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Intelligent Parking Technology Adoption

A Dissertation submitted by

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Abstract

Inefficient parking practices have costs associated with them that extend well beyond lost profits and frustrated customers. This dissertation focuses on why parking providers appear hesitant in adopting Intelligent Parking Technology (IPT) that could help benefit all stakeholders. More specifically, this dissertation analyses the following question:

Why do parking providers appear reluctant to adopt intelligent parking technologies?

Intelligent Parking Technology (IPT) potentially offers drivers many benefits including faster parking times, more convenient payment options and safer parking lots. For parking providers, benefits of IPT implementation might include higher profits realized through increased business process efficiencies such as automated payment collection. Society could potentially benefit from IPT through primary effects such as reduced traffic congestion, greenhouse gas emissions and driver frustration levels. It may also benefit through secondary effects where, for example, a government uses profits realized through increased efficiencies and spends it on things that will benefit the community such as better roads and more green spaces.

We define Intelligent Parking Technology (IPT) as technologies that are managed by a parking service provider and add value by adapting themselves to whatever a parking situation may be. Intelligent Parking Technology (IPT) includes those technologies that offer a unique functionality such as giving customers the ability to pay for parking using their cellular telephone (m-commerce), automatically directs them to empty parking spaces or automates payment via smart cards.

The parking providers investigated include businesses, schools, and governments. We consider technologies currently available to them as well market willingness to adopt them.

The Delphi technique is used and consists of interviewing independent content experts such as parking services managers within various organizations. We also interview one senior level manager working for a company that licenses or sells Intelligent Parking Technology (IPT). Questions formulated from these interviews are then brought forward and

used in surveying drivers. Data is collected from the surveys and then analysed and interpreted through discussion with the independent content experts initially interviewed so that they may corroborate or disapprove the findings. Their interpretations of the data are also considered in the study, as this research is primarily qualitative in nature.

The driver survey included questions that explored the perceived value drivers might get from different parking technologies currently available to parking providers. Findings from the driver surveys clearly show that drivers are more than willing to adopt Intelligent Parking Technology (IPT).

In every case, the majority of drivers indicated that they would get at least some value from the specific parking technologies presented. This varied from a low of 60.9 percent of respondents indicating they would get value from a robotic parking system to a high of 94.7 percent indicating they would receive value from a system that would direct them to empty parking spaces.

Over 66 percent of drivers also stated that they would be willing to pay more for a parking space if Intelligent Parking Technology (IPT) added value for them.

The senior manager from the parking technology company was not at all surprised by the driver survey results. Parking providers, on the other hand, seemed somewhat surprised by the survey findings and the follow-up interviews where these findings were discussed seemed to initiate a state of reflection for them.

Keywords: Parking Technology, Adoption, Diffusion,

Certification of Dissertation

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

_____ _____

Signature of Candidate Date

ENDORSEMENT

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Signature of Supervisor/s Date

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Special thanks go out to those I interviewed and surveyed. Your time to help advance this research has not gone unnoticed. I only hope that your participation in this research is someday awarded with a realization that you helped make the world a better place or at least that someday soon you will be able to find your parking space quicker.

And last, but not least, I thank my family. My wife Lori and two children Christiane and Daniel deserve special mention for their unwavering support and belief in me. That is appreciated more than they will ever know.

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1 INTRODUCTION

1.1 Background and Significance of the Research

'Although it is sometimes disputed, Carl C. Magee, of Oklahoma City, Oklahoma, is generally credited with originating the parking meter. He filed for a patent for a "coin controlled parking meter" on May 13, 1935. The patent, #2,118,318, was issued May 24, 1938.' (Luttrell II 2001)

More than 70 years have now passed since the first patent application for a parking meter. Parking providers, however, still rely on parking meters even though it is in many ways an inefficient and inadequate technology for meeting the demands of today's parking industry. The same can also be said for many parking lots where we might see an attendant sitting idly by waiting for payment from drivers who are entering or leaving the lot.

With the price of a permanent parking space typically costing more than the price of a car in cities such as Hong Kong and total revenue from parking meters in cities such as Pasadena, California exceeding $2,000 per meter each year, it is easy to understand how profitable the industry can be (Wong et al. 2000; American Planning Association 2005).

The parking providers, typically departments within larger organizations that manage paid-for parking spaces, are like most other organizations in that they want to reduce inefficiencies and become even more profitable. Inefficiencies for the parking providers might occur through higher than necessary costs. For example, there are additional costs when the parking providers need to hire additional people to collect coins from meters, collect payment from drivers in parking lots, issue parking violations and maintain collection equipment. This they need to do while also having to contend with vandalism and theft from the meters.

For drivers, frustration occurs when they receive a parking ticket because their meter expired while they were running an errand or because they did not have any coins on hand to insert in the meter. In parking lots, frustration may stem from time wasted trying to find an empty space or having to walk to a self-serve kiosk during harsh weather in order to make a payment.

These are only a few examples of situations in the parking industry that can be improved on with the use of appropriate technology. Recently developed

Intelligent Parking Technology (IPT) could potentially deal with many of these issues.

These Intelligent Parking Technology (IPT) solutions can facilitate or enhance the parking process and may include, among many other things, giving customers the ability to pay for parking using their cellular telephone (m-commerce), automatically directing drivers to empty parking spaces or automating payment via smart cards.

For parking providers, what Intelligent Parking Technology (IPT) offers is the potential for significant savings and increased profits. Customers would also potentially benefit through increased value realized every time they park their vehicle. Examples of these technologies and some of the benefits they might promise include:

- *Technologies that facilitate the payment process.* These may include technologies that allow for payment by cell phone, key FOB or smart card:
    - Benefits for drivers include increased convenience through availability of different payment options and reduced stress resulting from assurances that a parking ticket will not be issued.
    - Benefits for parking providers include higher profits through facilitation of payment for a parking space as well as through reduced expenses related to the collection and processing of payments.
- *Technologies that directs drivers to empty parking spaces.* These may include signs or lights that direct drivers to empty spaces as detected by sensors or may even include other technologies such as those based on GPS technology:
    - Benefits for drivers include a faster and smoother parking process.
    - Benefits for parking providers include reduced traffic congestion, efficiency at maximizing parking space availability and attracting more drivers to use their parking lots over the competition.

    - Benefits for society include reduced traffic congestion, lower greenhouse gas emissions and less driver frustration and road rage.

- *Technologies that make parking lots safer.* These may include technologies that sense motion and as a result increases lighting in the parking lot. It may also include security systems that automatically detect suspicious activity by monitoring the movement of vehicles and people in a parking lot.

    - Benefits for the driver include personal safety and reduced vehicle break-ins and theft.

    - Benefits for parking providers include the potential of increased parking lot usage and reduced chances of liability claims from drivers.

Previous research on technology adoption is not accurate enough in its predictability to be useful in helping us determine why the parking industry appears reluctant to implement intelligent parking technologies (Rodier, Shaheen & Blake 2010, Chen 2008, Dewan & Chen 2005; Pedersen 2005, Townsend 2002, Zmijewska 2004).

Chapter 2 presents both established as well as more recent research on the adoption and diffusion of technology. However, none of this research specifically includes or refers to the unique characteristics surrounding its adoption and diffusion into the parking industry. As such, it would be dangerous to assume that the existing research on adoption and diffusion of technology would accurately apply to an implementation of IPT by the parking industry.

Many intelligent parking technologies currently available to the parking providers have already existed for several years. Their apparently slow adoption rate however, is only recently encouraging research focusing specifically on this and surrounding issues. As such, there are significant gaps in existing research focused on adoption of new technologies as it pertains to this industry.

1.2 Research problem, research issues and contributions

Intelligent Parking Technology (IPT) holds the promise of increasing value for the customer and profits for parking providers. Its implementation within the parking industry worldwide, however, does not appear to be

occurring to the degree one might expect. This observation, coupled with a literature review (see chapter 2 for details) and convergent interviews with parking providers, drivers and parking technology owners (see chapter 3 for details) has led to the investigation of the following **research question**:

Why do parking providers appear reluctant to adopt intelligent parking technologies?

Research is first done in the context of existing theoretical models that study the adoption and diffusion of technology. We take this approach, as we assume that adoption of intelligent parking technology by drivers would have a direct effect on the adoption of this technology by the parking providers. After all, it is reasonable to expect that parking providers would only consider adopting a technology if it had an economic benefit to the organizations' bottom line and that this would be realized through drivers' willingness to use the technology.

Finding an answer to the research problem begins with consideration of existing research that may shed light on the research problem. Han (2002) discusses the major existing adoption and diffusion models used for technology. These models are presented in Table 1.1 and 1.2 below and the approach each model takes is summarized. These models are used to help us further understand the factors that might influence adoption of Intelligent Parking Technology (IPT) by both the parking providers as well as their customers.

Table 1.1 – Adoption Models

Model	***Author***	***Approach***
Theory of Reasoned Action (TRA)	Fishbein and Ajzen, 1975	General model for studying technology acceptance levels.
Technology Acceptance Model (TAM)	Davis, 1989	Studies adoption of specific technology through ease of use and perceived usefulness.
Theory of Planned Behaviour (TPB)	Ajzen, 1985	Used to study the link between behaviour and attitudes.

(*Adapted from*: Han 2002, p. 7)

Table 1.2 – Diffusion Models

Model	***Author***	***Approach***
Diffusion of Innovation (DOI)	Rogers, 1962	Used to study consumer behaviour by categorizing adopters of new innovations.
Bass New Product Growth Model	Bass, 1969	Used to study how consumer products are adopted.
Multi-Generation Technology Diffusion Model	Norton and Bass 1987, 1992; Bass et al., 1994	Used to study diffusion and technology substitution factors.

(*Adapted from*: Han 2002, p. 7)

Consideration of the many diffusion and adoption models and how they might apply to the parking industry gave rise to the following specific research issues that we gather data about in order to satisfactorily address our research problem.

For clarification purposes, they are clustered here into different categories as they relate to our constructs:

1.2.1.1 Customer Factors Affecting IPT Adoption by the Parking Industry

Research Issue 1:

What can intelligent parking technology offer to the customer?

Research Issue 2:

Are parking customers willing to adopt intelligent parking technology?

1.2.1.2 Parking Provider Factors Affecting IPT Adoption by the Parking Industry

Research Issue 3:

What can intelligent parking technology offer to the parking providers?

Research Issue 4:

Are parking providers willing to license intelligent technology? And why?

Research Issue 5:

How might future technological advances render newly implemented parking technology obsolete?

1.2.1.3 Technological Factors Affecting IPT Adoption by the Parking Industry

Research Issue 6:

What intelligent technologies are available and accessible by the majority of parking customers?

Research Issue 7:

What are suitable technology interfaces for customers and parking provider employees?

Research Issue 8:

How will intelligent parking technology integrate with the various parking methods available to drivers?

1.2.1.4 Other Factors Affecting IPT Adoption by the Parking Industry

Research Issue 9:

Who *really* makes the decisions to adopt new technologies for the parking provider?

Research Issue 10:

What motivates a parking provider to follow through on adoption of a new parking technology?

Research Issue 11:

What are the real and perceived relationships between technology companies, parking providers and customers?

These research issues guide us in our pursuit of understanding the willingness or not of parking providers to adopt intelligent parking technologies. The focus of this research is on the parking industry only.

Contributions of this research may include insight into how best to increase efficiency of business operations for parking providers. This could lead to tangible benefits for all stakeholders and may include things such as higher profits, safer parking lots, reduced customer frustration and reduced impact on the environment. It may also contribute to existing research on emerging technologies specific to other industries facing similar challenges.

1.3 Justification for the research

1.3.1 Importance of parking technology research

If an organization were profit driven, then a move to adopt a technology that makes the operations more profitable would seem to be an obvious choice. However, managers still commonly resist implementation and use of computer systems that could create significant performance gains (Alavi & Henderson 1981; Davis, Bagozzi & Warshaw 1989; Nickerson 1981; Swanson 1988). Previous research on why people accept or reject computers has shown that it is a very challenging issue to understand. It has been studied in the context of many different factors including users attitudes, internal beliefs, external factors, user involvement, technical design, user involvement in the development process and even cognitive styles (Davis, Bagozzi & Warshaw 1989).

Although research on the parking industry likely sounds quite mundane to most people, it is important to realize that just as knowledge of databases, another potentially lacklustre topic, can lead to very significant profits and give an organization a competitive edge, knowledge of powerful technology available to the parking industry can also have the same effect. This is why this research is exciting and the topic needs to be further studied.

1.3.2 Gaps in literature

Research findings on computer system adoption are mixed and inconclusive and this may be due in part "to the wide array of different belief, attitude, and satisfaction measures which have been employed, often without adequate theoretical or psychometric justification" (Davis, Bagozzi & Warshaw 1989).

Because people and organizations are inherently different from one another it is easy to understand why a research model suited to one industry may not apply to another. This is especially true when the research models are primarily based on characteristics unique to the individual. The lack of strong and specific organizational technology adoption theory as it pertains to the parking industry can be explained by these differences existing between various organizations and the people that work within them.

Although there has recently been a significant amount of research in the area of intelligent technology adoption in the health care field, this has not been the case for what is the focus of this research: the parking industry.

Studies that consider technology adoption often cite the need for more research in the area and often these recommendations are for similar research to be done in different companies and under different circumstances.

For example, Goodhue and Thompson (1995) who developed the Task-Technology Fit model suggest that future research expand the scope of testing across more diverse settings and they state that there is still ample room for improvement in construct measurement.

De Moor et al, (2010) recognize that the role of the technology user with regards to technology has changed over time and that as a user; they have become an important stakeholder. They go on to state that having clear insight into users' needs and experiences has become indispensable and yet there continues to be a lack of tools to enable context and co-creation research in living labs.

Acemoglu et al. (2008) developed a framework for the analysis of the relationship between contractual incompleteness, technological complementarities, and technology adoption. This is interesting as it may apply to the parking industry; however the model they present assumes that all activities are symmetric. The authors then go on to emphasize the need to see if similar results to would be obtained under different conditions. They also state the importance of investigating whether the relationship between contracting institutions, technological complementarities, and the choice of technology is different when different approaches to the theory of the firm, such as managerial incentives are used (Acemoglu et al. 2008).

Another recent study by Ammenwerth (2006) states that although factors of IT adoption have been largely discussed in the literature, existing frameworks such as TAM and TTF are failing to include one important aspect: the interaction between user and task. The authors develop the FITT framework based on the retrospective analysis of the adoption of a nursing documentation system and state that although they expect it to be valid for other setting, this still needs to be verified (Ammenwerth 2006).

Frambach et al. (2002) developed a framework that addresses the adoption decision at the organizational and individual adopter levels. However, they state that there is still a need for studies to be carried out in "different organizational settings and for different types of innovations" (Frambach et

al. 2002).

As such, we feel this research is justified. The parking industry is very large and there are simply too many potential gains to be made for all stakeholders for this research to be ignored or cast aside.

In the parking industry, adoption of intelligent parking technologies appears to be happening at a very slow pace. Existing technologies such as cell phone payment systems, camera networks that track individuals and vehicles, systems that use smart cards for accessing lots, automated parking systems integrated with lighting and security, wireless transmitters for accessing lots, robotic parking systems, satellite based information systems, internet enabled meters, GPS enabled camera based ticketing systems are rarely seen even though they do exist and are readily available for implementation by parking providers.

If we assume that parking providers are, like many other organizations, constantly searching for new ways of potentially increasing efficiencies for their organizations while simultaneously providing more value for their customers, then we must ask ourselves why they appear hesitant in adopting Intelligent Parking Technology (IPT). We must also ask how existing research on technology adoption currently applies to this industry and then build on this.

1.3.3 Benefits of outcomes

The goal of this study is to help the parking providers reflect on the factors that may be holding them back from adopting intelligent parking technologies. Awareness of these factors allows them to face and address them. This, in turn, hopefully assists them in becoming more efficient, which could lead to increased profits and more satisfied customers.

This study helps provide us with new insight into best practices for parking providers considering implementation of such IPT in their day-to-day operations.

The less obvious benefits tied to this study are those indirectly linked to increased efficiencies to the parking process. These may include faster parking times, reduced traffic congestion and even lower greenhouse gas emissions.

1.4 Brief Overview of Research Methodology

This study on the adoption of intelligent parking technology is explanatory in nature and as such, we focus our research around the independent content expert, a senior manager of a parking services department within an organization that manages paid-for parking spaces. The study is conducted in a Canadian context.

The Delphi Technique, developed in the 1960s by Rand Corp., was chosen for this qualitative study because there is a lack of hard data available to help us forecast adoption of intelligent parking technology by parking providers and it accommodates recognition of the value of the parking providers' experience, intuition and opinion (Murrow 2005).

We began by interviewing a few key content experts in order to help us explore our research issues and how these might apply to our constructs. These content experts consisted of a random sampling of senior level decision makers within Canadian organizations that manage paid-for parking spaces. These organizations included municipal governments, airports, colleges and universities, as well as private firms.

We also interviewed one senior level manager from a company that is a provider of Intelligent Parking Technology (IPT). All interviews incorporated convergent and in-depth interview techniques.

After the interviews had been conducted, we came away with a broader understanding of the key research issues related to our constructs and were then able to proceed with formulating specific survey questions to ask drivers.

We then surveyed 133 randomly chosen drivers using a cluster sampling approach to keep time and administrative costs low. The natural clusters by type of parking space increases randomness while making it easier to find and survey actual drivers having experience parking a vehicle. Survey questions focused on past and potential future parking experiences to further help reduce any bias from creeping into the study. Data generated from the driver surveys was gathered and organized before being brought back to the content experts who reviewed it and, through discussion, helped interpret the findings.

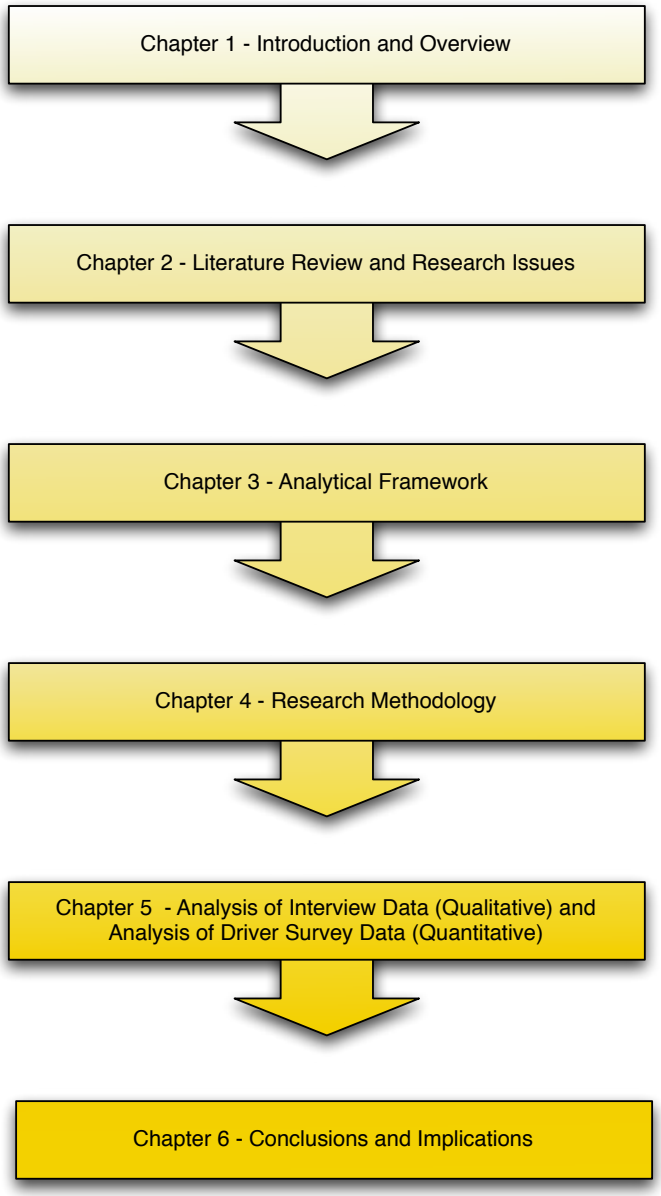
This approach allowed for triangulation of data and increased the credibility and validity of the results while enabling replication for theory generalisation. Triangulation gives us a balanced picture of the complex situation (Altrichter 2008; Cohen, Manion & Morrison 2000).

Ultimately, this research helps the content experts reflect on how intelligent parking technology might best suit their organizational needs and assists them in achieving their goals. Further details on the research methodology used can be found in Chapter 4.

1.5 Outline of this dissertation

An outline of this study is presented in Figure 1.1.

Figure 1.1 - Outline of the Study



Source: Developed for this research

Chapter 1 introduces the reader to the research problem and any necessary background information. The focus is on the parking industry and the research problem asks why parking providers appear reluctant to adopt Intelligent Parking Technology (IPT).

Chapter 2 consists of the literature review. Intelligent parking technologies available today, as well as those beginning to appear on the horizon, are considered. Established as well as more recent technology adoption and diffusion models help serve as a framework for our research and serves initially to guide us to an eventual understanding of why parking providers appear hesitant to adopt intelligent parking technology. Constructs are developed and research issues related to the constructs are formulated. Gaps in existing research are also identified.

Chapter 3 discusses the steps taken in the preparation, execution and analysis of the interviews with the parking providers and a senior member from a parking technology company. We refine the research issues and the theoretical framework for the research is explained.

Chapter 4 discusses in greater detail the research methodology used. The research in part consists of interviews with content experts (parking providers) and a senior manager from a company that provides intelligent parking technology to the parking providers. Based on information gathered during the interviews, we formulated surveys and had them completed by 133 randomly chosen drivers.

Chapter 5 consists of the data analysis. We gather all data from the interviews and surveys and bring this back to the content experts for discussion and interpretation. Findings are compared and contrasted through qualitative analysis of the transcribed interviews and the statistical results stemming from the surveys given to drivers.

Chapter 6 is where we present our conclusions. We point out implications the research has on theory, as well as for policy and practice. Limitations that may have become apparent during the progress of the research and any implications to future research are also discussed.

1.6 Key Definitions and Terminology

Research discussing parking technologies is often placed under the broad term of Intelligent Transportation Systems (ITS). Intelligent Transportation Systems (ITS) refers to any general effort to add information and communications technology to transport infrastructure and vehicles (Barfield 1998; Conroy 2000; Drane 1998; Figueiredo 2002; Fink 2002; Knaian 1999; Nam 1999; Palen 1997; Wang 2005).
This includes managed factors such as the vehicles themselves, vehicle loads, improved safety, transportation times and even fuel consumption (Wikipedia 2011).

These factors are all beyond those a parking provider would be responsible for implementing and managing. These systems may also provide information on available parking spaces, parking lot status, and traffic volumes (Barfield & Dingus 1998).

Other existing research uses the term "Smart Parking" (Lu 2009; Idris 2009), "Intelligent Traffic Guidance Systems (Lee 2008) or even "Intelligent Parking Systems" (Crowder 2003). However, these terms also potentially describe technologies beyond the control of the parking service provider.

While it is clear that there is a need for innovative approaches to transportation problems, which includes parking, the term ITS simply covers too many facets (Ghosh & Lee 2000). The other terms discussed above simply are not specific enough to technologies under the management and control of the parking provider.

As such, we define Intelligent Parking Technology (IPT) as a technology managed by a parking service provider that adds value by adapting itself to whatever a parking situation may be. We consider Intelligent Parking Technology (IPT) to be a subsection of the much broader ITS.

In the context of this study, this may include technology that lets customers know their parking meter is about to expire, is able to direct them to available parking spaces, or even be an m-commerce based system that allows for remote payment. M-commerce refers to ability to conduct business and services over portable wireless devices such as a cellular telephone (Senn 2000).

The independent expert is the person who makes decisions regarding parking technology implementation. They would typically be a senior

manager for a private parking firm or manager of the parking services department within a larger organization such as a university. The independent expert is typically an employee of an organization managing paid-for parking services, which we refer to as the parking provider.

Parking technology companies refer to companies that own, distribute or hold patents on intelligent parking technologies. Parking providers may need to work with parking technology companies when adopting new technologies for parking operations.

