins, swiping a card at the meter, or reinserting payment information within the application every time they park. It has been proven that even with the creation of a mobile parking application, the payment process may not be simple. Many reviews for PayByPhone written by users complain that the payment system isn't simple nor quick due to the fact that users are required to re-enter their payment information for each transaction. This shows that people are not happy with just being able to pay electronically, they want to do it quickly too, with a simple tap.

Cost-Effectiveness

A one tap payment feature would have minimal cost compared to the happiness of the users it would provide. The city would be able to collect revenue from parking meters almost immediately and users would be more likely to use the application to pay, due to only having to submit payment information once. The only downside to supporting credit cards is the merchant fee charged by credit card companies, but this could easily be recuperated through a small increase in the parking fees.

Reliability

One tap payments have been proven reliable by PayPal, a payment processing company that has been at the forefront of mobile application payments. PayPal was founded in 1998 and introduced its one touch payment option 2014. As technological advances continue in upcoming years, the reliability of this service and other services that offer similar features will only be improved upon which will increase reliability.

Sustainability

From our research on similar applications, we found that processing payments was rarely an issue in terms of long-term use. This feature does not seem like it will be obsolete within the next five years. This feature would require little maintenance once established, and if users experience problems, the problems could be fixed through updates, which is to be expected with any mobile application.

Feature Two: Easy Ticket Fine Payments

Not many people like receiving parking violations, however parking enforcement is essential to keep parking spaces open and the streets decongested to allow individuals to interact with entities in busy areas of Detroit. An easy ticket fine payment feature that is simple, reliable and sustainable will allow users to easily pay violations and the city to efficiently collect the payments.

Simplicity

It has been proven that simple and easy to use features are well received by both users and administrators, which in this case would be the parking enforcement agency. On the user end, this feature would present a simple and easy option to view and pay for parking violations. It would also incorporate the one tap payment feature to help create a seamless, time effective payment process.

On the enforcement agency side, there will need to be modifications to the way that tickets are issued to ensure simplicity for the users and an effective collecting system. To eliminate discrepancies, enforcement agencies must continue to issue physical tickets to vehicles in addition to adding parking violations to a user accessible database within the parking application. However, these two tasks would be combined into one to make the task simple for parking enforcers. With the help of new machinery, parking enforcers would add vehicle and violation information into a system which will in turn print the violation and automatically add it to the user accessible parking database. This would allow instantaneous access of the violation to the user in addition to enabling the user to simply and effectively paying the violation.

Cost-Effectiveness

This feature would incur an addition to the cost of development and an additional cost for upgrading machinery to allow parking enforcers to instantly add parking violations to a user accessible database. However, once the feature is in effect, it would offer major advantages to the city of Detroit such as quickly collecting ticket payments. This could allow the Detroit Municipal Payment and Information Center to redirect workers from collecting payments to other departments in order to offer better services to individuals in the city of Detroit. This feature may have some initial costs, however the realistic benefits that are offered to the city of Detroit are well worth the cost.

Reliability

Paying for parking violation tickets through the application would be functional considering that the city of Detroit already has a website currently in place for users to pay parking violations. There will need to be modifications made to the website to allow for parking enforcers to add parking violations instantly and a modification to allow users to access and pay the violation through the mobile parking application.

Sustainability

If implemented simplistically and reliably, this feature would not become obsolete within the next five years. Society is using technology to solve more and more problems as time progresses, with this feature the problem of paying and collecting parking tickets will be addressed. Resolving a ticket without the hassle of mailing a payment, driving down to the Detroit Municipal Payment and Information Center, or sitting on a computer to pay your ticket offers time saving and other sustainable benefits for the city of Detroit and the parking violators.

Feature Three: Extended Time Parking Rates

An issue that many students and individuals have faced when using the parking system is that they may run out of time on the parking meter before completing their task which puts them at a risk of receiving a parking ticket. In such instances, WSU students have indicated that they want the ability to avoid receiving a parking ticket by paying a premium price to extend the parking time past the maximum limit, just enough for them to be able to get back to their cars. This feature, when implemented, will provide cost-effective, reliable, and sustainable solution for this problem.