Other terms describing factors that influence adoption by both customers and parking providers alike include the following:

Security

- Wireless networks are particularly vulnerable to undetected intruders, attackers and eavesdroppers accessing confidential data. *Security* refers to the confidentiality of the data being transmitted. (Himmeisbach 2006)

Budgetary constraints

- Although deployment costs may be less than those for hard-wired networks, there are still initial costs for monitoring systems, transmitters and other hardware and software such as handheld devices used by parking meter ticketers. *Budgetary constraints* refer to implementation limitations due to insufficient funds. (Jutila, Kaukonen & Schmitgen 2001)

Compatibility

- Will the new technology work well within existing and future infrastructures? If so, it is said to be *compatible.* (Himmeisbach 2006)

Acceptance

- Will the technology be well received and *accepted* by users? (Gundanna & Agrillo 2000; Himmeisbach 2006); (Carpenter & Stima 1996)

Bandwidth

- What is the data rate or *bandwidth* the technology will support and is that enough to meet the needs of the organization and its customers? (Trotter et al. 1998); (Els & Kelly 2005)

Scalability

- Will the technology grow, or be *scalable,* with changing needs? (Jutila, Kaukonen & Schmitgen 2001); (Cyr & Simmons 1998) (Carpenter & Stima 1996)

Obsolescence

- Will the technology need to be replaced soon as newer and better technologies become available? (Jutila, Kaukonen & Schmitgen 2001) *Obsolescence* in this context might mean that the equipment driving the functionality of the system is no longer supported by industry.

1.7 Delimitations of scope and key assumptions, with their justifications

This study focuses on the parking industry and strives to include the input from the two primary types of parking providers preliminary research has shown typically exists.

The first of these include those where the parking provider behaves in a supporting role within their organization. An example of this might be an educational institution where parking spaces are provided for a fee. The parking services department exists to support the primary business of the organization, which in this case is education.

The second type of parking provider is typically privately owned and its primary business revenue comes from charging for parking spaces. This represents its primary - and often only - source of revenue.

Both types of parking providers can gain from increased efficiencies. However, their attitudes, beliefs, approach and intentions to adopting Intelligent Parking Technology (IPT) may differ based on the business model they follow.

An underlying assumption for this research is that, from the parking provider's point-of-view, intelligent parking technology adoption would correlate well with return on technology investment. This assumes that the technology really does add value and is well aligned with the goals and mission of the organization. A parking provider wanting to realize increased efficiencies and a distinct competitive advantage, would naturally appreciate having access to research that could help them better achieve this. This type of information would potentially be very valuable, as it

would result in increased profit margins and happier customers. For parking providers, the task of finding relevant information on parking technologies available to them and what benefits they may offer can be overwhelming. We hope to address this with this focused study.

The scope of this study is limited to examining reasons why parking providers appear reluctant to adopt intelligent parking technology. Even though adoption of such technology by customers or employees may play an important role in the decision of parking providers to adopt a new technology or not, we do not focus directly on these groups as they have different motivations for adopting a new parking technology than do the parking providers themselves.

We consider the rate of diffusion of the various intelligent parking technologies available today as this directly affects when parking providers may realize financial benefits from implementing such a new technology.

Individuals *interviewed* for this study include independent content experts such as parking services managers within private firms or large organizations including universities, airports or government. We also interview a senior level manager from a firm that owns and distributes intelligent parking technology (IPT). The administering of driver surveys follows interviews. Finally, findings from these surveys are gathered, reviewed and discussed with the content experts.

1.8 Summary

This chapter maps out the report that follows. A primer on the role of different technologies in the past, present and future as it applies to the parking industry has been briefly discussed. The research problem of why parking providers appear reluctant in adopting intelligent parking technology, as well as the issues surrounding this, have been presented. The need for this research has also been justified. Methodology to be used was briefly described and justified. The scope of the study along with limitations that may present themselves has also been discussed. Based on this, we now proceed into a more detailed description of the research.

2 LITERATURE REVIEW AND RESEARCH ISSUES

2.1 Introduction

> *As an industry, parking now accounts for billions of dollars and more than a million jobs each year, and as a profession, it is now a serious career choice. As such, it demands continuous information and specialized training* (International Parking Institute 2007).

> *Every day in Beijing an additional 1,466 cars are added the city's roads* (McDermott 2009).

> *Our unwise parking policies have damaged out cities, our economy, and our environment. ... Cities can charge fair-market prices for curb parking, return the resulting revenue to pay for neighbourhood public services, and remove the requirements for off-street parking* (Shoup 2005, p. 601).

Statements such as these give us an indication of the importance and value of research focused on helping the parking industry become more efficient. The parking industry has grown in size over the years as the number of vehicles on the road has increased worldwide. The adoption of technology to support it however does not appear to have grown at the same rate. For example, many parking providers still use the same type of coin operated parking meter that has essentially remained unchanged over the last 50 years and drivers continue to be frustrated with the task of having to park their vehicle.

Even though the majority of parking in the United States is free for motorists, society is in many ways subsidizing it through increased costs for everything else including the economy and environment (Shoup 2005). For example research in a 15-block area in downtown Los Angeles found that over a one year period, those cruising the streets looking for a free or low-cost parking space drove in excess of 1.5 million kilometres while consuming approximately 178,000 litres of fuel and producing more than 650,000 kilograms of carbon dioxide emissions (Shoup 2005).

Figures such as these reveal the staggering waste and inefficiency associated with the parking industry. Imagine what these numbers might be if we consider the waste on a global scale.

Herein lies an argument for paid parking which, among other things, has the potential to help reduce congestion, conserve energy, improve air quality and produce public revenue that can then be reinvested to improve urban areas (Shoup 2005).

Achieving this through near-obsolete parking technologies such as the parking meter would be cost prohibitive and likely impossible. However, with the proper use of efficient intelligent parking technologies (IPT), parking providers could help maximize the benefits realized from paid parking. These are benefits that extend far beyond increased profits.

There are some instances of IPT being implemented worldwide that achieve these benefits. These include a system at Heathrow's Terminal 5 that directs drivers to an empty parking space and then on the way home shows the driver a 3D map image on a screen indicating where the car is parked (roadtraffic-technology.com 2008).

Another IPT implementation guarantees that you will be able to park your car in 60 seconds or less even if it is in the last available space (Schick Electronic 2011).

There are pay-by-cell options available for parking in Miami, Florida (Verrus 2008).

Some parking lots use technology for security and enforcement purposes as well by tapping into existing closed circuit video cameras to automatically recognize licence plates (Park Assist 2011).

In Hong Kong, the Octopus smart card is used to transfer electronic payments in online or offline systems and can be used with on-street parking meters among other things (Octopus 2011).

However, such implementations of IPT seem few and far in between. It follows then, that there is a need for research that aims to understand why parking providers are not adopting, or appear hesitant to adopt currently available Intelligent Parking Technology (IPT). We are not referring to technologies, such as computer systems, that are only used internally within the parking providers' offices, but more specifically to those technologies that interact directly with the driver adding value to the parking process for them.

The two core processes we consider involve finding a parking space and then paying for it. Our primary focus is on the technologies that facilitate and make these two core processes more efficient. Of course many of the technologies available also add value in other ways. These may be related to the environment or driver safety for example.

Ultimately, we consider intelligent parking technologies that could significantly increase profitability for the organization while simultaneously increasing value for the customer and society as a whole.

As such, the purpose of this study is to investigate the following research question:

Why do parking providers appear reluctant to adopt intelligent parking technologies?

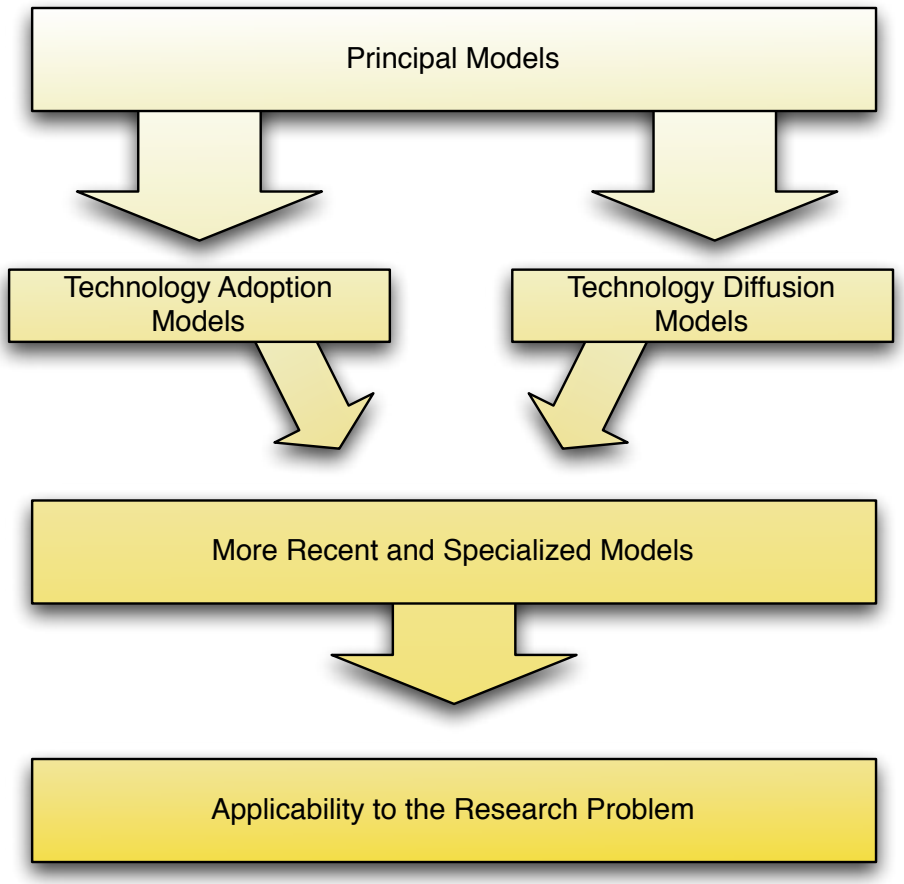
Rudall and Mann (2007) point out that the degree of "intelligence" in a system is very rarely defined, measured or specified in scientific terms. As such, we loosely define Intelligent Parking Technology (IPT) as technology that adds value by adapting itself to whatever a parking situation may be. It is technology that promises to help parking providers and customers more efficiently manage the vehicle parking process when compared to the more dated parking methods prevalent around the world today.

We begin our study of intelligent parking technology (IPT) adoption by parking providers in the context of pioneer studies that have focused on technology adoption. Diffusion models, which measure how quickly a technology dissipates through the population, are also considered as this has a direct impact on how long it takes to reach the financial break-even point. This diffusion rate is likely to significantly influence the parking providers' decision to adopt intelligent parking technology or not.

Although the more recent research on technology adoption for emerging technologies tends to be very specific with regards to different technologies and different industries, we consider it as it may also apply to the parking industry. What we find is that there are still gaps that present themselves with regard to those technologies and how they may apply to parking providers and the parking industry as a whole. Figure 2.1 provides us with a visual representation of the analytical structure of the literature review.

In order to investigate our research problem of why parking providers appear reluctant to adopt intelligent parking technology, we need to consider attitudes towards intelligent parking technology by drivers, parking technology companies as well as the parking providers themselves. These three groups are the primary stakeholders.

Figure 2.1 - Analytical structure of the literature review



Source: Developed for this research

In effect, we are considering previously proposed theories to see how applicable they are to the parking industry as a whole. We are also exploring to see how well they might apply to the three primary

stakeholders, each of whom has different reasons and motivations for using Intelligent Parking Technology (IPT).

Our focus in this study, however, focuses primarily on the adoption of intelligent parking technology by the parking providers.

2.2 Parent theories and classification models

2.2.1 Historical Development

Many theoretical models have been developed over the years in an attempt to explain user adoption of technology. Many of these theories were initially developed to help lead to a better understanding of human behaviour as there was a need to bridge the gap between humans and emerging technologies.

Organizations may then have attempted to apply these theoretical models to their own business processes in hopes of effectively introducing technology to its employees. Proper implementation and use of these technologies, it was assumed, would lead to an increase in profits. This, of course, assumed that the technology in question was well aligned with the goals and objectives of the organization.

Naturally attitudes and beliefs, as do new technologies, change over time. Theories on technology adoption have also evolved. The introduction of mainframe computers, desktop computers, wireless technologies and more recently m-commerce, has initiated the development of newer theoretical models focused on the adoption of these newer technologies.

2.2.2 Parent Theory

The major technology adoption and diffusion models discussed by Han (2002) are presented in Table 2.1 and Table 2.2. These models typically try to explain in broad terms which factors or combination of factors best explains why people accept or reject computers. The underlying theories behind these models typically consider users' internal beliefs and attitudes and how they might be affected by external factors such as system design, implementation or development process. They have resulted in mixed or inconclusive findings (Davis, Bagozzi & Warshaw 1989).

These parent theories are important as they help give us a better understanding of what factors might affect adoption of Intelligent Parking

Technology (IPT). However, they do not consider more recent technologies specific to the parking industry nor do they necessarily consider any attitudes or beliefs that may be unique to the parking industry.

The parent theories may also apply more to the consumer rather than the parking provider. The driver is, after all, the one who is likely the primary user of any technology the parking providers implement.

In this explanatory study, adoption and diffusion rates by the consumer - the vehicle driver - are only be one of the many factors influencing the decisions of parking providers to adopt an intelligent parking technology or not.

2.2.2.1 Major Adoption Models

The major adoption models are presented in Table 2.1. A more thorough discussion of them follows.

Table 2.1 - Adoption Models

Model	***Author***	***Approach***
Theory of Reasoned Action (TRA)	Fishbein and Ajzen, 1975	General model for studying technology acceptance levels.
Technology Acceptance Model (TAM)	Davis, 1989	Studies adoption of specific technology through ease of use and perceived usefulness.
Theory of Planned Behaviour (TPB)	Ajzen, 1985	Used to study the link between behaviour and attitudes.

(*Adapted from*: Han 2002, p. 7)

Many of the earlier adoption theories from social psychology such as the *Theory of Reasoned Action* (TRA) were chosen to study users' acceptance levels with regards to technology even though these models had never been applied in that way before (Fishbein & Ajzen 1975).

It is understandable that they had not been used to focus on technology adoption before as the primary technology most of us are familiar with today, the desktop computer, had not yet been introduced to the world at that time. That did not happen until 1976 (Berndt & Rappaport 2001).

It is not until many years later that a model was developed specifically to study technology acceptance. The *Technology Acceptance Model* (TAM) developed by Fred Davis in 1986 is an adaptation of *Theory of Reasoned Action* (TRA) and states that a persons' intention to use the computer, their ability to easily use it, along with how they perceive the usefulness of the technology, will determine its usage rate (Davis, Bagozzi & Warshaw 1989).

The *Technology Acceptance Model* (TAM) model has been used extensively in recent years for modelling user acceptance of computer technology and routinely explains up to 40 percent of usage intentions and 30 percent of systems usage (Burton-Jones & Hubona 2006, p. 706).

However, these percentages are probably not as significant as most implementers of technology would like to see and so researchers continue efforts to develop more accurate theoretical models regarding technology adoption. After all, a busy business manager is not going to want to spend time and effort studying and trying to apply existing research to their own operations unless it is reasonably clear they will succeed at adding significant value to what they are already doing.

The *Theory of Planned Behaviour* (TPB) model is yet another extension to the *Theory of Reasoned Action* (TRA) model and links attitudes and behaviour. It has its roots in the field of psychology. It was introduced by Icek Ajzen and essentially states, in the context of technology adoption, that the more favourable a persons' attitude and subjective norm are, combined with a high level of perceived control by that person, the more likely they will be to use the technology presented to them (Ajzen 1985, 1991).

It is logical to think that attitudes and behaviours play an important role in the adoption of new technologies, but how can these accurately be measured? Do attitudes and behaviour vary depending on the industry, the type of technology being used or even for which task it is being used?

These major adoption models appear to focus primarily on the end user of the technology. Although in this study we are not focusing primarily on the end user, their attitudes towards intelligent parking technologies absolutely need to be considered. Parking providers and parking technology companies need to know, after all, if and how many people will potentially be willing to adopt a newly adopted parking technology before they initiate the process to acquire and implement such technology.

2.2.2.2 Major Diffusion Models

The major diffusion models are presented in Table 2.2. A more thorough discussion of them follows.

Table 2.2 - Diffusion Models

Model	***Author***	***Approach***
Diffusion of Innovation (DOI)	Rogers, 1962	Used to study consumer behaviour by categorizing adopters of new innovations.
Bass New Product Growth Model	Bass, 1969	Used to study how consumer products are adopted.
Multi-Generation Technology Diffusion Model	Norton and Bass 1987, 1992; Bass et al., 1994	Used to study diffusion and technology substitution factors.

(*Adapted from*: Han 2002, p. 7)

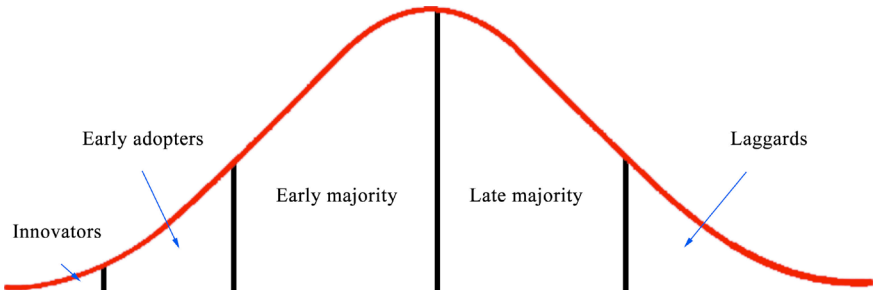
The Diffusion of Innovations (DOI) theory was first presented in 1962 by Everett Rogers and describes the *rate* at which innovations are adopted through the population (Rogers 1962). Rogers describes different characteristics about innovations that help explain their rates of adoption or how quickly they diffuse into the population. These include the relative advantage they offer over existing solutions, compatibility with potential adopters, their complexity, their ability to be experimented with on a limited basis, as well as the degree to which their benefits can be observed. He also points out that one cannot assume that all innovations represent equivalent units of analysis (Rogers 1995).

Rogers' also describes five adopter categories representing different groupings of people having similar levels of willingness to adopt a new technology relative to the others. The categories include the:

- *innovators,*
- *early adopters,*
- *early majority,*
- *late majority,* and
- *laggards*

The curve these categories create represents how new technologies typically diffuse across a population over time (Rogers 1995) (See Figure 2.2).

Figure 2.2 – Diffusion of Innovation



Another very influential study on technology diffusion is the Bass New Product Growth Model (Bass, F 1969). In 2004, 35 years after the model had been initially published, Bass describes how he was reading Rogers' Diffusion of Innovations study and decided to couple it with stronger mathematics to come up with a conditional likelihood of adoption where adoption at time *t* was a linear function of the number of previous adoptions (Bass, FM 2004). The Bass New Product Growth Model is a highly cited study popular in the areas of management science and marketing. In fact, it is recognized as one of the top 10 most influential papers ever published in the history of *Management Science* (Bass, FM 2004).

The *Multi-generation technology diffusion model* simply combines the *Bass new product growth model* with Fisher and Pry's (1971) *Technological substitution model*. The resulting model is one that considers diffusion and substitution factors (Norton & Bass 1987, 1992).

Diffusion rate is a very important factor for parking providers to consider as it helps them determine how quickly they will reach the break-even point on their intelligent parking technology investment.

2.3 Research problem theory

2.3.1 Theoretical Frameworks

A summary of more recent research, significant in that it may be applicable to the parking industry, is listed in Table 2.3 below. It demonstrates that there is more recent research regarding the adoption and diffusion of newer technologies. Interestingly, the trend for recent research appears to indicate a stronger focus on specific industries, much like this study does.

Information summarized in Table 2.3 allows us to more clearly see where there are gaps in existing research and how this may or may not apply to the parking industry. This leads us to develop a theoretical framework, which guides us in the development of constructs, research issues and propositions on which we focus our data collection. We first present this framework in section 2.3.4 and then in section 3.2, we expand and formally present it as our analytical framework.

Table 2.3 - More Recent Research & Models

Model	*Author(s)*	*Approach*	*Findings*	*Limitations*
Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh et al., 2003	Unifies eight of the more prominent models.	Able to account for 70% of the variance in usage intention	More complex than other models and geared more towards end-user. Not proven for application to parking industry.
No new model presented	Legris, Ingham & Collerette 2003	A critical review of the *Technology acceptance model* (TAM).	Three limits of TAM research to date because of the following: involving students, type of applications & self-reported use.	Presentation of findings limited to the general conclusion: in all groupings except one, the research findings were found to be heterogeneous.
No new model presented	Burton-Jones and Hubona, 2006	Builds on a study by Legris	Reveals that external variables *could* have direct effects on usage behaviour.	Potentially serious internal validity threat in that they did not control users' tasks while using their IT. Construct validity might also contain measurement errors.

Model	*Author(s)*	*Approach*	*Findings*	*Limitations*
Integrated model adding one trust related construct and two resources related constructs to TAM	Yi-Shun, Hsin-Hui & Pin 2006	Based on TAM, TPB M-Banking acceptance model	"Luarn & Lin's m-banking acceptance model can be generalized to predicting consumer intention of using m-services" (Yi-Shun, Hsin-Hui & Pin 2006, p. 176).	Potentially biased as data was collected from consumers that likely perceive m-services as being much more expensive than wire based e-commerce
Model of three latent constructs: Facilitating conditions, wireless trust, and intention to adopt wireless internet services via mobile technology	Lu, Chun-Sheng & Chang 2005	Looks at user intention to adopt wireless	Emphasises the importance of "trust" in m-commerce technology.	Study needs to be replicated to confirm findings.
Fit-Viability Model (FVM)	Liang and Wei in 2004	Combines fit and viability of technology	Framework for successful technology adoption	Specific to mobile technology. Not proven for application to parking industry.

Model	*Author(s)*	*Approach*	*Findings*	*Limitations*
Refined Fit-Viability Model (FVM)	Liang et al., 2007	Extend FVM and develop operable instruments for using the FVM	Now useful tool for assessing successful use of mobile technology in organizations	Specific to mobile technology. Nature of an industry may affect reliability of model. As such, it may not be applicable to the parking industry.
Rejection of superior new industrial technologies	Woodside, 1996	Looks at market failure of proven superior new industrial technologies.	Failure appears to be marketing related.	Would benefit from personal interviews and triangulation of data collection methods.
No new model presented	Biemans, 1989	Case research	Insufficient contact with third parties by manufacturers of superior new technology may lead to that technology not being adopted.	Not specific to parking industry and those technologies, but may be applicable.
Task-Technology Fit (TTF)	Goodhue & Thompson , 1995	Searched for better methods to assess the success of information systems beyond self-reported evaluations.	For IT to have a positive impact on individual performance, it must be used and it must be a good fit with the task it supports.	Utilization is not always voluntary.

Model	*Author(s)*	*Approach*	*Findings*	*Limitations*
Compass Acceptance Model	Amberg & Hirschmeier et al., 2004	Specifies a conceptual framework and the fundamental requirements for a service platform to cooperatively develop and provide situation-dependent mobile services.	Four dimensions that are relevant for an in-depth analysis of user acceptance: perceived usefulness, perceived ease of use, perceived mobility and perceived costs.	Focused primarily on mobile services only
No model presented	He & Lu, 2007	Reviews the literature on the acceptance of mobile business and tries to construct an integrated conceptual framework on m-business acceptance.	Identifies a need to integrate the theories and reach a common conceptual ground for further theory development.	Has not evaluated other potential factors

Model	*Author(s)*	*Approach*	*Findings*	*Limitations*
FITT framework - **F**it between **I**ndividuals, **T**ask and **T**echnology	Ammenwerth et al., 2006	Based on a literature study and a case study, authors developed the FITT framework to help analyse the socio-organisational-technical factors that influence IT adoption in a health-care setting.	FITT framework successfully used to support a structured retrospective analysis of the introduction of a nursing documentation system.	Has only been verified in a limited way within the health-care industry in Germany

Source: Developed for this research

As new technologies are being introduced and used in ways that were previously unthought-of, the need for more accurate and industry specific adoption and diffusion models emerges.

Research addressing this development includes a more recent attempt to unify eight of the more prominent models used to describe information technology adoption and diffusion. This resulted in what is called the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2003). Theoretical models used in the formulation of this new model include the TRA, TAM and DOI models mentioned in section 2.2.2, along with the *motivational model*, *a model combining TPB with TAM*, the *model of PC utilization* and the *social cognitive theory* (Venkatesh et al. 2003). It is important to note that many of these theories have their roots in sociological studies dating back to the early 1960s.

The UTAUT study neatly summarizes and discusses the role of moderators in each of the theoretical models (Venkatesh et al., 2003). In their analysis of these eight different models, the study shows that the variance of the eight models in explaining user intention to using information technology varies from 17 to 53 percent (Venkatesh et al., 2003).