Simplicity

This feature would be developed to work cohesively with the functionality of the parking notifications and active meter timer displayed on the mobile application. As parking time nears expiration, users could simply extend their session for a desired amount of time at a premium price (if parked above the maximum time limit). The feature would be simple to develop, because it would only involve minor modifications the coding of the application. This feature would also include the one tap payment feature for seamless payment transactions.

Cost-Effectiveness

This feature deems itself cost-effective to the people parking and the city of Detroit. Users would have the option to pay a premium price for parking for past the limit, which can help users avoid receiving a parking ticket. If individuals used this feature, it would in turn reduce the need for parking enforcers to issue tickets to individuals who have parked over the maximum parking limit, which in turn would save the city time and the cost of issuing a parking ticket. This would not only save the city time and money, but it could possibly generate more money if individuals used the feature. There would be no hardware cost to implement this solution, however there may be costs for coding this feature within the application.

Reliability

Reliability of this feature is essential, and would be accomplished by establishing a mobile application that has a fully functional and accurate timing synchronization with the parking space, as well as a seamless payment method system.

Sustainability

This feature is sustainable in that it will not become obsolete within the next five years and it will produce continuous benefits (mentioned above) for both the city Detroit and the users of the parking application.

Feature Four: QR Code Parking Meter

Adding QR codes to all of the parking meters offers an important way for users to select and pay for their parking spot and is something that is needed for the application to have full functionality.

Simplicity

The ability for a person to scan a QR code, which links them to their specific parking space would be a simple for both the users and developers. Scanning the QR code would allow users to use their camera to scan the barcode of their space location, which would prompt them to open the parking mobile application, and they could then easily pay for their parking session.

Cost-Effectiveness

Addition of this feature to the mobile application would be very affordable integrate into Detroit's current parking system, as it would only require the addition weatherproof stickers with unique QR codes to be assigned to each of the parking spaces.

Reliability

Reliability of this feature would be dependent on ability of the QR codes to withstand the elements and the device's ability to capture a clear image of the QR code. If the QR code is not scannable,

there will also be a unique number displayed on the electronic screen associated with each individual parking space.

Sustainability

Adding QR codes to already existing meters would be a quick and easily a long term solution for the parking app. It would not be hard to replace them if they somehow were destroyed which would be unlikely if they were high-grade weather-proof stickers.

Feature Five: Real-time Parking Map

A real time parking map is essential to meet one of the most common complaints of someone trying to park in a busy city: “Where are there open parking spaces?”

Simplicity

A real-time interactive map displaying available spaces would make the parking process incredibly simple for the user by allowing users to quickly view available spaces, saving them from wasting time circling around looking for a space and would further reduce traffic congestion.

Cost-Effectiveness

A real-time parking map would require the addition of sensors to each parking space. Although adding sensors to each parking space would require a somewhat substantial upfront cost, the sensors would provide real time parking availability, which would further open up the capability to determine which parking spaces are used most frequently. The data of available parking spaces may allow for Detroit to adjust parking rate prices, which would complement demand, by increasing rates in areas that are congested with cars and decreasing rates in areas where people are not parking at all. This may cause a shift in where people decide to park until there is available parking in all areas. Over time, increased parking rates in areas associated with this feature offer potential to bring economic growth to WSU and Detroit.

Reliability

The sensor technology required to detect real-time availability of individual parking spaces must be reliable. These sensors must be able to endure the harsh weather conditions of Detroit, and must also consistently provide accurate parking space availability data. Failing sensors would cause the application to lead drivers to a parking spaces with availability that they had not expected, which may cause frustrations.

Sustainability

The decreased traffic congestion accompanying this feature and would produce a positive effect on the environment by reducing unnecessary vehicle emissions.

Feature Six: Parking Notifications

In this fast-paced society, people continually rely on their mobile applications to keep them updated with up-to-the-minute information.

Simplicity

The development and integration of this feature would be relatively simple, as adding a notification functionality would only require the application to set a timer to alert a user that their parking session is nearing expiration. The user experience would be incredibly simple, they would pay for their parking session, and when their expiration is approaching, would be prompted with options to allow the session to end, or add more time. Combining this feature with the one tap pay feature would allow users to quickly and easily add time to their expiring session.

Cost-Effectiveness

The development of a function to notify users of their expiring parking would require a minor upfront cost for the time of development, however, once this feature is integrated into the application, it would prompt users with the option to either to add more time remotely, which is would provide additional revenue to the city of Detroit

Reliability

There are many reviewers of Parkmobile from the Apple App Store who stated that the notifications did not work properly. A reliable integration of this feature would require an extensive testing process to ensure it delivers notifications accurately. Any issues encountered with notifications would need to be addressed by updating the application to flawlessly provide notifications

Sustainability

There was no significant research to back up how long-term this solution is, but we can reasonably assume that this feature solves a problem well which means it should be sustainable in the long run. Additionally, it seems that mobile phones will stick around for a while, so we do not have to worry about notifications phasing out over the next couple years.

Conclusion: A Quick Recap of This Study

As we near the end, let us quickly walk through what we have laid out in this study. The city of Detroit has recognized the existing parking meter problem and has started taking action to fix it. As a result, Detroit is in the early stages of implementing new electronic parking meters, which will cover most parking spaces throughout the streets of Detroit. As of yet, we have not seen whether or not the city has an application created or in the works.

After thoroughly researching existing mobile parking solutions, we have concluded that the easiest route for implementing a fully functional application, in a very short time, would be to use an already established service such as PayByPhone or Parkmobile as previously explained. Although these applications work and would create a relatively usable parking system, we argue that they will not save the city any money or generate more revenue in the long run because of the pricy convenience fees they charge. Since these applications do not collaborate well with the city, citizens parking in the area will inevitably be frustrated with the application if they get ticketed for a parking spot they paid for.

A better solution would be to choose to collaborate with our university's diverse talent to create a custom, ideal parking application. Not only would you create an application that works well for your current needs, but you would be able to start implementing the new application on the Wayne State campus streets as the initial testing ground for the new application and new features. Ideally, you would incorporate the six major features we suggest within this study because they voice the strong opinion of the current student body and they offer a powerful mobile solution to parking payments. Features which include one tap payments, easy ticket fine payments, extended parking time rates, QR code parking meter, real-time parking map, and parking notifications.

Collaborating with our university like this offers you many strong benefits: Not only will you be strengthening your relationship with the university, but you would also be potentially saving millions of dollars in development costs by having the university create the application. Additionally, this solution would allow you to test the application on the campus of Wayne State first. Why would you want this? Since students tend to be more tech-savvy and have a much shorter learning curve when adopting technological ideas, you can recruit them to test the new features. Also, testing the application on campus allows you to make sure the application is fully ready to be implemented city-wide. Finally, collaborating with the university would be a significant financial advantage if you consider that the available applications like Parkmobile charge nearly fifty cents on top of the parking cost.

Recommendation: Our Informed Opinion

After thoroughly analyzing and synthesizing our research, we strongly recommend you bring a mobile parking application developed through the university to the Wayne State community. Not only do we recommend you bring a parking application, but we also strongly suggest you adopt most (if not all) of the features we outlined in this study. Why? First, doing so will further solidify Wayne State and Detroit's relationship allowing the city to enhance urban learning and the school to contribute to urban growth. Second, doing so will inevitably satisfy the current student's frustration with the parking system and give them the power to change it. Finally, adopting a modern solution to a historical problem (parking) has the efficacy of drawing new and diverse talent to our regenerating city and expanding university. Your next step would be to open up a discussion with the Campus Technology Leaders Council to discover cost and begin planning.

Appendix A1

Summary of the results from the survey that targeted 100 WSU students regarding various background questions.

Do you live on Wayne State University's campus or do you commute?	Students
<i>On Campus</i>	15
<i>Near Campus (No Drive Required)</i>	11
<i>Commute</i>	74

Have you ever used a mobile application to pay for parking?	Students
<i>Yes</i>	4
<i>No</i>	95

How often have you used parking meters around Wayne State University?	Students
<i>Never</i>	31
<i>Rarely</i>	30
<i>Occasionally</i>	31
<i>Very Often</i>	8

Do you own a smartphone?	Students
<i>Yes</i>	100
<i>No</i>	0

Have you encountered any broken parking meters around Wayne State University?	Students
<i>Never</i>	17
<i>Rarely</i>	12
<i>Occasionally</i>	23
<i>Very Often</i>	48