In contrast, the new Unified Theory of Acceptance and Use of Technology (UTAUT) model explained user intention to use information technology with significantly higher accuracy. "UTAUT was able to account for 70 percent of the variance (adjusted R2) in usage intention – a substantial improvement over any of the original eight models and their extensions." (Venkatesh et al., 2003, p. 467).

This result is significantly higher than that for previous studies and the authors acknowledge that further research in this area might include different moderating influences such as different technologies (Venkatesh et al., 2003). Consequently, focusing on the unique characteristics of the parking industry may ultimately affect the accuracy of this models prediction of user intention towards intelligent parking technologies. Again, this study is qualitative in nature and as such we will not be quantitatively testing existing models, but rather will consider them in our quest to gain a better understanding of the current situation in the parking industry.

Other efforts to develop more accurate models that either parallel or build on existing models have been ongoing. One such case is Burton-Jones and Hubona's research that builds on Davis' *Technology Acceptance Model* (TAM) presented in section 2.2.2.1. Their research shows, contrary to the normally accepted assumption, that external variables *could* have direct effects on usage behaviour over and above their indirect effects (Burton-Jones & Hubona 2006). It also builds on a study by Legris et al. that found that in TAM studies, there was "no clear pattern with respect to the choice of the external variables considered." (Legris, Ingham & Collerette 2003, p.196).

A more recent study specifically focusing on user adoption and diffusion of m-commerce technology includes a new integrated model for predicting consumer intentions to use wireless service. This model based on TAM, TPB and Luarn and Lin's 2005 mobile banking acceptance model adds *perceived credibility*, *self-efficacy* and *perceived financial resources* to Davis' technology adoption model (TAM) and re-examines the relationships between the proposed constructs (Yi-Shun, Hsin-Hui & Pin 2006). The model is validated and from this the authors claim "Luarn & Lin's m-banking acceptance model can be generalized to predicting consumer intention of using m-services" (Yi-Shun, Hsin-Hui & Pin 2006, p. 176).

It is important to note however, that there may also be a bias introduced in this study as data was "collected from 258 users in Taiwan" and "most consumers in Taiwan perceive that using wireless m-services is much more expensive than using wire-based e-commerce" (Yi-Shun, Hsin-Hui & Pin 2006, pp. 157, 172). Should this theoretical model be used in a country

where consumers have a different perspective vis-à-vis wire-based and m-services, which includes m-commerce, then the validity of the model may be compromised.

Another recently developed theory discusses the importance of "trust" in m-commerce technology as a determinant for user acceptance and adoption. Based on a review of the literature, Lu, Chun-Sheng and Chang propose a model of three latent constructs: *Facilitating Conditions*, *Wireless Trust*, and *intention to adopt Wireless Internet services via Mobile Technology (WIMT)* (Lu, Chun-Sheng & Chang 2005, p. 17). The authors of this article do concede however that the study needs to be replicated to confirm the findings (Lu, Chun-Sheng & Chang 2005).

Woodside (1996) developed a model on rejection of superior new industrial technology. This model was developed based on a review of relevant literature and one set of data on channel and customer evaluations of new technology. His findings appear to revolve primarily around marketing issues including the difficulty of overcoming resistance in the marketing channel. He states that what is likely required is the development of hybrid marketing channel relationships (Woodside 1996). His recommendations on improving theories on customer rejection and acceptance of new superior technologies include triangulation of data collection methods and having face-to-face conversations with respondents (Woodside 1996).

Research by Liang et al. describes mobile commerce as any transaction made via mobile devices such as phones or personal digital assistants (PDAs). Although many studies have been published on the application of mobile technology, few have studied how a company decides on adopting mobile technology (Liang et al., 2007; Matskin and Tveit, 2001; Lee and Ke, 2001).

To address this, Liang, Matskin and Tveit recently refined a Fit-Viability Model (FVM), first presented by Liang and Wei in 2004, to become a useful tool for assessing successful use of mobile technology in organizations. However, they state that they are unsure as to whether the nature of an industry, or other factors, play roles in the model (Liang et al. 2007).

He (2007) conducts a review of the literature on technology adoption and finds that concerning m-business adoption, future research should aim at developing a comprehensive model for m-business and involve both conducting interviews and having questionnaires. This is something this research does and is not limited to only m-business IPT applications.

Amberg et al. (2004) introduce the Compass Acceptance Model (CAM), which is designed for the analysis and evaluation of user acceptance for mobile services. They identify four dimensions that are relevant for an in-depth analysis of user acceptance: Perceived usefulness, perceived ease of use, perceived mobility and perceived costs (Amberg 2004). The study focuses on supporting the development of mobile services and as such may potentially cover only one type of IPT implementation.

Goodhue and Thompson (1995) developed the task-technology fit model to better understand the linkage between information systems and individual performance. The authors suggest the model could serve as a diagnostic tool to evaluate if information systems in a given organization are meeting user needs. Although the study is a step in the right direction to providing a useful diagnostic tool, the authors admit their measures of characteristics of information systems and services were crude.

Ammenwerth et al. (2006) developed the FITT model to help analyse the socio-organisational-technical factors that influence IT adoption. However, this model was developed in a health care setting and has not been applied to the parking industry to test its effectiveness.

When smart card technology was first introduced as a payment method, it appeared that its rate of diffusion across the population would be greater than it had been for ATM or banker's cards. Perceptions were that a driving force to this success would be marketing managers making sure people were aware of the existence of the smart card and its specific and desirable functions (Antonides *et al.* 1998).

Two years later it seemed that smart cards had failed, particularly in the financial services industry, because they continued to be an application in search of a viable set of consumer needs to fill (Plouffe et al., 2000). This is another indication of how important proper marketing can be for organizations to realize successful implementation of a new technology.

2.3.2 Relationships

Applicability to the Research Problem

Most theories on adoption and diffusion of technology have to date been somewhat generic in nature. Even Bass, creator of the highly regarded Bass New Product Growth Model, stated in 2004 that “the fact remains that little is known about the relationship between stated intentions and actual

adoptions and even less is known about how to adjust stated intentions in individual cases to estimate market potential. In my judgement knowledge in this area can only be developed over time with the accumulation of experience in matching prelaunch stated intentions in individual cases, with all of the conditions surrounding the product and the market, with actual outcomes" (Bass, FM 2004).

In essence, his statement describes the contribution this research hopes to make as a result of efforts to gather information as it pertains to the parking industry. This is done by considering the limitations of existing theories as they apply to the research problem and through analysis and consideration of intentions of the customers, parking providers and parking technology companies.

For example, many studies state that in order to achieve consideration and further evaluation, information about the performance characteristics of a new superior technology needs to be overwhelming (Rogers and Shoemaker 1971; Soete 1985; Woodside 1996). After all, simply bringing a new technological innovation to market does not guarantee that it will replace currently used product service technology (Woodside 1996; Gatignon and Robertson 1989; Ram 1987; Sheth 1981).

Does this apply to intelligent parking technology and its adoption by parking providers? If a new parking technology, such as payment for a parking space using a cellular telephone is overwhelmingly more efficient, why is it still often not immediately considered for adoption? There are obviously other factors, beyond beneficial innovation, that play an important role in influencing whether or not a technology is adopted. To understand this, one can simply consider the non-diffusion of the more efficient Dvorak keyboard layout as compared to the more commonly used and less efficient Qwerty keyboard layout (Rogers 1995).

While it is true that some parking providers have already begun adopting various different intelligent parking technologies, diffusion through the parking industry appears to be quite slow. Not all leaders of organizations responsible for the administration of parking spaces are as forthcoming as the mayor of San Francisco when he stated on September 28, 2007 that: "feeding your parking meter with a cell phone is a no-brainer" (http://www.sanfranciscosentinel.com/?p=5464, 30 September 2007).

For parking providers, making the transition from old and out-dated equipment to Intelligent Parking Technology (IPT) is likely difficult as they might already be satisfied with existing business processes. It is financially and socially difficult to make a transition such as this as it requires

significant commitment and assumption of varying degrees of risk (Woodside 1996).

After all, in making such a transition, the parking provider would typically have to liaise not only with their customers, but also with those organizations providing and supporting the Intelligent Parking Technology (IPT).

Parking technology companies face a significant roadblock when *their* customers, the parking providers, do not fully understand the benefits that may come from adopting Intelligent Parking Technology (IPT).

Biemans' (1989) research concluded that manufacturers of new technologies often interact insufficiently with third parties during the development and testing stages of an innovative technology, and that this is one of the major causes of superior new technology not being adopted (Biemans, Hart & Reneman 1989).

The customer's customer (in this case the parking providers' customers) has a critical influence on whether a technology innovation is adopted or not (Woodside, 1996; Imparator and Harari 1994). Consequently, it might be necessary for the marketer of a technological innovation to recruit *them* to champion the new innovation.

In the context of intelligent parking technology adoption, this means that the driver who will be using the intelligent parking technology becomes very valuable to the parking technology company in their efforts to sell or license technology to the parking providers.

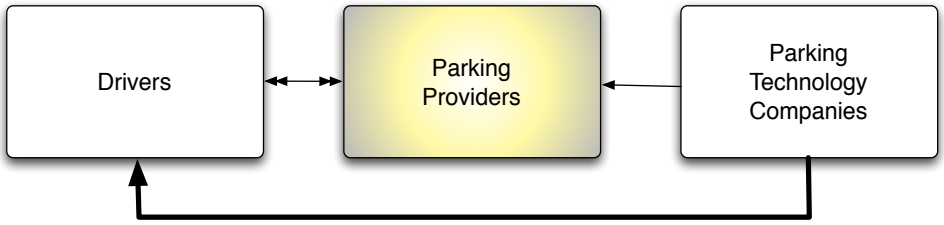
2.3.3 Propositions

Consideration of the following two propositions contribute to answering our research question by helping us better understand the relationships that exist between the different stakeholders in the parking industry. I propose that the nature of these relationships has significant influence on the adoption and diffusion of intelligent parking technologies.

Proposition 1: Parking technology companies can benefit more from using a "pull" marketing strategy rather than a "push" strategy.

If parking technology companies inform drivers of the benefits of their proprietary Intelligent Parking Technology (IPT), drivers may want it and may request it from the parking providers (See Figure 2.3). This marketing strategy is different from a push strategy where the parking technology companies simply try to push their products on the parking providers (See Figure 2.4).

Figure 2.3 - Visual representation of parking technology companies using drivers to "pull" their products through parking providers



Source: Developed for this research

Figure 2.4 – Visual representation of parking technology companies "pushing" their products on parking providers

Source: Developed for this research

Proposition 2: Parking technology companies might benefit by forming alliances with suppliers of existing, and out-dated, parking equipment.

Given that suppliers of out-dated parking equipment already have working relationships with the parking providers, it might be beneficial for parking technology companies to form alliances with them in order to more easily get their products/services adopted by the parking providers (See Figure 2.5).

Figure 2.5 – Visual representation of a parking technology company forming alliance with existing supplier of parking equipment in order to gain access to parking providers

Source: Developed for this research

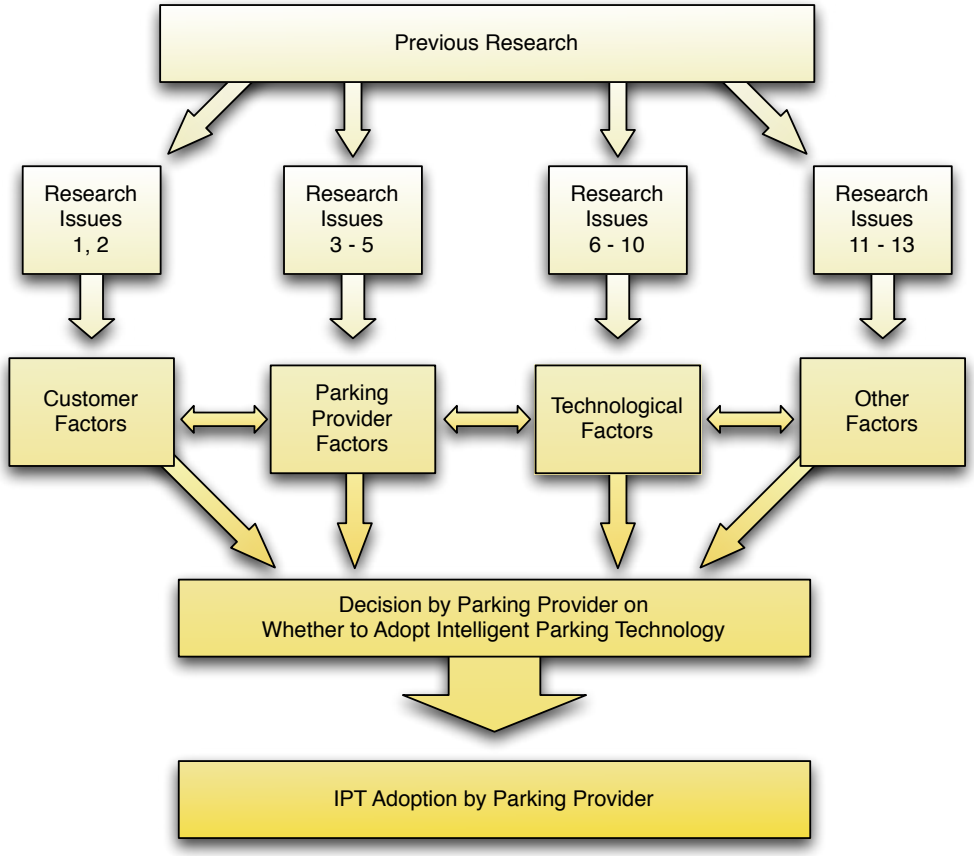
Application of both propositions by the parking technology companies would result in maximizing push and pull marketing benefits.

2.3.4 Constructs

We have developed four constructs that we believe will guide us to having a better understanding of why parking authorities appear reluctant to adopt intelligent parking technology.

It is previous research, combined with efforts to find answers to our research issues that will help us clarify our constructs. A better understanding of the influences each of the constructs has on parking providers then gives us insight into better understanding why parking providers appear hesitant in adopting intelligent parking technology. A visual representation of this theoretical framework is presented in Figure 2.6.

Figure 2.6 – Visual representation of Theoretical Framework



Source: Developed for this research

The four constructs for this study are as follows:

2.3.4.1 Customer Factors Affecting IPT Adoption by the Parking Industry

Our research of existing adoption models indicated that the end users' internal beliefs and attitudes are linked to their willingness to adopt a new technology (Fishbein & Ajzen 1975; Davis 1989; Ajzen 1985).

The *Technology Acceptance Model* (TAM) developed by Fred Davis in 1986 states that a persons' intention to use the computer, their ability to easily use it, along with how they perceive the usefulness of the technology, will determine its usage rate (Davis, Bagozzi & Warshaw 1989).

The *Theory of Planned Behaviour* (TPB) model links attitudes and behaviour. It essentially states that the more favourable a persons' attitude and subjective norm are, combined with a high level of perceived control by that person, the more likely they will be to use the technology presented to them (Ajzen 1985, 1991).

The Diffusion of Innovation (DOI) theory suggests five important determinants that would potentially help explain the diffusion of IPT's by parking providers. This of course assumes that driver willingness to use the technology is affected by the five determinants of relative advantage, complexity, compatibility, observability and trialability (Rogers 1995; Folorunso 2010).

Each of these determinants will fluctuate in value between drivers for various reasons. Drivers are the ones who pay for parking and it is reasonable to assume that what they have to say would be important to the parking providers.

We explore the factors that affect their attitudes and beliefs as previous research shows this will be important in the context of this study.

2.3.4.2 Parking Provider Factors Affecting IPT Adoption by the Parking Industry

Assuming parking providers operate like most businesses and seek increased profits and higher efficiency, we can ask what the key factors are for them regarding the potential adoption of IPT. Here we seek to learn how they might benefit from implementation of different technologies into their operations. As the parking provider would be the one making the initial purchase of any IPT and likely be responsible for managing it, the factors that affect them would seemingly be important to this study.

Previous research on adoption and diffusion could also potentially apply to them as it did to the end customer, the driver. Other previous research indicated that market failure of proven superior new industrial technologies appeared to be marketing related (Woodside 1996). There are parking provider factors that need to be looked at and considered more carefully in this study.

2.3.4.3 Technological Factors Affecting IPT Adoption by the Parking Industry

There are many different intelligent parking technologies available to the parking providers. Some of these are low-cost whereas others are complex and expensive. It is reasonable to expect that the relative advantage the technology provides over existing parking procedures, the difficulty of using the technology, its compatibility with the existing business model and business procedures, the degree to which the benefits of the technology are observable and drivers' and parking providers' opportunity to experiment with the technology on a limited basis will affect the parking providers' decision to adopt IPT or not (Rogers 1995; Folorunso 2010).

2.3.4.4 Other Factors Affecting IPT by the Parking Industry

A better understanding of the relationships that exist between all stakeholders in the parking industry as well as an understanding of how the industry is structured can help us better understand the reasons why the parking industry may be hesitant in adopting IPT. For example, previous research concluded that insufficient contact with third parties by manufacturers of superior new technology may lead to that technology not being adopted (Biemans 1989).

There may be also be unique factors affecting how the parking industry is structured, including the relationships between stakeholders that could help explain this apparently slow adoption of IPT by the parking industry.

These four constructs allow us to bring together various conceptual elements and a better understanding of their relevancy helps us address our research problem.

2.3.5 Research issues

The four constructs presented in Section 2.3.4 were developed based on our literature review and our initial interviews with the parking providers. From this, we identified thirteen research issues that would ultimately help us identify the determinants or unique factors that influence IPT adoption. The research issues below are presented by category as they relate to our constructs. Finding answers to these research issues helps us gain insight into each of our constructs which helps us address our research problem of why parking providers appear reluctant to adopt intelligent parking technologies.

A summary of the research issues as they relate to each of the constructs is listed in Table 2.4.

Table 2.4 – Construct and Research Issue Relationships

Construct	***Research Issues***
Customer Factors	1, 2
Parking Provider Factors	3 - 5
Technological Factors	6 - 10
Other Factors	11 - 13

2.3.5.1 Customer Factors Affecting IPT Adoption by the Parking Industry

Research Issue 1:

What can intelligent parking technology offer to the customer?

Many intelligent parking technologies available today would add value to the parking process for the customer. Of course this would depend on the nature of the parking situation and the technology itself, but these technologies primarily appear to focus on helping the customer find a parking space and facilitate the process of them having to pay for it.

There are many intelligent technologies currently available including the following that we feel would primarily add value to the parking process for the customer:

- A payment system that allows drivers to pay for their parking using their cellular telephone. (<http://www.new-parking.com/>, April 2007)(Chapman 2007)

- A network of cameras able to track individuals, as well as vehicles, in real-time through a parking lot. This could be used to direct drivers to empty parking spaces or even to track normal or potentially dangerous activities (e.g. thieves moving from vehicle to vehicle) (Micheloni, Foresti & Snidaro 2005).

- An electronic parking-payment system where drivers load value onto smart cards or other electronic device, then activate it with the zone/space they are parking in. Drivers then deactivate the smart card or electronic device when they leave so that they are only paying for the parking time they have used ('Tomorrow in Brief' 2004). (<http://www.otiglobal.com/>, May 2007) (<http://www.parkalbany.com/CashKey.aspx>, May 2007)

- Satellite based systems that send empty parking space information to the vehicles satellite radio (<http://www.engadget.com/2005/11/10/xm-shows-off-concept-for-tracking-parking-lot-openings/>, 10 November 2005).

- Internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a Radio Frequency Identification tab (RFID) in front of the meter (Lin 2006).

- Wireless sensor networks that guide traffic to an empty parking space (Lee, Yoon & Ghosh 2008).

Research Issue 2:

Are parking customers willing to adopt intelligent parking technology?

The majority of existing adoption and diffusion models revolve around the end-user of the technology in question. In the context of this research, this would mean the drivers themselves. Answers to this question likely influence the decision of the parking providers to adopt intelligent parking technology or not.

It is fair to say that in some cases intelligent parking technology will be forced upon users and in other cases, it will be left to them to decide if they use it or not. A parking technology that is mandatory for the driver to adopt will obviously have different adoption and diffusion rates than what it would be in the case where drivers are given a choice such as payment by cell phone or with coins.

2.3.5.2 Parking Provider Factors Affecting IPT Adoption by the Parking Industry

Research Issue 3:

What can intelligent parking technology offer to the parking providers?

Many of the intelligent parking technologies available today would help parking providers operate more efficiently. What the technology offers to the parking provider depends on the inherent characteristics of the parking spaces they manage.

Some of the intelligent technologies currently available that we feel would primarily add value for the parking provider include:

- Automated parking systems that allow parking areas to be controlled via access card and are integrated with lighting and security (Rothenberg & King 2004).

- The use of wireless transmitters to impose and track charges as a car travels through a gate (Rothenberg & King 2004).

- Robotic parking systems that move vehicles to a storage compartment and back without human intervention (Achilles 2005; Rothenberg & King 2004).

- GPS enabled cameras, attached to golf carts used by ticketers, which can read your license plate and determine how long you have been parked in that space (<http://www.wired.com/cars/energy/news/2005/09/68754>, May 2007).

- Parking meters that increase fees over time so that long stays become progressively more costly (<http://www.wired.com/cars/energy/news/2005/09/68754>, May 2007).

- Under pavement sensors that transmit data to notify of empty parking spaces which leads to an automatic resetting of the meter so the next driver needs to pay the full amount (<http://www.wired.com/cars/energy/news/2005/09/68754>, May 2007).

Research Issue 4:

Are parking providers willing to license intelligent technology? And why?

It is reasonable to assume that parking providers are be more than willing to adopt intelligent parking technology in their day to day operations if it adds to their margins while simultaneously providing more value to their customers.

Research Issue 5:

How do parking providers consider initial costs and payback period?

Parking providers have different reasons for adopting intelligent technology than do drivers. We consider the degree to which parking providers look to the customer and *their* willingness to adopt a new technology.

2.3.5.3 Technological Factors Affecting IPT Adoption by the Parking Industry

Research Issue 6:

How might future technological advances render newly implemented parking technology obsolete?

Depending on the particular parking scenario, the parking provider needs to consider many different factors. One of these considerations likely includes whether an intelligent parking technology is flexible enough to meet future demands.

Research Issue 7:

What intelligent technologies are available and accessible by the majority of parking customers?

The literature review coupled with input from the content experts helps determine which technologies currently exist that would be accessible to the majority of the parking providers' typical customers.

Research Issue 8:

What are suitable technology interfaces for customers and parking provide employees?

Interfaces can have a strong impact on whether or not a technology is adapted. Further exploration of a various number of intelligent parking technology interfaces is included in the study.

Research Issue 9:

How will intelligent parking technology integrate with existing parking meters?

Will modifications need to be done to the meter as would be the case when enabling the Internet to work with it, or might it simply involve putting a sticker on it with a meter ID number and phone number to call to register payment to a previously set up account?

Research Issue 10:

How will intelligent parking technology integrate with parking lots?

There are currently many unique situations in which people park their vehicles. Three of the most common include the use of parking meters, driver retrieval of a parking pass to park in a lot and attendant occupied parking lots/parkades.

2.3.5.4 Other Factors Affecting IPT by the Parking Industry

Research Issue 11:

How is the parking industry structured?

Parking providers represent organizations responsible for parking services. These may include municipal governments, universities and colleges, and private business.

It is important to understand that there are primarily two types of parking providers. The first is where the parking provider behaves in a supporting role within their organization. For example, the parking services department within a university exists to support the primary business of the organization, which in this case is education. The second type of parking provider is typically privately owned and its primary business revenue comes from charging for parking spaces. This often represents its only source of revenue.

Research Issue 12:

What is the typical process leading to adoption of new parking technology by parking providers?

This study takes the stance that the models presented in this literature review serve as a good starting point, but cannot be used alone to accurately predict whether or not a parking provider will adopt intelligent parking technology.

Observation of the parking industry indicates that there are still relatively few parking providers using intelligent technology today.

Research Issue 13:

What are the real and perceived relationships between technology companies, parking providers and customers?

Most intelligent parking technologies have patents on them. These patents are typically owned by parking technology companies who may want to sell or license out their technology to parking providers in order to recoup research and development costs. Doing so would allow them to be profitable and could potentially generate a significant revenue stream for them with little ongoing effort.

2.4 Summary

Chapter 2 reviews the parent and more recent theories relevant to the research problem with the goal of showing where our research problem fits in the existing body of knowledge. From there, we identify propositions, constructs, and research issues to explore further. These are summarized as follows:

Propositions:

- *Proposition 1: Parking technology companies can benefit more from using a "pull" marketing strategy rather than a "push" strategy.*
- *Proposition 2: Parking technology companies might benefit by forming alliances with suppliers of existing, and out-dated, parking technologies.*

Constructs:

- Customer Factors
- Parking Provider Factors
- Technological Factors
- Other Factors

Research Issues:

Research Issue 1:

What can intelligent parking technology offer to the customer?

Research Issue 2:

Are parking customers willing to adopt intelligent parking technology?

Research Issue 3:

What can intelligent parking technology offer to the parking providers?

Research Issue 4:

Are parking providers willing to license intelligent technology? And why?

Research Issue 5:

How do parking providers consider initial costs and payback period?

Research Issue 6:

How might future technological advances render newly implemented parking technology obsolete?

Research Issue 7:

What intelligent technologies are available and accessible by the majority of parking customers?

Research Issue 8:

What are suitable technology interfaces for customers and parking provider employees?

Research Issue 9:

How will intelligent parking technology integrate with existing parking meters?

Research Issue 10:

How will intelligent parking technology integrate with parking lots?

Research Issue 11:

How is the parking industry structured?

Research Issue 12:

What is the typical process leading to adoption of new parking technology by parking providers?

Research Issue 13:

What are the real and perceived relationships between technology companies, parking providers and customers?

Are existing technology adoption models, many of which are more than 35 years old, reliable enough to explain adoption of IPT by parking providers? Are the newer adoption models mentioned in section 2.3.1 more appropriate?

These are some of the issues that surface from this literature review and we see that there *is* a gap in existing research as it applies to this particular problem and that needs to be addressed. This gap in existing research is addressed by this study and using our propositions, constructs and research issues as tools, we further investigate our research question: Why do parking providers appear reluctant to adopt intelligent parking technologies?

3 ANALYTICAL FRAMEWORK

3.1 Introduction

As we saw in Chapter 2, the trend for recent research appears to indicate a need for a sharper and stronger focus on specific industries. Information gathered during our literature review showing the advantages and disadvantages of existing research as it might apply to IPT adoption by the parking industry leads us to develop our analytical framework, which we present in this chapter.

More specifically, this chapter discusses the steps taken in the preparation, execution and analysis of the interviews with the parking providers and senior member from a parking technology company. Key issues arising from the initial round of interviews and research literature are discussed and used to develop a questionnaire that is administered to drivers.

3.2 Interviews: Refinement of the Research Focus

In the exploratory stage of this research we asked questions to independent content experts (parking providers) with hopes that it would assist in the refinement of the research focus and help us determine how best to efficiently develop the study.

Convergent interviews with the independent experts began as fairly unstructured and proceeded with questions becoming more specific. As opinions surfaced, patterns began to show themselves. It is based on this, as well as the ethical guidelines of the Office of Research and Higher Degrees, that an outline of specific questions to ask drivers was developed.

When data from driver questionnaires had been collected, we went back to the independent content experts for follow-up interviews.

3.2.1 Interview Design and Preparation

The interview guide developed for interviews with the content experts (see Appendix B) was developed to help provide us with the first step to finding a solution to our research question.

Six content experts (parking providers) were chosen based on the characteristics of their particular organization and interviewed. These included a city municipality, a private parking company, two educational institutions, an airport parking provider and a sporting event coordinator.

Initial questions to the parking providers were quite general in nature as they were intended to give us an inventory of the interviewee's organization with regards to its structure, goals, culture, mission and vision. These questions were developed as a method to quickly understand the parking industry structure and the forces that were at play in it.

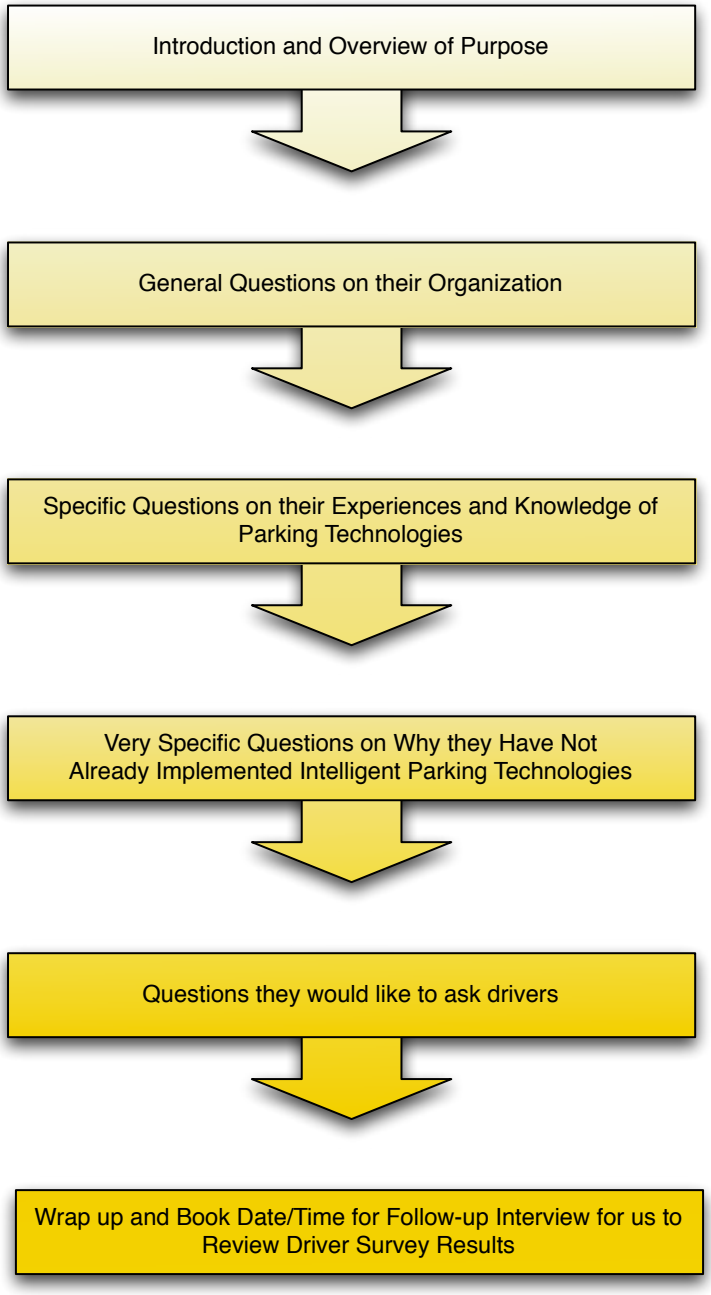
As we progressed, the questions became more focused on the parking providers current operations and explored any current or intended use of intelligent parking technologies.

Following this, the parking providers were asked to reveal any questions they would like to ask drivers. These might include questions where they had no idea how drivers would respond or simply questions to confirm any existing general assumptions they might already have about drivers and their preferences. These questions would serve as the foundation for the driver survey.

At the end of the initial interview with the parking providers, we agreed upon a date and time when we could meet to discuss the driver survey findings and any implications they might have.

Figure 3.1 outlines the steps taken during our initial interview with the parking providers.

Figure 3.1 – Steps Taken During Initial Interviews With Parking Providers



Source: Developed for this research

3.2.2 Data Analysis

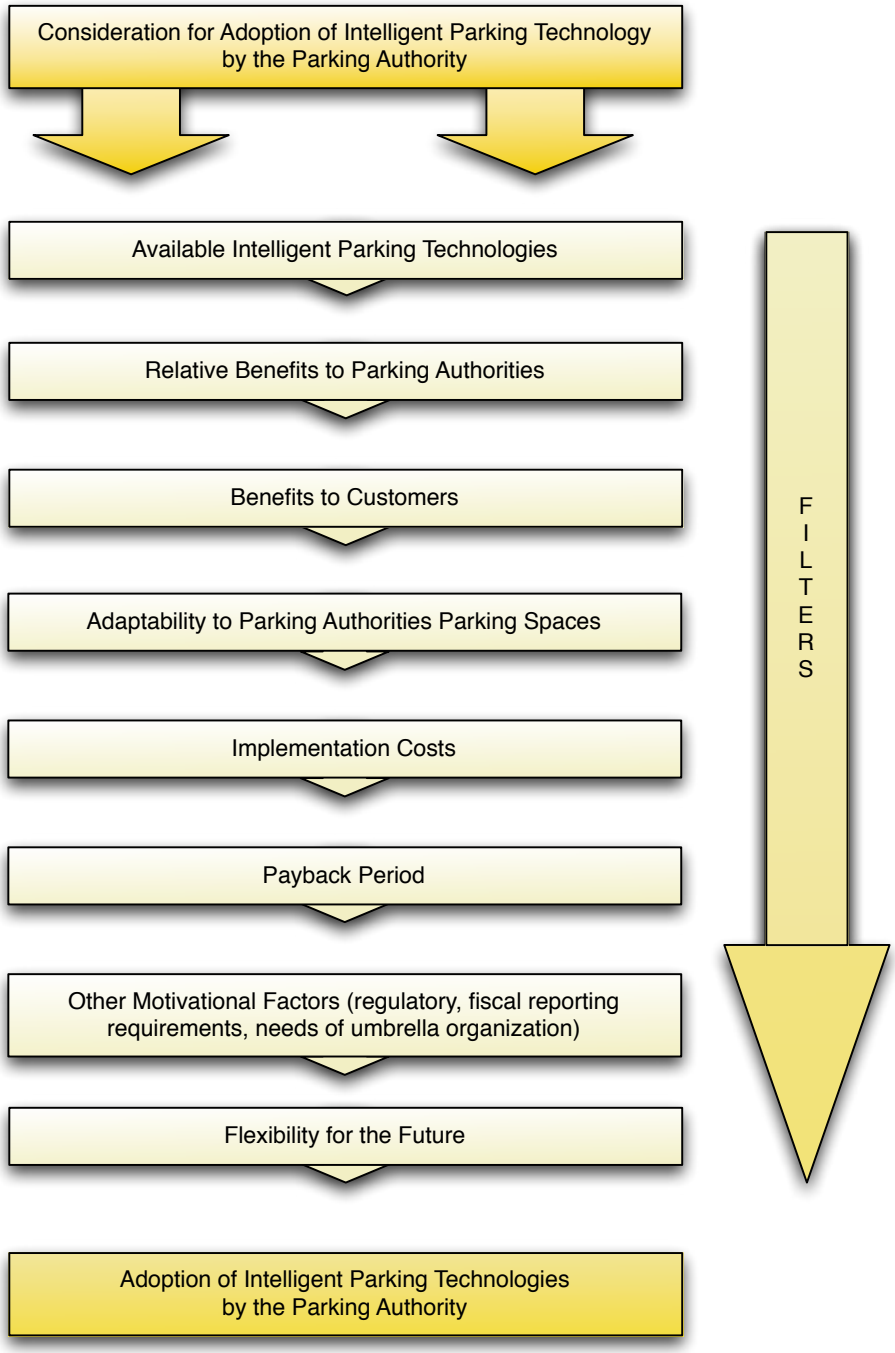
Interviews with content experts were voice recorded and comments were coded and then analytically categorized (see Appendix G). Comments regarding their organizational structure and how they see themselves fitting in the parking industry were brought together and compared. Similarities and differences between each of the parking providers were noted.

The same process was used for codifying the questions they would like to ask drivers. In an effort to keep the driver questionnaires limited to an acceptable number of questions, similar questions from different parking providers, as well as from the parking technology company, were given priority to appear on the survey.

3.3 Identification of Relevant Determinants

Initial interviews seemed to indicate that factors that might behave as filters to what will be an eventual adoption of an intelligent parking technology by the parking provider include those presented in Figure 3.2. This non-exhaustive list of factors presented in Figure 3.2 can in-fact be categorized as elements under one of our four constructs: customer factors, parking provider factors, technological factors and other factors.

Figure 3.2 – Filters to IPT Adoption



Source: Developed for this research

3.4 Presentation of Analytical Model

Interviews with the content experts and the parking technology company led to a better understanding of what factors might play a stronger role in helping us answer the research question:

> ***Why do parking providers appear reluctant to adopt intelligent parking technologies?***

These findings, some of which are presented in Figure 3.2, are used to refine the research framework in a way that offers more insight into why this appears to be the case. We also refine our research issues after our initial interviews revealed that the research issues could be further condensed.

Initial interviews with the parking providers and the parking technology company revealed that research issue 11 required clarification. Research issue 11 was vague and was changed to reflect an effort to find out who ultimately makes the decision to adopt IPT. As such, research issue 11 has been changed to the following:

> Who *really* makes the decisions to adopt new technologies for the parking provider?

Research issue 5 has been merged with research issue 12 as parking providers indicated that system costs and payback period are strong influencers of whether or not a parking provider chooses to pursue adoption of a new parking technology. As such, research issue 12 has been changed to the following.

> What motivates a parking provider to follow through on adoption of a new parking technology?

Different parking situations for the various parking providers indicated that research issues 9 and 10 could also be merged together in a way that encompasses all parking methods. The combined research issue is now:

> How will intelligent parking technology integrate with the various parking methods available to drivers?

After discussion with the parking providers, we have determined that the revised research issues to explore are now as follows:

Research Issue 1:

What can intelligent parking technology offer to the customer?

Research Issue 2:

Are parking customers willing to adopt intelligent parking technology?

Research Issue 3:

What can intelligent parking technology offer to the parking providers?

Research Issue 4:

Are parking providers willing to license intelligent technology? And why?

Research Issue 5:

How might future technological advances render newly implemented parking technology obsolete?

Research Issue 6:

What intelligent technologies are available and accessible by the majority of parking customers?

Research Issue 7:

What are suitable technology interfaces for customers and parking provider employees?

Research Issue 8:

How will intelligent parking technology integrate with the various parking methods available to drivers?

Research Issue 9:

Who *really* makes the decisions to adopt new technologies for the parking provider?

Research Issue 10:

What motivates a parking provider to follow through on adoption of a new parking technology?

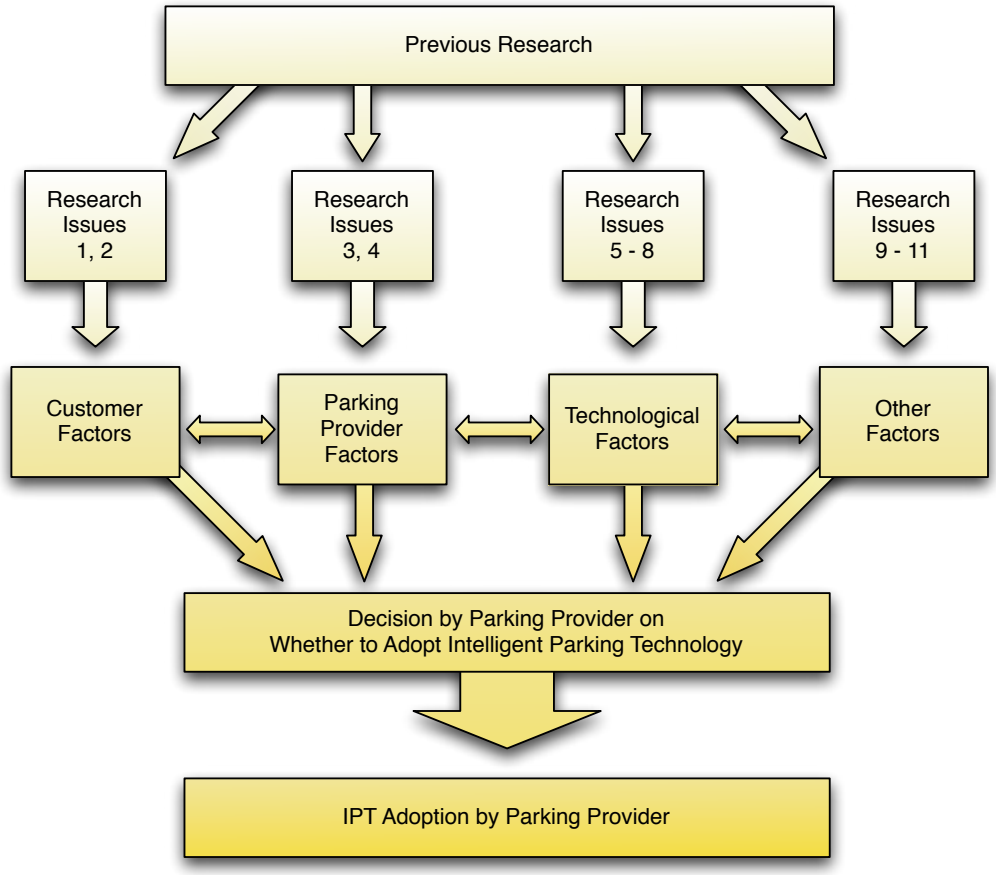
Research Issue 11:

What are the real and perceived relationships between technology companies, parking providers and customers?

Finding answers to the all of these research issues, in the context of previous research, is the next step in helping us find an answer to our research question.

A revised visual representation our analytical framework is presented in Figure 3.3. Here we see how answering our research issues, in the context of previous research, leads to a better understanding of the factors (our constructs) that influence parking providers' decisions to adopt IPT or not.

Figure 3.3 – Revised Visual representation of Analytical Framework



Source: Developed for this research

We can gain a better understanding of the influences each construct has on the ultimate decision by the parking provider to adopt IPT or not by gaining a better understanding of each of the research issues. Ultimately, this helps the parking providers build a solid business case for implementing IPT or not. In addition, the interviews and driver surveys raise awareness of which intelligent parking technologies exist and how they might benefit each stakeholder.

Initial interviews with the parking providers revealed that they were all particularly interested in what drivers' responses would be with regards to their willingness to adopt specific intelligent parking technologies. The constructs stemming from previous research and initial interviews with the parking providers led to our research issues. Most of the eleven revised research issues revolve quite tightly around the specific type of technology in question. As such, it was determined that the following hypotheses would be tested:

Hypothesis 1 (H_{10}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from being able to pay for parking with a cell phone. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from payment by cellular telephone (Driver Survey Question 17).

Hypothesis 2 (H_{20}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from being directed to empty spaces. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from a system that directs drivers to empty parking spaces (Driver Survey Question 18).

Hypothesis 3 (H_{30}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from a system that allows for loading value onto smart cards that can be used in specific parking lots. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from smart cards for use in specific parking lots (Driver Survey Question 19).

Hypothesis 4 (H_{40}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from a system that uses wireless transmitters to impose and track charges as your vehicle travels though a gate. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from wireless transmitters that impose charges when a vehicle travels through a gate (Driver Survey Question 20).

Hypothesis 5 (H_{50}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from a robotic parking system that moves the vehicle to a storage compartment after the driver leaves it at the entrance of the parkade. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from a robotic parking system (Driver Survey Question 21).

Hypothesis 6 (H_{60}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from internet enabled meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from internet enabled meters that verify and activate an account when a drivers waves a key fob in front of the meter (Driver Survey Question 22).

These hypotheses are tested using the driver survey data and have been formulated as null hypotheses because of a lack of prior research on adoption of parking technologies by parking providers (see chapter 2). The results of these tests will lead us to identify the actual determinants.

3.5 Summary

This chapter discussed the steps taken in the preparation, execution and analysis of the interviews with the parking providers and senior member from a parking technology company. Key issues that arose from the interviews, coupled with research literature were used to develop a questionnaire that was administered to drivers.

We discussed how the analytical framework for this study would involve gathering data from different sources as they related to each of our constructs. The research issues that we refined with the assistance of the parking providers serve to help us address and better understand each of the constructs and what effect these might have on the parking providers choice to adopt IPT or not.

The initial interviews with the parking providers and the parking technology company helped us better understand the current parking industry as well as other factors that might be affecting their decision to adopt IPT or not. After listening to and transcribing the digital voice recordings, we were able

to codify the similarities and the sometimes-subtle differences that exist between different types of parking providers. These differences or similarities appeared to predominantly stem from what the parking providers role was within a larger organization or if parking was their core business.

Convergent interviews led to the formulation of questions that would be asked to drivers through a driver survey. Data from these questions helps us better understand the customer factors influencing the parking providers decision to adopt IPT or not.

Previous research serves not only to guide us in shedding light on all four constructs, but to also demonstrate the different technology factors at play from adoption and diffusion models to which intelligent parking technologies exist and are ready to be adopted.

4 RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the methodology used to provide data to investigate the research issues and propositions identified in chapter 2. We build on our introduction to the research methodology first presented in Section 1.4.

We begin with a discussion of our choice of qualitative research as being an appropriate choice to explore and lead us to finding an answer to our research question. We follow this with a justification of our choice to use the Delphi technique.

The role of prior theory and initial interviews with independent content experts, the parking providers, helps us formulate our follow-up interview and driver survey questions. This enables us to properly generate relevant data. Our data collection procedures and techniques for analysing this data are then described. Finally, we discuss any limitations or ethical considerations associated with the research.

4.2 Justification for the research paradigm and methodology

Constructivism is a theory of knowledge where "the aim of inquiry is *understanding* and *reconstruction* of the constructions that people (including the inquirer) initially hold, aiming toward consensus but still open to new interpretations as information and sophistication improve" (Guba & Lincoln 1994).

Constructivism also assumes that "facts are facts only within some theoretical framework" (Hesse 1980, p. 25). As such, constructivism is appropriate as a research paradigm for this study as we are seeking to understand why parking providers appear reluctant to adopt intelligent parking technology and section 2.3.1 provides us with the theoretical framework within which to work.

4.2.1 Ontology

We begin with a construct of user adoption and diffusion theories as they may apply to the parking industry and the parking providers potential adoption of new technologies. Then, as we interview those working for the

parking providers and parking technology companies, discussing with them data gathered from our surveying of drivers, we bring forward new constructs. These are generated from their experiences and interpretations of what the reality of the current situation is. Constructivism's relativism assumes that these multiple and sometimes conflicting perceived realities may change over time as people become more informed, but this is acceptable as it ultimately helps lead us to answering our research question (Guba & Lincoln 1994).

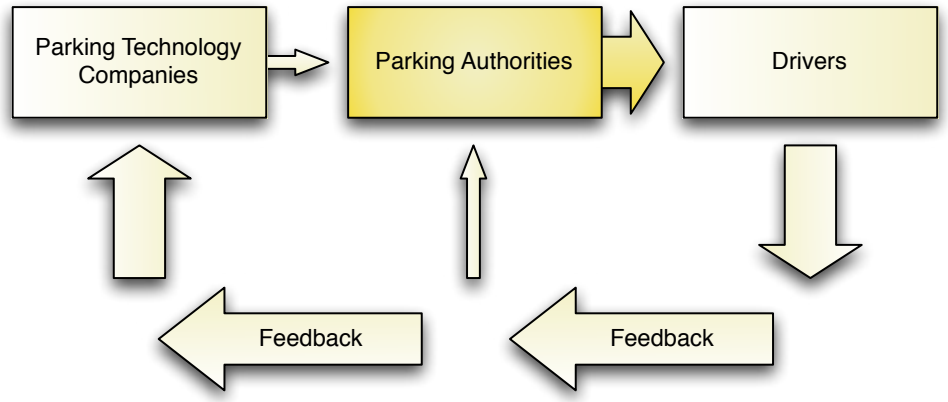
4.2.2 Epistemology

A constructivist paradigm works well with this qualitative research as the researcher interacts with participants and develops refined constructs after learning their beliefs, attitudes and behaviours of those involved. The epistemology is transactional and subjectivist as the investigator and the object of investigation are interactively linked in a way that findings are created as the investigation proceeds (Guba & Lincoln 1994).

4.2.3 Methodology

The Delphi technique, developed in the 1960s, is chosen for this qualitative study because there is a lack of hard data available to help us understand the reluctance of parking providers to adopt intelligent parking technologies. This technique also accommodates recognition of the value of the parking providers' experience, intuition and opinion (Murrow 2005). It is an easy to use research instrument that allows us to achieve consensus among the individuals and experts involved in this research.

Figure 4.1 - Parties involved in adoption of intelligent parking technologies



Source: Developed for this research

Through careful planning, surveying drivers and interviews with parking providers and parking technology companies we are able to minimize or avoid any weaknesses that may introduce themselves through unconventional thinking by some of the content experts interviewed.

The Delphi technique allows us to properly consider the true impact and value of intelligent parking technology and how it might be used to achieve the goals of the parking providers. It helps us find an answer to our research problem.

Why do parking providers appear reluctant to adopt intelligent parking technologies?

As this is a qualitative study, reliability is increased through triangulation. Triangulation is achieved by collecting data from three sources including in-depth interviews with parking providers and parking technology companies. The third source of data comes from surveying drivers.