How likely are you to use a mobile application on your smartphone to pay for a parking spot?	Students
<i>Never</i>	15
<i>Rarely</i>	24
<i>Occasionally</i>	34
<i>Very Often</i>	27

How often do you use the Wayne State Mobile application on your smartphone?	Students
<i>Don't Have It</i>	18
<i>Never</i>	8
<i>Rarely</i>	15
<i>Occasionally</i>	23
<i>Very Often</i>	36

How often do you have change available to be able to pay for parking?	Students
<i>Never</i>	21
<i>Rarely</i>	43
<i>Occasionally</i>	23
<i>Very Often</i>	13

Appendix A2

Summary of the results of the survey that targeted 100 WSU students regarding the features that were most desired to implement in a mobile parking application. They were asked to rate each feature on a scale of 1-10. 1 was the least desired, 5 was neutral, and 10 was most desired.

Features	Desirability
Payments by credit card/PayPal from the mobile application	7.16
Payments of ticket from the mobile application	7.29
Option to scan a QR code, which would immediately link application to parking space	7.07
Real time map including locations of available parking spaces	8.67
Notification warning of expiring time via smartphone	8.49
A tap and pay option, such as (Apple Pay) to pay for parking from application.	7.32
Integration of application into vehicle navigation systems	6.52
Option to pay a premium price to extend parking time past maximum limit to avoid a ticket	7.65

References

- Anderson, P. V. (2014). *Technical Communication: A Reader-Centered Approach* (8th ed.). Cengage Learning.
- Apple. (2015). ParkChicago on the App Store on iTunes. Retrieved April 24, 2015, from <https://itunes.apple.com/us/app/parkchicago/id686658594?mt=8>
- Apple. (2015). Parkmobile on the App Store in iTunes. Retrieved April 24, 2015, from <https://itunes.apple.com/us/app/parkmobile/id365399299?mt=8>
- Apple. (2015). PayByPhone Parking on the App Store on iTunes. Retrieved April 24, 2015, from <https://itunes.apple.com/us/app/paybyphone-parking/id448474183?mt=8>
- Badger, E. (2014, March 19). Detroit spends more money issuing parking fines than it collects from them. Retrieved April 24, 2015, from <http://www.washingtonpost.com/blogs/wonkblog/wp/2014/03/19/detroit-spends-more-money-issuing-parking-fines-than-it-collects-from-them/>
- BCD Group. (2015). Parkmobile. Retrieved April 24, 2015, from <http://www.bcdgroup.com/en/parkmobile/>
- Campus Technology Leaders Council - Computing & Information Technology - Wayne State University. (2015). Retrieved from <http://computing.wayne.edu/about/ctlc.php>
- Cato, J. (2014, January 11). Pittsburgh's parking kiosk system pays off. Retrieved April 24, 2015, from <http://triblive.com/news/alleghey/5004713-74/parking-authority-plate#axzz3W dElf17D>
- Chicago Parking Meters, LLC. (2014, May 28). Chicago Parking Meters. Retrieved April 24, 2015, from <http://chicagometers.com/>
- Chicago Parking Meters, LLC. (2014). ParkChicago. Retrieved April 24, 2015, from <http://parkchicago.com/>
- City of Detroit's Website. (2015). Retrieved from <http://www.detroitmi.gov/>
- Detroit City Council Standing Committees Information. (2015). Retrieved from <http://www.detroitmi.gov/How-Do-I-Find/City-Council-Standing-Committees-Information>
- Detroit Free Press. (2015, March 25). High-tech Detroit parking meters to offer choice. Retrieved April 24, 2015, from <http://www.freep.com/story/news/local/michigan/detroit/2015/03/24/new-detroit%20-meters/70401508/>
- Detroit Municipal Parking. (2013). Agency Plan: Mission, Goals and Budget Summary. Retrieved March 26, 2015, from <http://www.detroitmi.gov/Portals/0/docs/budgetdept/2013->

14_Budget/Executive%20Budget_14/34%20EB%2013-14%20Municipal%20Parking_stamped(2).pdf

Detroit's New Parking Meters Will Utilize Your Car's License Plate. (2015, March 23). Retrieved from <http://detroit.cbslocal.com/2015/03/23/detroits-new-parking-meters-will-utilize-your-cars-license-plate/>

Google. (2015). ParkChicago - Android App. Retrieved April 24, 2015, from <https://play.google.com/store/apps/details?id=com.passportparking.mobile.parkchicago&hl=en>

Google. (2015). Parkmobile - Android App. Retrieved April 24, 2015, from <https://play.google.com/store/apps/details?id=net.sharewire.parkmobilev2&hl=en>

Google. (2015). PayByPhone - Android App. Retrieved April 24, 2015, from <https://play.google.com/store/apps/details?id=com.paybyphone&hl=en>

Houser, L. (2012, July 11). Birmingham Parking Meters to Go Mobile With Parkmobile. Retrieved April 24, 2015, from <http://patch.com/michigan/birmingham/birmingham-parking-meters-to-go-mobile-with-parkmobile>

International Data Corporation. (2015, February 24). Android and iOS Squeeze the Competition, Swelling to 96.3% of the Smartphone Operating System Market for Both 4Q14 and CY14, According to IDC. Retrieved April 24, 2015, from <http://www.idc.com/getdoc.jsp?containerId=prUS25450615>

Janacek, T. A., & Dejong, J. (2007, June 14). Patent US20070136128 - Method and System to Provide Electronic Parking Validation for Drivers Using a Pay by Cell Parking System. Retrieved from <https://www.google.com/patents/US20070136128>

Lord / Pittsburgh Post-Gazette, R. (2015, March 23). App could be used to pay at Pittsburgh parking meters, but could privacy issues arise? Retrieved from <http://www.post-gazette.com/local/city/2015/03/23/Phone-app-could-be-used-to-pay-for-parking-at-meters/stories/201503230009>

Mushell, J. (1995, August 15). Patent US5442348 - Computerized Parking Meter. Retrieved from <https://www.google.com/patents/US5442348>

ParkBoston App Expands After Successful Pilot. Retrieved April 24, 2015, from <http://www.govtech.com/dc/articles/ParkBoston-App-Expands-After-Successful-Pilot.html>

Parking and Transportation Services - Wayne State University. (2015). Retrieved from <http://parking.wayne.edu/>

Parkmobile. (2015). Parkmobile - Parking Made Simple. Retrieved April 24, 2015, from <http://us.parkmobile.com/#how-it-works>

- Passport Parking. (2015). PCI Compliance. Retrieved from <https://gopassport.com/pci-compliance/#certification>
- Passport Parking. (2015). Private Label Mobile Pay. Retrieved April 24, 2015, from <https://gopassport.com/privatelabel/>
- PayByPhone. (2013). NFC Parking in San Francisco. Retrieved April 24, 2015, from <https://paybyphone.com/san-fran-nfc/>
- PayByPhone. (2015). About Us. Retrieved April 24, 2015, from <https://paybyphone.com/about-us>
- PayPal. (2015). Use PayPal's App to Make Mobile Payments On The Go. Retrieved April 24, 2015, from <https://www.paypal.com/webapps/mpp/pay-with-app>
- PCI SSC Data Security Standards Overview. Retrieved April 24, 2015, from https://www.pcisecuritystandards.org/security_standards/
- Reddick, D. (1951). Parking Meters Yield \$50,000,000 a Year. In *Popular Science Monthly*. Retrieved from http://books.google.com/books?id=diEDAAAAMBAJ&pg=RA1-PA70&dq=popular+science+1951+%22bed+bikes%22&hl=en&ei=RQXETI7MHtC9ngee4ZA3&sa=X&oi=book_result&ct=result&resnum=1&ved=0CC8Q6AEwAA#v=onepage&q&f=true
- SFMTA. (2015). PayByPhone – SFpark. Retrieved April 24, 2015, from <http://sfpark.org/how-it-works/paybyphone/>
- SFMTA. (2015). SFpark. Retrieved April 24, 2015, from <http://sfpark.org/how-it-works/open-data-page/>
- Winchester, H. (2015, February 25). Local 4 Defenders reveal Detroit's plan to fix parking system. Retrieved from <http://www.clickondetroit.com/news/local-4-defenders-reveal-detroits-plan-to-fix-parking-system/31478434>