A fixed-structure questionnaire is presented to drivers. Surveyed individuals consist of randomly chosen drivers leaving their vehicles either at a parking meter or in a parking lot. These surveys are not collected all at once in one location, as such convenience sampling would not allow us to scientifically make generalizations about the total driver population. Rather, an effort is made to lessen the potential of ending up with a non-random sample.

A cluster sampling approach is used as it helps reduce travel and administrative costs while increasing the variability of the samples above what a simple random sampling approach would offer. Surveys are given to drivers leaving their vehicles at different types of parking lots or spaces at different times of day and even in different cities. These natural groupings, or clusters, include private, government, shopping mall, university and other parking lots or spaces.

By surveying drivers in the different clusters, we help ensure that the results are not biased. For example, we know that not all responses come from only one particular group of people with similar experiences or backgrounds such as students at a university.

Another factor that further increases the randomness of the sample is the fact that survey questions do not ask drivers specifically about their experience with the parking space/lot they have just parked in but rather ask them questions to be answered in the context of their past and potential future parking experiences. Even drivers within one specific cluster would likely have different answers for those types of questions.

Drivers are asked to answer the survey we generated after our initial interviews with the independent content experts.

The survey contains both quantitative and qualitative questions. The quantitative questions give us statistical information regarding the drivers willingness to adopt intelligent parking technologies and the qualitative questions to help give us a feel for their perceptions and expectations vis-à-vis this kind of technology as it applies to the parking industry.

Data generated from the surveyed drivers are gathered and organized before being brought back to the content experts who review it and, through discussion, help interpret the findings.

Combining data from these different sources, all of which have either a direct or indirect influence on the adoption of intelligent parking technology by the parking providers increase the reliability of our interpretation of the data while reducing bias.

4.2.4 Validity

The validity of instrument measures for this study stem from the comprehensive literature review done in chapter 2. This literature review helped us build a context in which we may solidly interpret the data.

Validity is also increased through our use of the Delphi technique. We return to the independent content experts we have interviewed and present them with our findings from our surveying of drivers and interviews with parking technology companies. The content experts, the parking providers, may then corroborate or disapprove our findings.

4.2.5 Role of prior theory

Prior theory has been pivotal in helping us develop interview and survey questions that ultimately enable us to understand why parking providers are reluctant to adopt intelligent parking technology.

Although we have seen that there has been significant research with regards to adoption and diffusion of technology, most of this research considers this from the end-users point-of-view and does so in a rather generic way. Many of the parent theories are in fact more than 30 years old and although they do serve as an excellent framework on which to build new theories and models, it can be argued that alone they are inadequate for consideration to new technologies being applied in ways previously unthought-of.

Very recent research also seems to imply that this is the case as recent studies typically focus on either a particular emerging technology and/or a specific industry.

All prior theory discussed in chapter 2 has helped provide a framework on which to build new constructs on the adoption of intelligent parking technology by the parking providers.

4.3 Justification of the Delphi Method

The nature of this research is qualitative and is based on the Delphi Method, which is systematic and relies on a panel of independent experts. These independent experts represent the parking providers and they answer questions in two rounds. The researcher acts as facilitator in providing an

anonymous summary of their forecasted driver reaction to specific questions.

In the follow up interview, the independent experts have the opportunity to revise their earlier answers in light of data collected from driver surveys and the parking technology company.

This process is based on the principle that forecasts from a structured group of independent experts is be more accurate than those from unstructured groups or individuals (Rowe & Wright 1999).

4.4 Presenting the sample

As we are trying to understand why parking providers appear reluctant to adopt intelligent parking technology, we need to focus specifically on understanding their perceptions. Organizations representing the parking provider were chosen for their size as well as reasonable accessibility by the researcher. These independent content experts included six organisations: two educational institutions, a city municipality, an airport provider, a sporting event coordinator and a private parking firm. Interviews were granted on the condition that the names of these firms remain anonymous. One senior employee was interviewed at each site.

Interviewed participants working for the parking provider were selected based on their level of knowledge of the parking industry and their ability to make business decisions regarding potential adoption of intelligent parking technologies in their own operations. These individuals are whom we refer to as the independent content experts. Their responses during the interviews are critical to this research.

Following the interviews with these parking providers, an interview was scheduled with a senior level manager from a company that provides intelligent parking technology to different parking providers. This is necessary, as it gives us their perspective on how they see themselves fitting into the bigger picture. From this, we gain a better understanding of how and why they have developed intelligent parking technologies as well as garner an understanding of what types of relationships they currently have and seek to have with the parking providers and the end customer – the driver.

After all of the interviews had been conducted, we had a broader understanding of what the research issues were and how they related to our

constructs. We then proceeded with formulating specific questions to use when surveying drivers.

Surveyed drivers included a random sampling of drivers returning to or having just parked their vehicle. Without these individuals, the parking providers or the parking technology companies would not exist. Results from these surveys are presented to the parking providers (the content experts), for discussion and interpretation in a follow-up interview.

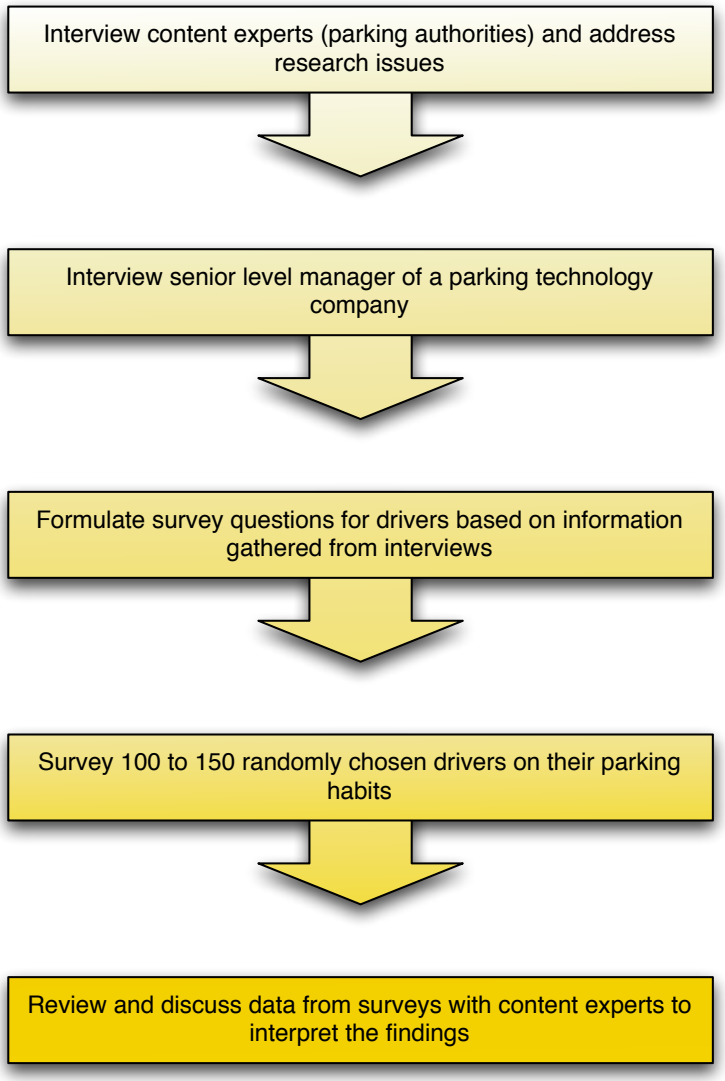
The feedback this provides to the parking providers is in itself beneficial as it stimulates reflection on what the real reasons are why they might not be adopting intelligent parking technology.

4.5 Data collection procedures

4.5.1 Sources of Data

Figure 4.2 summarizes the primary data collection procedure that is followed.

Figure 4.2 - Summary of primary data collection procedure



Source: Developed for this research

Our choice of the Delphi Technique required that we properly code and store both qualitative and quantitative data for further analysis.

As this study takes a primarily phenomenological approach, in-depth unstructured interviews with experts were conducted first. A typical sample size for this type of study is from 5 to 25 individuals, all of whom have had direct experience with being a key decision-maker or expert in the field of parking services (Leedy & Ormrod 2005, p. 139).

Driver surveys, developed after our initial interviews with the independent content experts, are administered and results brought back to the independent experts for discussion in a follow-up interview.

4.5.2 General Data Collection Protocol

4.5.2.1 Interviews

Participants are told that the objective of the research is to gather information about adoption of intelligent technology as it applies to the parking industry. Parking services managers could then potentially use this information to assist them in future implementations of intelligent parking technology in their own day-to-day operations. They may also use it to address reservations they may be having with regards to the adoption of such technology.

Pseudo-identification is used to keep the participants names anonymous. Company names and any other information collected that is or may be sensitive to that individual or organization also remains anonymous. Recorded interviews are not heard by anyone other than the researcher and participant.

Interviews are conducted with six independent content experts with the goal of helping us explore our research issues. The independent content experts consist of senior level decision makers within Canadian parking organizations. These six organizations include a city municipality, two educational institutions, an airport parking provider, a sporting event coordinator and a private parking firm. One senior level manager from a parking technology company is also interviewed.

We began our interview process with a list of all local organizations that manage paid for parking spaces. We contacted them to discuss our research plan and discussed how it might benefit their organization. From there, appropriate senior level parking provider employees were be chosen and

invited to participate. These senior level employees were chosen for interviews based on their accessibility, position within the organization and willingness to cooperate. Interviews were all voice recorded.

4.5.2.2 Surveys

Drivers were approached in parking lots and asked if they might mind taking a few minutes to answer questions as part of a research project. We surveyed a total of 133 drivers who had parked their vehicle at one of the parking spaces managed by the parking providers interviewed. To help reduce any bias, the researcher did his best to evenly distribute driver surveys across the parking spaces managed by the six different parking providers.

Appendix A contains a complete respondent consent form. As driver survey questions were developed with the content expert, a table relating each them to the research issues is presented in Table 5.3.

4.5.3 Data Collection Instruments

Our choice of the Delphi Technique required that we properly code and store both qualitative and quantitative data for further analysis. The interview protocol and driver surveys, the two data collection instruments used in this research, are discussed next.

4.6 Data processing and analysis

4.6.1 Industry Expert Interviews (Qualitative Data)

All those interviewed agreed to being voice-recorded as they realized this would help assist in the organization of the data, allow for revision as needed for the challenging task of formulating survey questions and allow the researcher to spend more time interpreting what was being said rather than focusing on taking notes. It also allowed the researcher to deviate from the planned research issues when an interesting issue comes up during the interview.

4.6.2 Assumptions

The assumption is being made that adoption of intelligent parking technology by parking providers, if properly done, results in increased efficiencies, higher return-on-investment and offers better value to customers. This would in turn encourage faster diffusion through the population and save money for the organization through niceties such as not having to collect coins, offering quicker service than competitors, having to hire less people to run booths, accepting different forms of payment and facilitating the parking process.

We also assume that the customer could benefit from such an implementation through a reduced number of parking tickets, increased convenience and lower stress levels among other things.

An example of this might be when a driver is waiting in line to purchase something in a store and they know the timer on their parking meter will soon run out. The convenience offered by an intelligent parking technology such as the option to pay by cellular telephone could reduce the drivers' frustration level by providing them with a convenient option for topping-up their meter while greatly minimizing the chance that they will receive a parking ticket.

4.6.3 Limitations

Although there is much strength associated with the Delphi technique, such as the ability to quickly achieve consensus between people with a wide range of expertise, it does have its limitations.

In particular, the researcher needs to be sure that he does not impose his own views or pre-conceptions of why parking providers appear reluctant to adopt intelligent parking technology. This could happen, if he is not careful, as he is immersed in the discussions and data gathering. He also needs to ensure that those chosen for interviews do indeed have in-depth knowledge of the industry and truly are "independent content experts". The success of the technique depends on it.

Limited time and financial resources only permitted us to conduct interviews with six independent content experts (parking services managers) and one senior level manager from a parking technology company. Finding independent content experts managing a significant number of parking spaces was a challenge in itself. Also, some of those parking services

managers initially contacted simply refused the request for an interview. Businesses developing, manufacturing and selling parking technologies are also far and few in between.

Another limitation that presented itself is the fact that all interviewees were men. This may have had an influence on how they responded to the driver survey results or may have presented itself through attitudes towards particular intelligent parking technologies such as those focused on parking lot safety for example.

4.6.4 Ethical considerations and clearance

The consent form in Appendix A outlines details regarding protection of privacy and the right of those interviewed or surveyed to withdraw from the research. Additionally, ethics clearance for the research project has been endorsed and given full ethics approval by the Postgraduate and Ethics Office at the Office of Research and Higher Degrees.

4.7 Summary

This chapter discusses, outlines and justifies the use of the Delphi technique as appropriate for this research as there is a lack of hard data available to help us accurately forecast the adoption of intelligent parking technology by parking providers. The Delphi technique is a relatively easy to use research instrument that allows us to achieve consensus among the individuals surveyed and experts interviewed.

We discuss the issues of validity and what the role of prior theory and our methodology choice have in addressing this. The data collection and analysis procedures are then described, as are assumptions and limitations. Finally, ethical considerations and ethics clearance are considered. We are now ready to begin our data analysis in chapter 5.

5 ANALYSIS OF DATA

5.1 Introduction

In the previous chapter, we discussed the basic design of the study as well as the dissertation methodology and collection process. This chapter presents the results from the survey and the in-depth interviews along with a brief analysis of the results as they pertain to the modified research issues presented in chapter 3. The results of the research are displayed using tables, figures and matrices. This helps us determine why parking providers appear reluctant to adopt intelligent parking technology.

The Chi-Square test for relatedness of fit was used to analyse the relationship between survey variables that were deemed to be of higher relevance to the parking providers with regards to their possible adoption of intelligent parking technology.

The quantitative section on Analysis of Survey Data (section 5.3) is followed with a qualitative section on Analysis of Interview Data (section 5.4), which focuses on the results from the in-depth follow-up interviews with the independent content experts and the senior manager from a parking technology company.

In particular, the following aspects receive attention:

- The reliability and validity of the survey questionnaire;
- A discussion on the prevailing perspectives for each of the different stakeholder groups;
- A discussion of the dynamics existing between all stakeholders;

A comparison of the results to existing literature, as well as a discussion on the implications they carry, follows in the chapter 6.

This chapter contains four sections. We begin with general descriptive data about the subjects and follow with an overview analysis and data display. Then, beginning at section 5.3, we consider data obtained from each of the stakeholders and present a summary on the findings as they pertain to the research issues.

5.2 Subjects

Interviews and surveys were administered in the province of Alberta, Canada during an economic boom due to primarily to oilsands development. As a result of this unique situation, the province was experiencing unprecedented growth while the rest of Canada was, in general, experiencing a downturn in economic development (Morissette 2008). In fact, the economic infrastructure in the province was growing so rapidly that it was clear to most that there was a resulting labour shortage across most industries.

> *"Rapid growth in its oil and natural gas industries has led to Alberta having the lowest unemployment rate in the country, as well as the most severe labor shortages. Because of unprecedented demand for workers in the oil and natural gas sectors, almost all other sectors of the Alberta economy have been affected. Many companies are at the point where a shortage of qualified workers is seriously hurting business and, indeed, some financially successful businesses have had to close because employees could not be found" (Derwing & Krahn 2008).*

This phenomenal economic growth has impacted organizations managing parking spaces in a number of different ways. In particular, the large yet still insufficient influx of workers the province has seen in recent years has resulted in an existing parking and traffic infrastructure that is in many respects lagging behind the current needs of the population. In terms of human resources as well, most organizations are having difficulties finding workers, skilled or not.

One would think that the population growth we have seen as a result of this influx of workers into the province would act as a catalyst and encourage quick adoption of intelligent parking technologies by the parking providers. However, the reality is that these technologies are still not readily accessible by drivers and little has changed in the last 20 years with regards to how people park their vehicles.

5.3 Initial Interviews

Interviews were conducted with senior level parking provider employees from both the public and private sectors. These people represent the independent content experts. We also conducted an interview with a senior manager from a parking technology company. Interview guides (see

Appendix B and Appendix C) were developed to help guide the interviews and help keep them within the allotted time requested for an interview. The interview guides were followed as closely as reasonably possible in order to help ensure that the core issues relevant to this research were covered.

From these initial interviews with the parking providers, and the interview with the senior manager from the parking technology company, a guideline regarding which and what types of questions to be asked of drivers through a driver survey was developed. Each of the driver survey questions were placed into categories derived from common themes that presented themselves during the initial interviews. These categories are listed in Table 5.1.

Table 5.1 - Categories for types and purpose of survey questions to ask drivers

Category	***Description***
Current	These questions should help determine existing parking habits.
Historical	These questions should help determine past parking experiences.
Unique Value	These questions should help gauge value drivers might receive from specific intelligent parking technologies.
Attitudes	These questions should help determine driver attitudes towards intelligent parking technologies.
Safety	These questions should relate to driver safety.
Environmental	These questions should relate to environmental issues such as CO_2 emissions resulting from unnecessary driving or idling time.

Source: Developed for this research

5.4 Driver Surveys

5.4.1 Question categories, research issues and related previous research

Table 5.2 summarizes how each of the questions from the driver survey (see Appendix D) relates to categories presented in Table 5.1, the revised research issues presented in section 3.3 and previous research presented in section 2.

This matrix will help us to better analyse the implications of the results stemming from each particular question. It also helps the parking providers better understand the possible implications associated with the subject of each survey question.

Table 5.2 - Driver survey questions as they relate to category, research issues and previous research

Question Number	*Question*	*Category*	*Related Research Issue(s)*	*Relevant Previous Research*
1	Do you drive a vehicle?	Current	ALL	
2	Have you ever paid to park a vehicle?	Current	ALL	
3	Do you pay for parking on either a weekly, monthly or annual basis?	Current	1, 2, 10	
4	How often on average do you pay to "casually" park a vehicle? (e.g. when you are shopping, running errands, parking at the airport, etc.)	Current	1, 2,	
5	When you pay to "casually" park a vehicle, how long on average would you say you park each time? (e.g. when you are shopping, running errands, at the airport, etc.)	Current	1, 2	
6	How do you typically pay to park a vehicle?	Current	1, 2	

7	Have you, in the last 3 years, ever felt rushed to get back to your vehicle because you knew time was running out on your meter/parking permit?	Historical	1, 2	Ajzen's Theory of Planned Behaviour (TPB)
8	Have you, in the last 3 years, received a parking ticket because the time ran out on your meter/parking permit while you were away from the vehicle?	Historical	1, 2	
9	Have you, in the last 3 years, found that you had no coins with you when you were wanting to park at a parking meter (or in a lot accepting only coins at the payment machine)?	Historical	1, 2	
10	Have you, in the last 3 years, ever felt unsafe in a parking lot/parkade?	Historical /Safety	1, 2	
11	Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose a lot offering intelligent parking technology over the other which does not? (All other variables being equal - including price)	Attitude	2, 9, 11	Ajzen's Theory of Planned Behaviour (TPB) Venkatesh et al. Unified Theory of Acceptance and Use of Technology (UTAUT)

12	Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose the lot offering intelligent parking technology over the other which does not? (Given that parking charges are slightly higher in the lot offering intelligent parking technology)	Attitude	2, 9, 11	Ajzen's Theory of Planned Behaviour (TPB) Venkatesh et al. Unified Theory of Acceptance and Use of Technology (UTAUT)
13	Have you, in the last 3 years, ever driven "around the block" looking for a no-charge parking spot when a parking lot or parking meter was readily available?	Historical /Environmental	1, 2	Ajzen's Theory of Planned Behaviour (TPB)
14	If the answer to Question 13 was "Yes", what was your reason for searching for a no-charge parking spot?	Historical /Environmental	1, 2	Ajzen's Theory of Planned Behaviour (TPB)
15	Have you, in the last 3 years, ever driven "around the block" for more than 10 minutes looking for a parking spot?	Historical /Environmental	1, 2	Ajzen's Theory of Planned Behaviour (TPB)

16	Would you be willing to pay more for a parking space if intelligent parking technology added value for you? (e.g. increased convenience, quicker navigation to an empty spot, etc.)	Attitude	ALL	Ajzen's Theory of Planned Behaviour (TPB) Venkatesh et al. Unified Theory of Acceptance and Use of Technology (UTAUT)
17	Value offered by payment by cellular telephone?	Value	1, 2, 6, 7, 8, 11	Davis' Technology Acceptance Model (TAM) Yi-Shun et al. m-banking and m-services Lu et al. Importance of "trust" in m-commerce Liang et al. Fit-Viability Model (FVM)
18	Value offered by a system that could direct you to empty parking spaces?	Value/Environmental	1, 2, 6, 7, 8, 11	Davis' Technology Acceptance Model (TAM)
19	Value offered by a system that allows for you to load value onto smart cards that you can then use to pay for parking in a specific parking lot?	Value	1, 2, 6, 7, 8, 11	Davis' Technology Acceptance Model (TAM)

20	Value offered by wireless transmitters that impose and track charges as your vehicle travels through a gate?	Value	1, 2, 6, 7, 8, 11	Davis' Technology Acceptance Model (TAM)
21	Value offered by a robotic parking system that moves your vehicle to a storage compartment after you leave your vehicle at the entrance of the parkade?	Value/Safety	1, 2, 6, 7, 8, 11	Davis' Technology Acceptance Model (TAM)
22	Value offered by internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter?	Value	1, 2, 6, 7, 8, 11	Davis' Technology Acceptance Model (TAM)

Source: Developed for this research

A total of 22 questions were developed to provide insight, as adequately as possible, into the research issues. Surveys were limited in length, as we did not want to overly impose on the drivers leaving their vehicles who were asked to respond to the survey.

Questions 17 through 22, those focused on the unique value offered by a sampling of specific existing intelligent parking technologies, were developed to help gauge driver attitudes towards new technologies that could potentially address negative past parking experiences, safety concerns and environmental issues. These are asked to help evaluate some of the currently available intelligent parking technologies that could add value for all stakeholders and, considering the results of the other survey questions, represent future potential business opportunities.

5.5 Analysis of Survey Data (Quantitative)

5.5.1 Introduction

The driver survey was conducted and results collected from 133 randomly chosen drivers. Raw data results for this survey are shown in Appendix E. The results for each question are also graphically represented (Appendix F), which makes it much easier to quickly scan the results and get a better perspective on how drivers responded to each question.

5.5.2 Survey Results and Findings

Question 1:

Do you drive a vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	133	100.0	100.0	*100.0*
B	No	0	0	0	*100.0*
	Total	*133*	*100*	*100*	

The first question was simply asked to confirm that we were in fact asking a *driver* to fill out the survey. Going back to the content experts with information that did not accurately reflect the views of their customers, the drivers, would have been not only inappropriate, but also detrimental to the study. All 133 respondents were drivers.

Question 2:

Have you ever paid to park a vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	133	100.0	100.0	*100.0*
B	No	0	0	0	*100.0*
	Total	*133*	*100*	*100*	

All driver survey respondents also happened to have paid for parking a vehicle before. This question was simply used as a measure to indicate how many driver survey respondents had experience in one form or another with paying for a parking space.

Question 3:

Do you pay for parking on either a weekly, monthly or annual basis?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	65	48.9	48.9	*48.9*
B	No	67	50.4	50.4	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 3 was asked to give us an idea of what proportion of drivers routinely pay for parking. Approximately half of the respondents indicated that they did.

Question 4:

How often on average do you pay to "casually" park a vehicle? (e.g. when you are shopping, running errands, parking at the airport, etc.)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Less than 4 times per month	96	72.2	72.2	*72.2*
B	4 to 10 times per month	29	21.8	21.8	*94.0*
C	More than 10 times per month	8	6.0	6.0	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 4 was asked as parking providers wanted to have a better understanding of how often people pay to casually park a vehicle. Almost 30% of respondents said they do this at least four times per month.

Question 5:

When you pay to "casually" park a vehicle, how long on average would you say you park each time? (e.g. when you are shopping, running errands, at the airport, etc.)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Less than 30 minutes	9	6.8	6.8	*6.8*
B	30 minutes to 2 hours	88	66.2	66.2	*72.9*
C	More than 2 hours	36	27.1	27.1	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 5 also deals with driver behaviour. Almost 95% of drivers indicated that they park for at least 30 minutes on average when they "casually" pay for parking.

Question 6:

How do you typically pay to park a vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Coins	96	72.2	72.2	*72.2*
B	Credit/Debit Card	36	27.1	27.1	*99.2*
C	Automatically debited from paycheck	1	.8	.8	*100.0*
D	Other	0	0	0	*100.00*
	Total	*133*	*100.0*	*100.0*	

Almost three quarters of drivers surveyed (72%) indicated that they typically paid for parking using coins. This might be an indication that most drivers are still experiencing parking using out-dated hardware such as parking meters. Only one driver out of the 133 surveyed typically paid for

parking through a means other than coins or credit/debit card and they indicated that their parking was paid through a paycheque deduction.

Question 7:

Have you, in the last 3 years, ever felt rushed to get back to your vehicle because you knew time was running out on your meter/parking permit?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	113	85.0	85.0	*85.0*
B	No	20	15.0	15.0	*100.0*
	Total	*133*	*100.0*	*100.0*	

The vast majority of drivers (85%) have at least once in recent years felt rushed to get back to their vehicle before the time ran out on the meter/parking permit.

Question 8:

Have you, in the last 3 years, received a parking ticket because the time ran out on your meter/parking permit while you were away from the vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	76	57.1	57.1	*57.1*
B	No	57	42.9	42.9	*100.0*
	Total	*133*	*100.0*	*100.0*	

The majority of drivers surveyed (57%) received a ticket at least once in recent years because time ran out on their meter/parking permit while they were away from the vehicle.

Question 9:

Have you, in the last 3 years, found that you had no coins with you when you were wanting to park at a parking meter (or in a lot accepting only coins at the payment machine)?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	111	83.5	83.5	*83.5*
B	No	22	16.5	16.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

A large majority of drivers surveyed (83 %) indicated that they did not have any coins with them at least once in recent years when they wanted to park at a parking meter or in a lot accepting only coins at the payment machine.

Question 10:

Have you, in the last 3 years, ever felt unsafe in a parking lot/parkade?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	75	56.4	56.4	*56.4*
B	No	58	43.6	43.6	*100.0*
	Total	133	100.0	100.0	

The majority of drivers surveyed (56%) felt unsafe in a parking lot/parkade at least once in the last three years.

Question 11:

Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose a lot offering intelligent parking technology over the other which does not? (All other variables being equal - including price)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Very likely	62	46.6	46.6	*46.6*
B	Somewhat likely	38	28.6	28.6	*75.2*
C	Not sure	28	21.1	21.1	*96.2*
D	Somewhat unlikely	5	3.8	3.8	*100.0*
E	Very unlikely	0	0	0	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 75% of drivers surveyed indicated that they were somewhat or very likely to choose a parking lot offering IPT over another one that does not given all other things being equal.

Question 12:

Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose the lot offering intelligent parking technology over the other which does not? (Given that parking charges are slightly higher in the lot offering intelligent parking technology)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Very likely	23	17.3	17.3	*17.3*
B	Somewhat likely	33	24.8	24.8	*42.1*
C	Not sure	27	20.3	20.3	*62.4*
D	Somewhat unlikely	33	24.8	24.8	*87.2*
E	Very unlikely	17	12.8	12.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 42% of drivers surveyed indicated that they were somewhat or very likely to choose a parking lot offering IPT over another one that does not that parking charges were only slightly higher. This represents a drop of 33% of drivers surveyed when compared to Question 11.

Question 13:

Have you, in the last 3 years, ever driven "around the block" looking for a no-charge parking spot when a parking lot or parking meter was readily available?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	123	92.5	92.5	*92.5*
B	No	10	7.5	7.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 92% of drivers surveyed indicated that at least once in recent years, they drove around the block look for a no-charge parking space when a parking lot or meter was readily available.

Question 14:

If the answer to Question 13 was "Yes", what was your reason for searching for a no-charge parking spot?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Had no coins on hand to pay for parking	24	18.0	18.0	*18.0*
B	Did not want to pay for parking	101	75.9	75.9	*94.0*
C	Other	2	1.5	1.5	*95.5*
D	Not applicable	6	4.5	4.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over three quarters of drivers surveyed searched for a no-charge parking space because they did not want to pay for parking. Only 18% searched because they had no coins to pay for a parking space.

Question 15:

Have you, in the last 3 years, ever driven "around the block" for more than 10 minutes looking for a parking spot?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	61	45.9	45.9	*45.9*
B	No	72	54.1	54.1	*100.0*
	Total	*133*	*100.0*	*100.0*	

Almost half of the drivers surveyed (45.9%) indicated that in the last three years they have driven around for more than 10 minutes while looking for a parking space.

Question 16:

Would you be willing to pay more for a parking space if intelligent parking technology added value for you? (e.g. increased convenience, quicker navigation to an empty spot, etc.)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	88	66.2	66.2	*66.2*
B	No	44	33.1	33.1	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Approximately two-thirds of drivers surveyed indicated that they would be willing to pay more for a parking space if they felt IPT added value for them.

For questions 17 to 22
How much value would the following intelligent parking technologies offer you?

Question 17:

Value offered by payment by cellular telephone?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	43	32.3	32.3	*32.3*
B	A little	55	41.4	41.4	*73.7*
C	None	28	21.1	21.1	*94.7*
D	Not sure	6	4.5	4.5	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 73% of drivers surveyed indicated they would receive value from an IPT that offered payment for a parking space by cellular telephone.

Question 18:

Value offered by a system that could direct you to empty parking spaces?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	66	49.6	49.6	*49.6*
B	A little	60	45.1	45.1	*94.7*
C	None	5	3.8	3.8	*98.5*
D	Not sure	2	1.5	1.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Approximately 95% of drivers surveyed indicated they would receive value from an IPT that could direct them to empty parking spaces.

Question 19:

Value offered by a system that allows for you to load value onto smart cards that you can then use to pay for parking in a specific parking lot?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	47	35.3	35.3	*35.3*
B	A little	64	48.1	48.1	*83.5*
C	None	19	14.3	14.3	*97.7*
D	Not sure	3	2.3	2.3	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 83% of drivers surveyed indicated they would receive value from an IPT that allowed for them to load value onto a smart card that could then be used to pay for parking in a specific parking lot.

Question 20:

Value offered by wireless transmitters that impose and track charges as your vehicle travels through a gate?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	31	23.3	23.3	*23.3*
B	A little	56	42.1	42.1	*65.4*
C	None	28	21.1	21.1	*86.5*
D	Not sure	17	12.8	12.8	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 65% of drivers surveyed indicated they would receive value from an IPT that used wireless transmitters to impose and track charges as their vehicle passed through a gate.

Question 21:

Value offered by a robotic parking system that moves your vehicle to a storage compartment after you leave your vehicle at the entrance of the parkade?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	50	37.6	37.6	*37.6*
B	A little	31	23.3	23.3	*60.9*
C	None	35	26.3	26.3	*87.2*
D	Not sure	17	12.8	12.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 60% of drivers surveyed indicated they would receive value from an IPT that used a robotic parking mechanism to move the vehicle to a storage compartment after they left their vehicle at the entrance of the parkade.

Question 22:

Value offered by Internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	41	30.8	30.8	*30.8*
B	A little	68	51.1	51.1	*82.0*
C	None	11	8.3	8.3	*90.2*
D	Not sure	13	9.8	9.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Over 81% of drivers surveyed indicated they would receive value from an IPT that allowed them to wave a key fob in front of an Internet enable meter that wirelessly verifies an account and activates it.

5.5.3 Driver Attitudes towards Intelligent Parking Technology (IPT)

In order to assess driver attitudes towards different intelligent parking technologies and help reveal their willingness to pay more for these types of technologies, we have formulated six hypotheses. The results stemming from the testing of the null hypotheses are then combined with the data gathered from the in-depth follow-up interviews with the independent content experts (the parking providers).

5.5.3.1 Driver willingness to pay extra for specific parking technologies

Initial interviews with the parking providers revealed that they would like to know what types of intelligent parking technologies drivers might be more willing to adopt and pay extra for. The thinking behind this is that if drivers are willing to pay more for a particular technology, the more likely the parking provider was willing to consider the adoption of that technology.

Six of the survey questions focused on specific intelligent parking technologies. The following Chi-Square tests for relatedness of fit explore this in more detail by analysing the relationship between survey question 16 (willingness to pay more for IPT) and survey questions 17-22 (perceived value obtained from different IPT's).

5.5.3.1.1 Payment by cellular telephone

Hypothesis 1 (H_{10}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from being able to pay for parking with a cell phone. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from payment by cellular telephone (Driver Survey Question 17).

Table 5.4 – Chi-Square Test for Relatedness of Fit Between Willingness to Pay for IPT and Value Received From Payment by Cellular Telephone

Count of Q16	Q17				
Q16	1	2	3	4	Grand Total
1	36	43	7	2	88
2	7	12	21	5	45
Grand Total	43	55	28	7	133
		Q17 response			
		Cell payment valued	Cell payment not valued		
	yes	79	9	88	
Q16 response	no	19	26	45	
		98	35	133	
		Q17 response			
		Cell payment valued	Cell payment not valued		
	yes	64.84210526	23.15789474	88	
Q16 response	no	33.15789474	11.84210526	45	
		98	35	133	
		3.80962E-09	p-value for the test of independence		

Source: Developed for this research

P-value (3.809E-09) **(H_{10})** hypothesis is rejected.

This means the finding is statistically significant at the 5 percent level and that there is a relation between how willing people are to pay extra for IPT and the perceived value they would receive from being able to pay for parking with a cell phone. (Questions 16 and 17)

5.5.3.1.2 System that directs driver to empty parking spaces

Hypothesis 2 (H_{20}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from being directed to empty spaces. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from a system that directs drivers to empty parking spaces (Driver Survey Question 18).

Table 5.5 – Chi-Square Test for Relatedness of Fit Between Willingness to Pay for IPT and Value Received From System that Directs Driver to Empty Parking Spaces

Count of Q16	Q18				
Q16	1	2	3	4	Grand Total
1	51	33	2	2	88
2	15	27	3		45
Grand Total	66	60	5	2	133
		Q18 response			
		Direct to space valued	Direct to space not valued		
	yes	84	4	88	
Q16 response	no	42	3	45	
		126	7	133	
		Q18 response			
		Direct to space valued	Direct to space not valued		
	yes	83.36842105	4.631578947	88	
Q16 response	no	42.63157895	2.368421053	45	
		126	7	133	
		0.604213996	p-value for the test of independence		

Source: Developed for this research

P-value (0.604) The calculated p-value exceeds 0.05, so the observation is consistent with hypothesis $\mathbf{H_{20}}$ and as such, the hypothesis cannot be rejected.

The implications of this are that we cannot say that there is a relation between how willing people are to pay for Intelligent Parking Technology

(IPT) and the perceived value they would receive from being directed to empty spaces. (Questions 16 and 18)

5.5.3.1.3 System that allows for loading value onto smart cards for use in specific parking lot

Hypothesis 3 (H_{30}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from a system that allows for loading value onto smart cards that can be used in specific parking lots. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from smart cards for use in specific parking lots (Driver Survey Question 19).

Table 5.6 – Chi-Square Test for Relatedness of Fit Between Willingness to Pay for IPT and Value Received From Smart Cards for use in Specific Parking Lots

Count of Q16	Q19				
Q16	1	2	3	4	Grand Total
1	37	38	10	3	88
2	10	26	9		45
Grand Total	47	64	19	3	133
		Q19 response			
		Smart card valued	Smart card not valued		
	yes	75	13	88	
Q16 response	no	36	9	45	
		111	22	133	
		Q19 response			
		Smart card valued	Smart card not valued		
	yes	73.44360902	14.55639098	88	
Q16 response	no	37.55639098	7.443609023	45	
		111	22	133	
		0.442682036	p-value for the test of independence		

Source: Developed for this research

P-value (0.4427) The calculated p-value exceeds 0.05, so the observation is consistent with hypothesis $\mathbf{H_{30}}$ and as such, the hypothesis cannot be rejected.

The implications of this are that we cannot say there is a relation between how willing people are to pay extra for Intelligent Parking Technology (IPT) and the perceived value they would receive from a system that allows for loading value onto smart cards that can be used in specific parking lots. (Questions 16 and 19)

5.5.3.1.4 System that uses wireless transmitters to impose and track charges as your vehicle travels through a gate.

Hypothesis 4 (H_{40}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from a system that uses wireless transmitters to impose and track charges as your vehicle travels though a gate. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from wireless transmitters that impose charges when a vehicle travels through a gate (Driver Survey Question 20).

Table 5.7 – Chi-Square Test for Relatedness of Fit Between Willingness to Pay for IPT and Value Received From Wireless Transmitters that Impose Charges when Vehicle Travels Through a Gate

Count of Q16	Q20					
Q16	1	2	3	4	5	Grand Total
1	27	36	11	13	1	88
2	4	20	17	4		45
Grand Total	31	56	28	17	1	133

		Q20 response			
		RFID valued	RFID not valued		
	yes	63	24	87	
Q16 response	no	24	21	45	
		87	45	132	

		Q20 response			
		RFID valued	RFID not valued		
	yes	57.34090909	29.65909091	87	
Q16 response	no	29.65909091	15.34090909	45	
		87	45	132	

	0.028366664	p-value for the test of independence	

Source: Developed for this research

P-value (0.0284) Hypothesis $\mathbf{H_{40}}$ is rejected. This means the finding is statistically significant at the 5 percent level.

The implications of this are that there is a relation between how willing people are to pay extra for IPT and the perceived value they would receive

from a system that uses wireless transmitters to impose and track charges as your vehicle travels though a gate. (Questions 16 and 20)

5.5.3.1.5 Robotic parking system that automatically moves your vehicle to a storage compartment

Hypothesis 5 (H_{50}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from a robotic parking system that moves the vehicle to a storage compartment after the driver leaves it at the entrance of the parkade. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from a robotic parking system (Driver Survey Question 21).

Table 5.8 – Chi-Square Test for Relatedness of Fit Between Willingness to Pay for IPT and Value Received From Robotic Parking System

Count of Q16	Q21				
Q16	1	2	3	4	Grand Total
1	39	20	18	11	88
2	11	11	17	6	45
Grand Total	50	31	35	17	133
		Q21 response			
		Robotic valued	Robotic not valued		
	yes	59	29	88	
Q16 response	no	22	23	45	
		81	52	133	
		Q21 response			
		Robotic valued	Robotic not valued		
	yes	53.59398496	34.40601504	88	
Q16 response	no	27.40601504	17.59398496	45	
		81	52	133	
		0.042324766	p-value for the test of independence		

Source: Developed for this research

P-value (0.0423) Hypothesis $\mathbf{H_{50}}$ is rejected. This means the finding is statistically significant at the 5 percent level.

The implications of this are that there is, in fact, a relation between how willing people are to pay extra for Intelligent Parking Technology (IPT) and the perceived value they would receive from a robotic parking system that moves the vehicle to a storage compartment after the driver leaves it at the entrance of the parkade. (Questions 16 and 21)

5.5.3.1.6 Internet enable parking meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter

Hypothesis 6 (H_{60}): There is NO relation between how willing people are to pay for Intelligent Parking Technology (IPT) and the perceived value they would receive from internet enabled meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter. In order to test this hypothesis, we perform a chi-square test for relatedness of fit between willingness to pay for IPT (Driver Survey Question 16) and value received from internet enabled meters that verify and activate an account when a drivers waves a key fob in front of the meter (Driver Survey Question 22).

Table 5.9 – Chi-Square Test for Relatedness of Fit Between Willingness to Pay for IPT and Value Received From Internet Enabled Meters that Verify and Activate an Account when a Driver Waves a Key FOB in Front of the Meter

Count of Q16	Q22				
Q16	1	2	3	4	Grand Total
1	33	45	4	6	88
2	8	23	7	7	45
Grand Total	41	68	11	13	133

		Q22 response		
		Internet/FOB valued	Internet/FOB not valued	
Q16 response	yes	79	9	88
	no	19	26	45
		98	35	133

		Q22 response		
		Internet/FOB valued	Internet/FOB not valued	
Q16 response	yes	64.84210526	23.15789474	88
	no	33.15789474	11.84210526	45
		98	35	133
		3.80962E-09	p-value for the test of independence	

Source: Developed for this research

P-value (3.809E-09) Hypothesis $\mathbf{H_{60}}$ is rejected. This means the finding is statistically significant at the 5 percent level.

The implications of this is that there is a relation between how willing people are to pay extra for Intelligent Parking Technology (IPT) and the perceived value they would receive from internet enabled meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter. (Questions 16 and 22)

Table 5.10 – Summary of Hypothesis Testing

Hypothesis	Hypothesis Rejected or Not	Implication
$\mathbf{H_{10}}$	Rejected	Drivers are willing to pay extra for being able to pay for parking with a cell phone.
$\mathbf{H_{20}}$	Cannot be Rejected	Drivers may not be willing to pay extra for a system that directs them to empty spaces.
$\mathbf{H_{30}}$	Cannot be Rejected	Drivers may not be willing to pay extra for a system that allows for loading value onto smart cards that can be used in specific parking lots
$\mathbf{H_{40}}$	Rejected	Drivers are willing to pay extra for wireless transmitters that impose and track charges as vehicle travels though a gate.
$\mathbf{H_{50}}$	Rejected	Drivers are willing to pay extra for robotic parking system.
$\mathbf{H_{60}}$	Rejected	Drivers are willing to pay extra for internet enabled meters that activate when a key fob is waved in front of the meter.

5.6 Analysis of Interview Data (Qualitative)

5.6.1 Introduction

Initial interviews with independent content experts (the parking providers) have been carried out following the procedures outlined and described in section 4.5. These initial interviews served to give us a general overview of the industry and strongly influenced our development of a questionnaire for drivers.

Following the initial interviews with parking providers, we interviewed a senior level manager for a parking technology company in order to gain an understanding of their perspective on the forces and issues affecting the decisions parking providers make with regards to intelligent parking technology adoption.

Finding companies that provide or develop parking technologies proved to be very challenging simply because there are relatively few of these worldwide. Because the focus of the study however is not on them, but rather on the parking providers and why *they* are slow to adopt IPT, it was felt that a different perspective from a different stakeholder would simply add value to the study. The list of interview questions we asked them is presented in Appendix C.

This senior level manager represents a company that has invested heavily in developing and patenting an intelligent parking technology they feel adds value for the driver while maximizing efficiency for the parking providers.

Their input was considered in the development of the driver survey and is also considered in our discussion, in section 5.4, of the data and how it pertains to each research issue. We then used this questionnaire to survey 133 randomly chosen drivers.

Follow-up interviews with the content experts (the parking providers) and the senior manager from the parking technology company were carried out and results from the driver surveys were discussed to confirm their validity. Input received from the parking providers and the senior manager from the parking technology company with regards to these results are discussed in section 5.4.

In the following section, we quote interesting and relevant statements from both the independent content experts as well as the senior manager from the parking technology company. We make and present this analysis in the context of our four constructs and the eleven research issues discussed in section 3.4.

5.6.2 Summary of Qualitative Data

5.6.2.1 Summary of Data from Content Experts (Parking Providers)

Appendix G presents a summary of data received from the content expert interviews. As we interviewed content experts from six different parking providers, we have decided to code each of the interviewees with a letter representing the organization they were from. We use letters A through F to code for the organizations. Each of the interviewees was interviewed twice. As such, we code which interview it was by denoting the letter code followed by a 1 or a 2. For example, Content Expert A1 refers to interview one with parking provider A. Content Expert F2 refers to interview 2 with parking provider F.

Of the six parking providers interviewed, two were quite large each managing in excess of 15,000 parking spaces. All suggested that they consider new technology implementation when there is a clear need to, although it was unclear what the criteria might be for that.

All of the parking providers interviewed used one or a combination of three older types of hardware and technology. These included coin meters, cashier based kiosks or remote payment stations. Two of the six also used RFID based cards for monthly parking pass holders. All parking providers stated that they had no existing relationships with a parking technology company but did have established relationships with the companies that provide them with their current equipment.

5.6.2.2 Summary of Data from Senior Level Manager for Parking Technology Company

The senior manager from a parking technology company was also interviewed twice. Appendix H presents a summary of the data received from the senior manager at this firm. To maintain confidentiality, we code the parking technology company with the letters PT followed by a 1 or a 2

depending on which interview we are referring to. For example, PT2 refers to interview 2 with the parking technology company.

In order to maintain confidentiality, the researcher does not describe what type of parking technology the parking technology company offers. The parking technology they have patented, however, would clearly be classified as an intelligent parking technology and its implementation worldwide is currently *very* low. The parking technology company began and continues to be a very entrepreneurial company. The principals of the company saw a problem with parking and decided to do something about it. From this came patents on a particular technology that they are now trying to license to the parking providers.

They believe that their technology would be beneficial to both the parking providers and the customers and have made the calculations to back this claim up. They believe that their licensing and pricing models are justified by these calculations.

The researcher felt that the senior manager at the parking technology company was very passionate about what they had to offer and perhaps because of this was a bit disillusioned by how willing parking providers might be wanting to adopt and implement their technology (PT1).

This became more apparent in the follow-up interview (PT2) when there was clearly frustration with how slow progress in selling to the parking providers had been. The senior manager felt local parking providers were aware of what they had to offer, yet they continued to make the decision to remain inefficient for various reasons.

What follows are results and findings for each of the research issues. These come from our follow-up interviews with the content experts (parking providers) and the senior manager from the parking technology company where we discuss with them the findings from our driver surveys.

5.6.3 Results and Findings for Research Issue 1

What can intelligent parking technology offer to the customer?

> Content Expert A made a statement during the initial interview that was echoed by other parking providers as well: 'We are looking at technology to give the client better payment options'.

Questions 17 through 22 explored a few of the different intelligent parking technologies that currently exist in the marketplace. Initial interviews with the parking providers and the parking technology company revealed that intelligent parking technology has a lot it can potentially offer the customer.

Customers have indicated that they would receive value from technologies that give better payment options. The percentage of respondents indicating they *would* receive value from technologies offering different payment options were quite high:

> Question 17: Payment by cellular telephone (73.7 percent)
>
> Question 19: Payment via smartcard (83.5 percent)
>
> Question 20: Automatic payment tracking while driving through a gate (65.4 percent)
>
> Question 22: Payment via key FOB through Internet enabled meter (82.0 percent)

Other benefits to the customers that further revealed themselves through survey results included time saving, safety and environmentally friendly technologies.

In fact, an intelligent parking technology that could save the customer time while simultaneously reducing environmental pollution through a reduction in driving time was presented in Question 18: A system that could direct you to an empty parking space.

Approximately 95 percent of respondents said they would receive value from this technology. Consider this in the context that 45.9 percent of respondents have said that, in the last three years, they have driven "around the block" form more than 10 minutes looking for a parking space (Question15). Interestingly, Hypothesis 2 ($\mathbf{H_{20}}$) revealed that drivers might not be willing to pay more for IPT that does this.

Results from Question 10 were surprising to a few of the parking providers. This question asked if the driver, in the last three years, had ever felt unsafe in a parking lot. 56.4 percent of respondents said yes. 'Sobering' was the term Content Expert B used upon seeing the results of this question. The other parking providers also seemed to raise their eyebrows upon seeing this result.

5.6.4 Results and Findings for Research Issue 2

Are parking customers willing to adopt intelligent parking technology?

Questions 17-22 explored the perceived value drivers might get from different intelligent parking technologies that are currently available to parking providers.

In every case, the majority of drivers indicated that they would get some value from the specific parking technologies presented.

This varied from a low of 60.9 percent of respondents indicating they would get value from a robotic parking system to a high of 94.7 percent indicating they would get value from a system that would direct them to empty parking spaces. There were no real surprises here although some of the parking providers appeared impressed by how high some of the results were indicating driver value for some of the specific technologies such as the robotic parking system.

5.6.5 Results and Findings for Research Issue 3

What can intelligent parking technology offer to the parking providers?

Parking providers seemed unsure as to what exactly intelligent parking technologies could offer them. Although they all admitted quite readily during the initial interview that there would clearly be benefits for their customers, many of them cited 'cost' as being the major hurdle to their adoption of intelligent parking technologies.

During the follow-up interviews however, most of the parking providers admitted that they had not done any cost/benefit or break-even analysis for these new technologies.

The parking technology company interviewed was quite adamant that their technology would save any parking provider implementing their system significant amounts of money while allowing them to offer up better value to their customers.

5.6.6 Results and Findings for Research Issue 4

Are parking providers willing to license intelligent technology? And why?

All parking providers indicated that they would be willing to licence, buy or pay royalties for any type of intelligent parking technology available to them as long as they could justify the expense and the technology suited their needs.

The parking technology company had a different view on this with their comments: 'Most of them are old and lazy and waiting for their pensions to kick-in! They don't want to rock the boat', 'The parking industry is slow and stupid. It can be profitable to anyone who has the patience to wait the years it will take (for the parking providers) to implement this type of technology.'

5.6.7 Results and Findings for Research Issue 5

How might future technological advances render newly implemented parking technology obsolete?

Discussion around how newly implement parking technologies might become obsolete was admittedly constrained as it became clear that the parking providers experiences and exposure to *available* intelligent parking technologies was very limited or non-existent and this would explain the lack of discussion on this topic.

However, discussion did seem to indicate that they believed that the willingness of drivers to adopt a particular technology will eventually determine the success of that technology. The idea behind comments such as 'The new generation is tech savvy and so new technologies for parking will likely be more readily adapted by them' (Content Expert E) and 'Children have cell phones now' (Content Expert F) seemed to echo amongst all stakeholders.

5.6.8 Results and Findings for Research Issue 6

What intelligent technologies are available and accessible by the majority of parking customers?

All of the parking providers interviewed currently manage parking spaces that are either kiosk or parking meter based (see Appendix G). Some parking lots make use of RFID technology that allows drivers, who pay monthly or annually for parking privileges, quick access to the parking lot via automated gates. Some of the kiosks geared to casual parkers are 'connected' allowing for extended payment options such as debit and credit cards. These appeared to be the most technologically advanced parking technologies currently available to parking customers through the parking providers interviewed.

5.6.9 Results and Findings for Research Issue 7

What are suitable technology interfaces for customers and parking provider employees?

A discussion of technology interfaces suitable for customers revealed that suitable customer technology interfaces appear to be those that enable efficiency and that users would feel comfortable with. 'Generation Y is comfortable with technology and so pay-by-cell, for example, will become more popular as a larger proportion of the population is willing and able to use this technology' (Content Expert B).

Technology interfaces suitable for parking provider employees would be those that are easy to work with and help minimize maintenance costs for the organization. 'Handing out tickets doesn't require a high-skill labour force…' (Content Expert D). 'A new high-tech machine for us is a payment machine that leaves a bit of a person's credit card sticking out so if the machine jams, they can still pull their card out and not have make a call and wait for a service technician to get out to them… which costs us money' (Content Expert C)

5.6.10 Results and Findings for Research Issue 8

How will intelligent parking technology integrate with the various parking methods available to drivers?

There appeared to be many factors that might affect implementation and integration with existing parking spaces. For most parking providers, these appeared to primarily revolve around HR issues and ease of transition issues. 'Do we do 100 spaces at once or 1000? If we do 1000, we risk putting a lot of people out of work' (Content Expert F). 'How seamlessly can a technology be implemented? Do we need to change the entire infrastructure of our existing systems, or can we add the technology as an add-on without making the management of enforcement more difficult?' (Content Expert E) The parking providers seemed to be aware that these new intelligent parking technologies existed, but did not seem to have a full grasp of all of the variable that would come into play with such an implementation. As one parking manager said: 'I would approach this by contacting one of my peers from another organization who has implemented something like what we were considering and ask them what the pros and cons were' (Content Expert B).

5.6.11 Results and Findings for Research Issue 9

Who really makes the decisions to adopt new technologies for the parking provider?

The parking industry appears to be controlled by very few organizations. Content Expert A even said that it was '…almost like a monopoly in certain areas'.

These organizations can be categorized as public (e.g. schools, governments, etc.) or private organizations. Most parking providers interviewed did not feel they were in a *highly* competitive market although they did say that 'price' is a factor in areas were parking spaces were available to drivers from more than just one organization.

What clearly came out during the interview process is that public organizations are generally more customer-focused while private firms are generally more profit driven. This makes sense, as parking

management services is for a private firm their core competency and as such must generate most, if not all, of its revenue. For public organizations, parking services typically exist to support the organizations mission as a whole.

5.6.12 Results and Findings for Research Issue 10

What motivates a parking provider to follow through on adoption of a new parking technology?

All parking providers seemed to echo the idea that they evaluate new technologies only when there is a clear need to. Content Expert C stated this when he said: 'We are still operating the business processes that were put in place over 20 years ago'.

Reasons for this ranged from 'Why should we (…pay to implement intelligent parking technology…) when we get more money giving out tickets?' as stated by Content Expert D to 'We don't really go out of our way to look at this because the auditor general is getting very interested in public spending lately and we don't want to come up under the microscope' (Content Expert C).

'Private industry can get more revenue through enforcement by giving out tickets at $60 versus payment for parking at $4' (Content Expert D). 'We are all pretty far behind in the times. Our idea of intelligent parking technology is one that reduces service calls' (Content Expert C).

These statements would seem to indicate that parking providers are slow to adopt intelligent parking technologies out of concern, in part, for what might happen to profits. This might come as a result of decreased revenue from less parking fines being given out or increased expenses for implementation of an IPT.

5.6.13 Results and Findings for Research Issue 11

What are the real and perceived relationships between technology companies and parking providers?

Parking providers were asked if they had ever been contacted by or had existing relationships with any parking technology companies. All said they had no relationships with any parking technology companies (with the exception of through their supplier perhaps). All but one stated that a parking technology company had never contacted them. The one organization (Content Expert B) that had been contacted had received a 'cold-call' to arrange a meeting that the parking technology company ended up cancelling 'at the last-minute'.

Interestingly, the parking technology company interviewed believed they had already established relationships with many parking providers as they were 'in talks' with different organizations interested in licensing their technology. It should be noted that these parking providers with which the parking technology company said they had relationships may or may not include those parking providers interviewed for this research.

5.7 Summary

In this chapter, we present the results from the survey and the in-depth interviews along with a brief analysis of the results as they pertain to the research issues presented in chapter 3.

A Chi-Square test for relatedness of fit is used to analyse the relationship between survey variables that are deemed to be of higher relevance to the parking providers and their decision to adopt intelligent parking technology or not.

We follow this quantitative section on Analysis of Survey Data with a qualitative section on Analysis of Interview Data. It is here that we present qualitative data from our discussion of the driver survey results with both the content experts and the senior manager from the parking technology company. This is done in the context of each research issue.

6 CONCLUSIONS AND IMPLICATIONS

6.1 Introduction

The purpose of this chapter is to discuss the research findings that were elaborated on in Chapter 5. These include the qualitative results from the interviews with the independent content experts and the senior manager from a parking technology company as well as quantitative results from the driver surveys. Conclusions, implications and recommendations are also discussed in the context of the research findings.

The development of the research question for this dissertation originated with the author's own frustrating experiences while parking a vehicle. This led to thoughts about what a potential solution might be that would benefit all stakeholders. Finding out later through preliminary research that there were already many parking technologies that were more intelligent than what seemed to dominate the parking industry, the researcher formulated the following research question:

Why do parking providers appear reluctant to adopt intelligent parking technologies?

The research is qualitative in nature as a comprehensive literature review revealed that although there are many studies surrounding adoption and implementation of technology, none seemed able to truly explain why parking providers have not already implemented these types of solutions into their organizations.

In order to gain a better understanding of the factors at play, research issues were developed and explored. After the initial interviews with the parking providers and the senior manager from the parking technology company, the research issues were refined to the following:

Research Issue 1:

What can intelligent parking technology offer to the customer?

Research Issue 2:

Are parking customers willing to adopt intelligent parking technology?

Research Issue 3:

What can intelligent parking technology offer to the parking providers?

Research Issue 4:

Are parking providers willing to license intelligent technology? And why?

Research Issue 5:

How might future technological advances render newly implemented parking technology obsolete?

Research Issue 6:

What intelligent technologies are available and accessible by the majority of parking customers?

Research Issue 7:

What are suitable technology interfaces for customers and parking provider employees?

Research Issue 8:

How will intelligent parking technology integrate with the various parking methods available to drivers?

Research Issue 9:

Who *really* makes the decisions to adopt new technologies for the parking provider?

Research Issue 10:

What motivates a parking provider to follow through on adoption of a new parking technology?

Research Issue 11:

What are the real and perceived relationships between technology companies, parking providers and customers?

These research issues were then grouped into categories associated with four different constructs. Together with previous research and newly collected primary data, we formed the structure of our analytical framework, which we use to guide us to finding an answer to our research problem (see Figure 3.3).

6.2 Cross-Method Synthesis

Survey results from 133 drivers were gathered and discussed with the parking providers and the senior manager from the parking technology company in follow-up interviews. The quality of the synthesis between the in-depth interviews and the drivers' survey data required a high level of organization on the part of the researcher. Otherwise, the complexity of the study would have become overwhelming. Minute details from the survey results coupled with broad observations or statements brought up by the interviewee required a holistic approach all while being tenacious in determining what was relevant to the research question.

A completed Delphi technique approach to this study allowed us to synthesise our findings and list them by research issue. We follow this with a discussion of the key findings as they pertain to answering the research question.

6.2.1 Research Issue 1: What can intelligent parking technology offer to the customer?

Results from the survey questions that considered intelligent parking technologies that facilitated the payment process confirm that most drivers felt there *was* value added for them. These results are summarized in Table 6.1 below.

Table 6.1 - Value offered by IPT's that facilitate payment for a parking space

Question	Payment Technology	Proportion of drivers who find technology offers value
17	Cellular telephone	*73.7 %*
19	Smart cards driver loads value on	*83.5 %*
20	RFID as you travel through a gate	*65.4 %*
22	Internet enabled meters coupled with key FOB	*82.0 %*

Drivers clearly demonstrated a willingness to adopt intelligent parking technologies. If they felt the technology added significant value for them, then they were even willing to pay more for this.

Other particular technologies that were not specific to facilitating the payment process were also viewed as being valuable. These are summarized in Table 6.2

Table 6.2 - Value offered by other IPT's

Question	Technology Feature	Proportion of drivers who find technology offers value
18	Directs driver to empty space	*94.7 %*
21	Robotic system moves vehicle for driver	*60.9 %*

Interestingly, an intelligent parking technology that directs drivers to empty spaces was viewed by almost 95 percent of drivers as being valuable. However, our Chi-Square test in section 5.5.3.1.2 revealed that drivers might not be willing to pay extra for this capability.

6.2.2 Research Issue 2: Are parking customers willing to adopt intelligent parking technology?

The majority of existing adoption and diffusion models revolve around the end-user of the technology in question. In the context of this research, this represents the drivers themselves. Survey questions that indicate to us a driver's willingness to adopt intelligent parking technologies include Question 11 and 12.

Given the choice to park in either of two parking lots side-by-side, both priced the same, 75.2 percent of drivers responded that they would be more likely to choose the parking lot offering IPT over the one that does not offer IPT.

Although it is fair to say that in some cases intelligent parking technology will be forced upon users and in other cases, it will be left to them to decide if they use it or not. A parking technology that is the only available choice to the driver will obviously have different adoption and diffusion rates than if the technology were presented as an optional choice. For example, payment by cell phone *or* with coins.

Only 42.1 percent of drivers surveyed stated they would be willing to pay more to park in a lot that offered IPT. Most of the drivers surveyed (92.5 percent) indicated that they have driven "around the block" at least once in the last three years looking for a no-charge parking spot when a parking lot or parking meter was readily available. Of all of these drivers, only 18 percent did this because they did not have coins on hand to pay for parking. 75.9 percent did it because they simply did not want to pay for parking.

The survey results clearly indicate that the majority of drivers would find value in the use of intelligent parking technologies (see section 6.2.1). They are however also very price sensitive as can be seen in the results from questions 12, 13 and 14. Questions 13 and 14 in particular indirectly indicate how willing drivers are to pay for a parking space.

6.2.3 Research Issue 3: What can intelligent parking technology offer to the parking providers?

Interestingly, ALL parking providers indicated in either the initial or follow-up interviews that they would like to give customers better payment options over what was already existing for the parking spaces they managed. They

viewed this as a potential win-win situation, as they would be able to increase their margins through increased revenues from both having more drivers pay for parking and a more automated payment collection process while simultaneously making the payment process more convenient for the customer. However, NONE of the parking providers had researched, at the time of the follow-up interview, which available intelligent parking technologies might be able to better do this for them.

Upon discussing a few of the many available intelligent parking technologies available to them, it became clear that the parking providers were unaware of most of them.

One of the parking provider employees summed up nicely an attitude that appeared to resonate among all the parking providers when he said: 'Our idea of intelligent parking technology is one that reduces service calls. For example, we are looking at acquiring a machine that accepts credit cards for payment, but instead of pulling the credit card all the way into the machine, it leaves a bit of the card sticking out so that if it jams, the customer doesn't get frustrated waiting for someone to come out and open the machine in order to retrieve their card. I've never even heard of most of the technologies you are talking about' (Content Expert C).

When asked if they had ever been approached directly by a parking technology company to see if they might be interested in purchasing or licensing intelligent parking technology, ALL parking providers responded that they have never spoken with anybody representing a parking technology company. One parking provider mentioned that he was to have a meeting with one of these companies a few weeks before our initial interview, but the parking technology representative did not show up for the scheduled meeting.

It is interesting to contrast this behaviour with that of the senior manager from the parking technology company who appeared to have a much better idea of how the intelligent parking technologies could benefit both the customer and the parking provider. They also seemed to have a keener insight into which technologies would apply best to each of the many different types of parking spaces. Their frustration with the parking industry revealed itself when they spoke about 'all of the red-tape and politics' within the parking provider organizations.

6.2.4 Research Issue 4: Are parking providers willing to license intelligent technology? And why?

All of the parking providers interviewed expressed an enthusiastic willingness to adopt intelligent parking technology in their day-to-day operations if they felt it truly added to their margins while simultaneously providing more value to their customers.

Follow-up interviews with the parking providers however revealed that very few, if any, of them had actually taken the time to research the options available to them and what the costs and benefits might be.

6.2.5 Research Issue 5: How might future technological advances render newly implemented parking technology obsolete?

After discussion of some of the many intelligent parking technologies available, both the parking providers and parking technology companies did not seem to be too concerned about obsolescence.

The senior manager from the parking technology company suggested that the only changes their patented technology might see would involve tweaking it in order to give it enhanced capabilities or increased efficiency. Their response to the question of potential obsolescence was simply: 'Cameras and cell phones will not go obsolete.'

The concern for obsolescence was not even on the radar screen for the parking providers. In fact, many of the responses to this question essentially skirted the issue. One parking provider summed it up by stating: 'We would consider (obsolescence) once we were seriously considering a technology' (Content Expert B).

This is a fair and understandable statement, yet one would think that if the technology in question might cause problems through its potential obsolescence, then it would never make it to the point where it would be a serious choice for an IPT implementation. The researcher believes that the majority of parking providers skirted this issue as it maybe caught them off guard while they were processing all of the other information that had been presented to them. Also, in all fairness, it is difficult to predict what future technological advances might be let alone predict how they will render newly implemented parking technologies obsolete.

6.2.6 Research Issue 6: What intelligent technologies are available and accessible by the majority of parking customers?

The discussions that took place during the in-depth interviews involved a brief introduction and overview of the following technologies:

- Cellular telephone payments systems
- Camera networks able to track individuals, as well as vehicles, in real-time through a parking lot. These systems can direct drivers to empty parking spaces or track potentially dangerous activities.
- IPT systems where drivers load value onto smart cards then activate it to work within the zone/space they are parking in. Drivers then deactivate the smart card when they leave so that they are only paying for the parking time they have used.
- Automated parking systems that allow parking areas to be controlled via access card and are integrated with lighting and security.
- The use of wireless transmitters to impose and track charges as a car travels through a gate.
- Robotic parking systems that move vehicles to a storage compartment and back without human intervention.
- Satellite based systems that send empty parking space information to the vehicles' satellite radio.
- Internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a Radio Frequency Identification tag (RFID) in front of the meter.
- GPS enabled cameras, attached to golf carts used by ticketers, which can read your license plate and determine how long you have been parked in that space.
- Parking meters that increase fees over time so that long stays become progressively more costly.

- Under pavement sensors that transmit data to notify of empty parking spaces which leads to an automatic resetting of the meter so the next driver needs to pay the full amount.

6.2.7 Research Issue 7: What are suitable technology interfaces for customers and parking provider employees?

There was not a lot said about technology interface design during the in-depth interviews and none of the driver survey questions *directly* addressed this.

However, interface design can have a strong impact on whether or not a technology is adapted. Questions 17 to 22 in the driver survey discussed specific intelligent parking technologies each having their own unique interface. A further study exploring the impact of those particular interfaces and how the parking provider and customers would interact with them would be interesting and valuable.

What significant discussion we did have about interface design seemed to stop at the stating of the fact that whatever technology it was, it had to be relatively easy to use.

6.2.8 Research Issue 8: How will intelligent parking technology integrate with the various parking methods available to drivers?

A discussion of some of the many intelligent parking technologies available seemed to initiate a genuine reflection on the part of the parking providers as they imagined and verbalized how each technology might or might not integrate well into their existing parking system. There was no situation where there was not at least one of the intelligent parking technologies that would work with the parking providers interviewed. The three most common forms of managed parking spaces amongst the parking providers interviewed included those where drivers used parking meters, used a parking pass to park in a lot or parked in an attendant occupied parking lots/parkades. Intelligent parking technologies that one would logically think would have low implementation costs, such as adding a payment by cell phone option, seemed to garner more interest from the parking providers as they seemed to think they might see a return-on-investment sooner than if they implemented other intelligent technologies such as a robotic parking system.

6.2.9 Research Issue 9: Who *really* makes the decisions to adopt new technologies for the parking provider?

Parking providers represent organizations responsible for parking services. These may include municipal governments, universities and colleges, and private business. Within larger organizations that are typically government funded, the department that control the organizations' parking spaces answers to a higher level in the business hierarchy. Their role also appears to be one of support for the organization primary business (e.g. parking for those taking a flight at the airport)

For the privately owned parking companies that typically manage parking lots located near higher traffic areas within municipal city limits, their primary business is profit from parking operations. One parking provider interviewee had prior experience working for a privately owned parking provider and suggested that they 'make more money giving tickets' rather than working to develop long-term relationships with customers that would ultimately be beneficial to both parties.

Most parking providers interviewed did not feel they were in a highly competitive market although they did say that 'price' is a factor in areas were parking spaces were available to drivers from more than just one organization.

Regardless of the company structure the parking provider belongs to, customers clearly stated that they would be willing to pay more for a parking space if intelligent parking technology added value for them. (See Table 6.3)

Table 6.3 – Driver willingness to pay more for IPT that adds value

Question		Proportion of drivers willing to pay more for IPT that adds value
16	Yes	*66.2 %*

This implies that the parking provider can get away with charging more for a valued feature that its intelligent parking technology offers customers. This increased margin coupled with the operational efficiencies an intelligent parking technology can bring to the organization would translate

directly into increased profits once the implementation payback period had passed.

Backed with proof that any new implementation would be profitable, the interviewees from the parking providers indicated that they would simply initiate the process of getting it approved. For the smaller parking provider organization this seemed it would be rather straightforward whereas for the larger organizations it seemed there would be many steps to go through including putting out a request for proposal.

6.2.10 Research Issue 10: What motivates a parking provider to follow through on adoption of a new parking technology?

All of the interviewed parking providers seemed to echo the idea that they evaluate new technologies only when there is a clear need to. 'We are still operating the business processes that were put in place over 20 years ago' (Content Expert C).

Reasons for this ranged from 'Why should we (…pay to implement intelligent parking technology…) when we get more money giving out tickets?' (Content Expert D) to 'We don't really go out of our way to look at this because the auditor general is getting very interested in public spending lately and we don't want to come up under the microscope' (Content Expert C).

The parking providers and the parking technology company both seemed to agree that change was slow to happen because nobody wanted to disturb the status quo.

For parking providers in the public sector, or those existing to support the organizations' primary business, there did not appear to be a lot of focus on the need for profit generation. It was almost as if that was expected only from what was the core business of the organization was (e.g. fees generated from student tuition versus fees generated from their parking at the school).

For the privately owned parking providers that were very much profit driven, generated profits were higher when handing out tickets as opposed to focusing on collection of payment. 'The job of handing out parking tickets does not require a high level of skill. Wages for those jobs are quite low and so a lot of money can be made handing out tickets on less than $100 in wages per day' (Content Expert A).

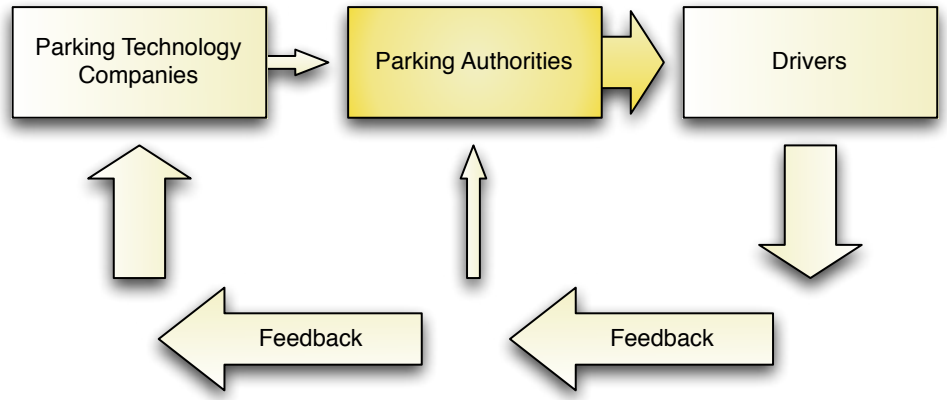
6.2.11 Research Issue 11: What are the real and perceived relationships between technology companies, parking providers and customers?

Patents on intelligent parking technologies are typically owned by parking technology companies who may want to sell or license their technology to parking providers in order to recoup research and development costs. Doing so would allow them to be profitable and could potentially generate a significant revenue stream for them with little ongoing effort.

Our in-depth interviews revealed very little if any relationships existing between the parking providers and the parking technology companies. It would seem that the parking technology companies have done their research in finding out what the drivers' needs and wants are and then used this information to develop patentable technologies in hopes of licensing it back to the parking industry.

However, as we can see in Figure 6.1, the parking providers do not seem to be very receptive to any feedback coming from parking technology companies or the drivers. We see this represented by the thinner arrows. The parking providers are adept, however, at controlling the parking process drivers will need to conform to if they want to park in one of their spaces.

Figure 6.1 - Parties involved in adoption of intelligent parking technologies



Source: Developed for this research

Both the parking provider interviewees and the senior manager from the parking technology company validated propositions 1 and 2.

Proposition 1: Parking technology companies can benefit more from using a "pull" marketing strategy rather than a "push" strategy.

> If parking technology companies inform drivers of the benefits of their proprietary intelligent parking technology, drivers will want it and will request it from the parking providers. This marketing strategy is different from a push strategy where the parking technology companies simply try to push their products on the parking providers.

Proposition 2: Parking technology companies might benefit by forming alliances with suppliers of existing, and out-dated, parking technologies.

> Given that parking providers are familiar and have experience working with existing firms that provide them with out-dated technologies, such as the parking meter, it might be beneficial for parking technology companies having patents on the intelligent parking technology to form alliances with organizations that are already well established in the parking industry, such as parking meter companies, and use these alliances to help them get their products/services adopted by the industry.

Parking providers expressed that if enough customers requested a particular service or technology from them that they would be more willing to consider it. This was especially true if it was regarding a parking space/lot adjacent to or within short walking distance to a competing parking lot/space. In other words, the parking providers stated they would consider it if the alternative was losing customers.

The parking technology representative admitted that using a pull strategy might be more fruitful that the approach they had been using. They acknowledged that joining forces with existing (and out-dated) parking technology firms such as parking meter manufacturers might be necessary to speed up adoption of intelligent parking technologies by the industry. However, the senior manager from the parking technology company was concerned about having to hand over their patents and profit share with 'the dinosaurs'.

6.3 Conclusions about the Research Problem

Parking providers have different reasons for adopting intelligent technology than do drivers. Although drivers generally appear very willing to adopt intelligent parking technologies, they remain somewhat price sensitive. This result likely stems from the fact that free parking is often subsidized in North America (Shoup, 2005). For example, a businessman wanting to open a new restaurant needs to factor in how much land they will need to not only build their new restaurant, but also provide free parking that accommodates all of the customers that may come in to the restaurant.

Parking providers that operate within a public organization such as an educational institution tend to view parking as an add-on service. They seem to believe that they exist to primarily support the organization's mandate and the only real expectation of them is that they at least cover

their own divisional costs. They do not seem to feel a need to generate high profit margins and as such, there is low motivation to implement intelligent parking technologies.

These public parking providers have a role within the organization that is quite different from those parking providers that are privately owned and generate all profit from offering parking services. These private parking firms are very much profit driven, but also appear to have low motivation to initiate implementation of intelligent parking technologies. Many of these private firms have monopolies on parking spaces in the areas of the city where they are needed and as such there is little competition to motivate them to change their existing profitable business practices. These include charging exorbitant rates for parking and aggressively ticketing those who park longer than for what they have paid.

In summary, it can be said that parking providers are reluctant to adopt intelligent parking technologies simply because they are not motivated to do so. Reasons for this include those presented in our four constructs (see Section 2.3.4) where we stated that in combination with one another, these would influence the decision by a parking provider to adopt IPT or not. Conclusions on the strength of each of these constructs as a motivator for a parking provider to adopt IPT are as follows:

- Customer Factors include behaviours towards new technologies. This construct is significant as research issues 1 and 2 revealed IPT has a lot to offer customers and in general they are willing to adopt it even though they may not be willing to pay more for it.

- Parking Provider Factors include their behaviours towards new technologies. This construct is also significant as research issues 3 and 4 revealed that IPT also had a lot to offer parking providers and they have indicated they are willing to implement it if it is clear that they will benefit from it.

- Technological Factors include integration issues surrounding a particular IPT. Research issues 5 through 8 revealed that obsolescence did not appear to be a concern and that there were many intelligent parking technologies with appropriate user interfaces available that could easily be integrated into existing parking operations. As such, we can state that this construct is also significant. We must however be cautious with our confidence as it pertains to the significance of this construct, as there was very limited awareness of these technologies and *how* they might benefit the parking providers.

- Other Factors include relationships that exist between the different stakeholders as well as who and what initiates an IPT implementation. As we found when researching our Technological Factors construct, a lack of awareness of the available intelligent parking technologies was a recurring theme in all of our interviews with the parking providers. From this, we ask how an organization can adopt and implement a new technology if it is not even aware exists? Without strong relationships between the stakeholders, through which communication occurs, there is little or no effort made to help the other. As such, we give this construct a subjective failing grade.

Research issue 11 revealed highly contrasting views regarding the perceived relationships between all of the stakeholders. Parking provider interviewees felt they had *no* existing relationships with parking technology companies. The parking technology company however felt they had relationships with many parking providers. The parking provider interviewees and senior manager from the parking technology company seemed to have the same type of arms distance relationship with the drivers that many companies do.

The researcher believes that it is the nature of relationships between the stakeholders that is ultimately the reason that parking providers are reluctant to adopt intelligent parking technology. Propositions 1 and 2 would serve well for all stakeholders as both would help increase the communication and strengthen the relationships between all stakeholders.

6.4 Implications for Theory

This section shows that this research has not only made a significant contribution to knowledge in the field of "Adoption of Intelligent Parking Technologies" as outlined in previous sections, but also to other related areas. It has done this by showing that there are complexities that can exist that are unique to a particular industry. In the case of this study, the relationships that exist between three different stakeholders were shown to be a significant factor to adoption of technology. This builds on Biemans' 1989 study where it was found that insufficient contact with thirds parties by manufacturers of superior new technology might lead to that technology not being adopted.

The implications are that further research on adoption and diffusion of technology is justified when considering a particular industry or technology. The unique characteristics of the technology or of the dynamics existing

within the industry studied can affect adoption and diffusion rates. Bass stated in 2004 that "the fact remains that little is known about the relationship between stated intentions and actual adoptions and even less is known about how to adjust stated intentions in individual cases to estimate market potential. In my judgement knowledge in this area can only be developed over time with the accumulation of experience in matching prelaunch stated intentions in individual cases, with all of the conditions surrounding the product and the market, with actual outcomes" (Bass, FM 2004).

In summary, this study has added to the body of knowledge of technology adoption, in particular intelligent parking technology as it applies to the parking industry. The study has followed Bass' advice of accumulating "experience in matching prelaunch stated intentions in individual cases, with all of the conditions surrounding the product and the market, with actual outcomes" (Bass, FM 2004) in successfully developing knowledge in this area.

Future research on technology adoption will also need to build on previous research and fine-tune it to apply to the specific technologies or industries being studied.

6.5 Implications for Management Practice

6.5.1 Parking Providers

This research highlights the fact that parking providers need to actively research which technologies are compatible with their existing parking space management practices. As all parking providers stated that maximising efficiency is important, information such as technologies currently available, how customers will use and benefit from it and what the financial implications will be all need to be considered. An effort on the part of the parking providers to acquire this knowledge is required to help lead them into the future.

6.5.2 Parking Technology Companies

Parking technology companies cannot simply rest on their laurels, which may have come about through having been granted a patent on a particular intelligent parking technology. They need to focus their efforts on forming good relationships with all stakeholders to help make their efforts of developing a technology succeed in a way that is beneficial to all. This includes taking advantage of pull marketing practices through customers as well as push marketing practices directly with the parking providers.

6.5.3 Reflection and learning

This study showed that collective reflection is important in getting to the root of a large problem. Whereas many studies seek to find concrete solutions to different problems, finding an answer to a research question that is admittedly broader than most required a more qualitative and holistic approach. The researcher had noticed during the follow-up interviews that the sharing of information and perspectives between each of the stakeholders that was occurring as a result of the research was already having positive outcomes in that the interviewees were looking at things in a more constructive way and were motivated to learn more. Drivers responding to surveys also were affected by the research and this showed when they asked questions wanting to know where these types of technologies were implemented or made comments on how great this or that technology would be if it were available to them. Even the senior manager from the parking technology company, in the follow-up interview reflected on thoughts of how better to reach out to the parking providers and drivers.

6.6 Limitations of the Research

The complexity and subjective nature of the research problem for this study led us to choose a qualitative approach for this study. This complexity and subjectiveness meant that there were many challenges regarding data collection. We discuss some of the limitations that may have presented themselves as well as how we avoided from having presented a potential distorting influence on the outcome of this study.

In order to best cope with gathering meaningful data to help us answer the research question, the Delphi technique was chosen. This technique accommodates recognition of the value of the parking providers' experience, intuition and opinion (Murrow 2005). It is an easy to use research instrument that allows us to achieve consensus among the individuals and experts involved in this research.

Although there is much strength associated with the Delphi technique, it does have its limitations. In particular, the researcher needed to constantly remind himself to not impose his own views or pre-conceptions to the research of why parking providers appear reluctant to adopt intelligent parking technology. The researcher also needed to ensure that those chosen for interviews did indeed have in-depth knowledge of the industry and truly were "independent content experts". The assumption was made that if the interviewees were in fact senior level employees of the organization that they would have a good understanding of how it operates.

6.6.1 Interviewee Selection

We interviewed six content experts representing the two different types of parking providers. These content experts were people who were senior level employees within the parking provider organization. We assumed they were people who knew what was going on in their industry as they are immersed in it as part of their job.

We also chose to interview a senior manager from a parking technology firm.

6.6.2 Quality of Qualitative Data

All interviewees became very open and very frank when discussing with the researcher during follow up interviews. Perhaps this was due to the

researchers ongoing communication with them along with a guarantee that their identity would remain confidential. There was also quantitative data to discuss, which made things more concrete. The researcher tried his best to avoid introducing bias or contamination to the discussions and believes he succeeded in doing this. The researcher did show genuine interest in answering the research question by asking difficult questions to all interviewees. The researcher believes this show of genuine interest in finding the answer to a problem that would potentially help the interviewees operate their businesses more efficiently is what contributed to their openness in answering any questions they were presented with.

6.6.3 Consistency of Qualitative Data

Qualitative data seemed very consistent amongst the six content experts. As we only interviewed one senior level employee from a parking technology company, we are unable to verify that the findings gathered from their initial and follow-up interviews would be consistent with findings from interviews with employees from other parking technology companies.

We did find very *inconsistent* data between the content experts and the parking technology company. This is particularly true with regards to research issue 11 which focused on the relationships between them and the parking providers. Parking providers indicated they had no established relationships with parking technology companies, yet the parking technology companies felt they had already established relationships with the parking providers.

The researcher found that the senior manager from the parking technology company seemed one step ahead of the parking provider in many regards. They were aware of many of the intelligent parking technologies available on the market, how each might benefit the driver as well as the parking provider, how they might be implemented with the different types of managed parking spaces, what the cost benefits would be as well as how much they might be able to license the technology for. Perhaps there was an assumption on their part that the research they did for their business was also done by the parking providers.

6.6.4 Quality of Quantitative Driver Survey Data

There are a number of factors that contribute to the good quality quantitative driver survey data we had to discuss during our follow-up interviews. Driver surveys were filled out by randomly chosen drivers leaving the managed parking spaces of the parking providers interviewed, the questions were grouped into our four constructs that were part of our analytical framework and we had 133 respondents.

6.6.5 Consistency of Quantitative Driver Survey Data

There were definite trends to the answers we received from the driver surveys. The parking providers as well as the senior manager from the parking technology company confirmed the consistency of this data. There were no real surprises with the results of the driver survey with the exception of question 10 which asked if, in the last three years, the driver ever felt unsafe in a parking lot/parkade. Over 56 percent of respondents answered yes to this question.

In summary, the qualitative approach chosen for this study is well suited to the complexity and subjective nature of the research problem. Challenges regarding data collection and the dangers of limitations that may have presented themselves were relatively well addressed and dealt with the choice of the Delphi technique coupled with an awareness of what limitations may exist.

6.7 Implications for Methodology

After the literature review, it was determined that a two-stage interview process based on the Delphi technique would best be suited to finding an answer to the research problem. This was the case because we had many stakeholders and needed to accommodate for recognition of the value of the parking providers' experience, intuition and opinion (Murrow 2005). This approach allowed us to achieve consensus among the individuals and experts involved in this research.

Reliability was increased through triangulation. We achieved this by collecting data from three sources including in-depth interviews with parking providers, interviews with a senior manager from a parking technology company and quantitative driver survey data.

Combining data from these different sources was important in increasing reliability of our interpretation of the data while reducing bias. Future qualitative research using the Delphi technique should also strive to do this. Without this, we would not have been able to answer our research question.

6.8 Directions for Future Research

Given the nature of the research question and the number of facets to be explored through the research issues and constructs, several suggestions for future research were identified. These future studies could include those that:

- Consider how different industries and new technologies could benefit from adapted data collection procedures based on the Delphi technique used in this study.
- Replicate this study in different parts of the world where attitudes and beliefs may be different. This would further substantiate the findings and conclusions of this research.
- Focus further on the practical business perspective of intelligent parking technology implementation.
- Are specific to particular intelligent parking technologies and the benefits they each carry.
- Track adoption and diffusion of intelligent parking technologies and correlate this to different factors.

In summary, this qualitative research showed that intelligent parking technology adoption by parking providers is more complex than what one might first imagine. The research showed that even though intelligent parking technology implementation offers apparent value to all stakeholders, its formal implementation by parking providers could be affected by subjective complexities such as attitudes prevalent in the workplace and other factors affecting their willingness to make the effort to make a change that could benefit all stakeholders. Although previous research such as the Diffusion of Innovation model identifies determinants that may affect a parking providers decision to implement IPT or not, there is also the factor of complex relationships existing between the three primary stakeholders: parking providers, parking technology companies and drivers.

These relationships serve as a vehicle for change by allowing each of the parties to communicate things that may be mutually beneficial. Lack of communication means awareness of those mutually beneficial things, such as intelligent parking technologies, is not shared. This lack of knowledge of how and which intelligent parking technologies may benefit the parking providers is what ultimately hinders its manifestation in society and makes it appear that the parking providers are reluctant in adopting it.

7 GLOSSARY

CAM:	Compass Acceptance Model
DOI:	Diffusion of Innovation
FITT:	Fit between Individuals, Task and Technology
FVM:	Fit-Viability Model
GPS:	Global Positioning System
IPT:	Intelligent Parking Technology
ITS:	Intelligent Transportation System
PDA:	Personal Digital Assistant
RFID:	Radio-Frequency Identification
RI:	Research Issue
TAM:	Technology Acceptance Model
TPB:	Theory of Planned Behaviour
TTF:	Task-Technology Fit
TRA:	Theory of Reasoned Action
UTAUT:	Unified Theory of Acceptance and Use of Technology
WIMT:	Wireless Internet Services via Mobile Technology

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Appendix A - Consent form

Consent Form

INVITATION TO PARTICIPATE IN PROPOSED RESEARCH

Dear Colleague,

A researcher studying at the University of Southern Queensland, Australia has been invited to research the impacts intelligent parking technology may have on our organization.

The researcher is Mr. Victor Bilodeau who is currently a full time faculty member at the MacEwan School of Business in Edmonton, Alberta, Canada.

As someone with direct involvement in parking services duties, you are invited to participate in this study. Mr. Bilodeau will be interested in your opinions about potential implementation of intelligent parking technology as well as any issues and problems you see with how parking services are typically operated and managed. Mr. Bilodeau will also be observing workflows and will be conducting surveys with drivers after interviews with you. You are encouraged to fully express your opinions about issues relating to workflows and paperwork.

ALL INFORMATION GATHERED IN THE RESEARCH WILL BE ANONYMISED, THAT IS CONTRIBUTORS OF COMMENTS WILL NOT BE IDENTIFIED.

At any stage you may withdraw from the study and not participate in discussions. You may also request not to be observed during your work. There will be no repercussions from withdrawing and you may ask for any documents you have provided to be returned to you.

Mr. Bilodeau will provide a report back to our organization on his findings, which will be shared with staff.

If you have a concern regarding the implementation of the project, you should contact The Secretary, Human Research Ethics Committee USQ or telephone (07)4631 2956

Victor Bilodeau
University of Southern Queensland
Tel (in Canada): (780) 707-2770
Fax (in Canada): (780) 707-2771
Email: mediabrook@mac.com

I agree to participate in the project as outlined above

Name: _____

*Signature:*_____*Date:*_____

Appendix B - Interview Guide for Parking Providers

Interview Guide

Initial interview with content experts (parking providers)

1. How many parking spaces does your organization manage?
2. What type of parking spaces does your organization manage?
3. Has your organization adopted any "intelligent" technologies? If so, what are they? (e.g. pay by cell, equipment to direct drivers to empty stalls, RFID tags for regular parkers, monitoring equipment, internet based metering, etc…)
4. If not, have you considered it? Why or Why not?
5. Does your organization have a "mission/vision" statement with regards to parking services?
6. Do you feel your organization is in a competitive market (i.e. Are there other local parking providers you are competing with?)
7. Have you developed any relationships with parking technology companies? If so, have they contacted you or have you contacted them?
8. How important is it for the parking services department in your organization to maximize efficiency with regards to delivery of parking services?

Follow-up interview with content experts (parking providers) to review survey results

1. Do any of the survey responses surprise you?
2. Why do you think parking providers (organizations that manage parking spaces) haven't pushed for more intelligent parking technology implementation? – Survey shows customers would feel the value added.

Appendix C - Interview Guide - Parking Technology Company

Interview Guide

Initial interview with senior level manager for parking technology company

1. What type of parking technology does your company offer?
2. Do you licence the technology, sell it or both?
3. What benefits do you feel your intelligent parking technology offers the customer? The parking provider?
4. Have you been in touch with many parking providers to communicate what you have to offer them?
5. Have you communicated what you offer with drivers directly?
6. Do you feel your organization is in a competitive market (i.e. Are there other technologies you are competing with?)
7. Have you developed any relationships with other companies involved in the parking industry? For example, parking meter manufacturers, etc.
8. Why do you think the parking providers appear reluctant to adopt intelligent parking technologies?

Follow-up interview with senior level manager for parking technology company to review survey results

1. Do any of the survey responses surprise you?
2. Why do you think parking providers (organizations that manage parking spaces) haven't pushed for more intelligent parking technology implementation? – Survey shows customers would feel the value added.

Appendix D - IPT Driver Survey

Intelligent Parking Technology Survey

I am conducting research into why parking providers appear reluctant to adopt intelligent parking technology. Intelligent parking technology holds the promise of increasing customer value as well as profits for parking providers. Technologies applicable to parking vehicles are wide ranging and may include payment by cell phone, systems that provide directions to empty parking spaces, RFID to automate payment as vehicles drive through a gate, etc…

This anonymous survey is designed to help us understand intelligent parking technology adoption from a customers' point of vu. You are under no obligation to answer this survey and there will be no repercussions if choose not to answer it. It should take 3 to 5 minutes to complete.

1) **Do you drive a vehicle?**

   A. Yes
   B. No

2) **Have you ever paid to park a vehicle?**

   a. .....Yes
   b. .....No

If the answer to questions 1 or 2 is NO, then please do not answer the rest of the survey

3) **Do you pay for parking on either a weekly, monthly or annual basis?**

   a. .....Yes
   b. .....No

4) **How often on average do you pay to "casually" park a vehicle? (e.g. when you are shopping, running errands, parking at the airport, etc.)**

a. .....Less than 4 times per month
b. .....4 to 10 times per month
c. .....More than 10 times per month

5) **When you pay to "casually" park a vehicle, how long on average would you say you park each time? (e.g. when you are shopping, running errands, at the airport, etc.)**

a. .....Less than 30 minutes
b. .....30 minutes to 2 hours
c. .....More than 2 hours

6) **How do you typically pay to park a vehicle?**

a. .....Coins
b. .....Credit/Debit Card
c. .....Automatically debited from paycheck
d. .....Other

7) **Have you, in the last 3 years, ever felt rushed to get back to your vehicle because you knew time was running out on your meter/parking permit?**

a. .....Yes
b. .....No

8) **Have you, in the last 3 years, received a parking ticket because the time ran out on your meter/parking permit while you were away from the vehicle?**

a. .....Yes
b. .....No

9) **Have you, in the last 3 years, found that you had no coins with you when you were wanting to park at a parking meter (or in a lot accepting only coins at the payment machine)?**

a. .....Yes
b. .....No

10) **Have you, in the last 3 years, ever felt unsafe in a parking lot/parkade?**

a. .....Yes
b. .....No

11) **Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose a lot offering intelligent parking technology over the other which does not? (All other variables being equal - including price)**

a. .....Very likely
b. .....Somewhat likely
c. .....Not sure
d. .....Somewhat unlikely
e. .....Very unlikely

12) **Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose the lot offering intelligent parking technology over the other which does not? (Given that parking charges are slightly higher in the lot offering intelligent parking technology)**

a. .....Very likely
b. .....Somewhat likely
c. .....Not sure
d. .....Somewhat unlikely
e. .....Very unlikely

13) **Have you, in the last 3 years, ever driven "around the block" looking for a no-charge parking spot when a parking lot or parking meter was readily available?**

a. .....Yes
b. .....No

14) **If the answer to Question 13 was "Yes", what was your reason for searching for a no-charge parking spot?**

a. .....Had no coins on hand to pay for parking
b. .....Did not want to pay for parking
c. .....Other
d. .....Not applicable

15) **Have you, in the last 3 years, ever driven "around the block" for more than 10 minutes looking for a parking spot?**

a. .....Yes
b. .....No

16) **Would you be willing to pay more for a parking space if intelligent parking technology added value for you? (e.g. increased convenience, quicker navigation to an empty spot, etc.)**

a. .....Yes
b. .....No

How much value would the following intelligent parking technologies offer you?

17) **Payment by cellular telephone**

a. .....A lot
b. .....A little
c. .....None
d. .....Not sure

18) **A system that could direct you to empty parking spaces**

a. .....A lot
b. .....A little
c. .....None
d. .....Not sure

19) **A system that allows for you to load value onto smart cards that you can then use to pay for parking in a specific parking lot.**

a. .....A lot
b. .....A little
c. .....None
d. .....Not sure

20) Wireless transmitters that impose and track charges as your vehicle travels through a gate.

a. .....A lot
b. .....A little
c. .....None
d. .....Not sure

21) A robotic parking system that moves your vehicle to a storage compartment after you leave your vehicle at the entrance of the parkade.

a. .....A lot
b. .....A little
c. .....None
d. .....Not sure

22) Internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter.

a. .....A lot
b. .....A little
c. .....None
d. .....Not sure

Thank you for taking the time to answer the survey. Have a good day!

Appendix E - IPT Driver Survey Results

Question 1:

Do you drive a vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	133	100.0	100.0	*100.0*
B	No	0	0	0	*100.0*
	Total	*133*	*100*	*100*	

Question 2:

Have you ever paid to park a vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	133	100.0	100.0	*100.0*
B	No	0	0	0	*100.0*
	Total	*133*	*100*	*100*	

Question 3:

Do you pay for parking on either a weekly, monthly or annual basis?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	65	48.9	48.9	*48.9*
B	No	67	50.4	50.4	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 4:

How often on average do you pay to "casually" park a vehicle? (e.g. when you are shopping, running errands, parking at the airport, etc.)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Less than 4 times per month	96	72.2	72.2	*72.2*
B	4 to 10 times per month	29	21.8	21.8	*94.0*
C	More than 10 times per month	8	6.0	6.0	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 5:

When you pay to "casually" park a vehicle, how long on average would you say you park each time? (e.g. when you are shopping, running errands, at the airport, etc.)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Less than 30 minutes	9	6.8	6.8	*6.8*
B	30 minutes to 2 hours	88	66.2	66.2	*72.9*
C	More than 2 hours	36	27.1	27.1	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 6:

How do you typically pay to park a vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Coins	96	72.2	72.2	*72.2*
B	Credit/Debit Card	36	27.1	27.1	*99.2*
C	Automatically debited from paycheck	1	.8	.8	*100.0*
D	Other	0	0	0	*100.00*
	Total	*133*	*100.0*	*100.0*	

Question 7:

Have you, in the last 3 years, ever felt rushed to get back to your vehicle because you knew time was running out on your meter/parking permit?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	113	85.0	85.0	*85.0*
B	No	20	15.0	15.0	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 8:

Have you, in the last 3 years, received a parking ticket because the time ran out on your meter/parking permit while you were away from the vehicle?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	76	57.1	57.1	*57.1*
B	No	57	42.9	42.9	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 9:

Have you, in the last 3 years, found that you had no coins with you when you were wanting to park at a parking meter (or in a lot accepting only coins at the payment machine)?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	111	83.5	83.5	*83.5*
B	No	22	16.5	16.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 10:

Have you, in the last 3 years, ever felt unsafe in a parking lot/parkade?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	75	56.4	56.4	*56.4*
B	No	58	43.6	43.6	*100.0*
	Total	133	100.0	100.0	

Question 11:

Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose a lot offering intelligent parking technology over the other which does not? (All other variables being equal - including price)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Very likely	62	46.6	46.6	*46.6*
B	Somewhat likely	38	28.6	28.6	*75.2*
C	Not sure	28	21.1	21.1	*96.2*
D	Somewhat unlikely	5	3.8	3.8	*100.0*
E	Very unlikely	0	0	0	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 12:

Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose the lot offering intelligent parking technology over the other which does not? (Given that parking charges are slightly higher in the lot offering intelligent parking technology)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Very likely	23	17.3	17.3	*17.3*
B	Somewhat likely	33	24.8	24.8	*42.1*
C	Not sure	27	20.3	20.3	*62.4*
D	Somewhat unlikely	33	24.8	24.8	*87.2*
E	Very unlikely	17	12.8	12.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 13:

Have you, in the last 3 years, ever driven "around the block" looking for a no-charge parking spot when a parking lot or parking meter was readily available?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	123	92.5	92.5	*92.5*
B	No	10	7.5	7.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 14:

If the answer to Question 13 was "Yes", what was your reason for searching for a no-charge parking spot?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Had no coins on hand to pay for parking	24	18.0	18.0	*18.0*
B	Did not want to pay for parking	101	75.9	75.9	*94.0*
C	Other	2	1.5	1.5	*95.5*
D	Not applicable	6	4.5	4.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 15:

Have you, in the last 3 years, ever driven "around the block" for more than 10 minutes looking for a parking spot?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	61	45.9	45.9	*45.9*
B	No	72	54.1	54.1	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 16:

Would you be willing to pay more for a parking space if intelligent parking technology added value for you? (e.g. increased convenience, quicker navigation to an empty spot, etc.)

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	Yes	88	66.2	66.2	*66.2*
B	No	44	33.1	33.1	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 17:

Value offered by payment by cellular telephone?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	43	32.3	32.3	*32.3*
B	A little	55	41.4	41.4	*73.7*
C	None	28	21.1	21.1	*94.7*
D	Not sure	6	4.5	4.5	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 18:

Value offered by a system that could direct you to empty parking spaces?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	66	49.6	49.6	*49.6*
B	A little	60	45.1	45.1	*94.7*
C	None	5	3.8	3.8	*98.5*
D	Not sure	2	1.5	1.5	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 19:

Value offered by a system that allows for you to load value onto smart cards that you can then use to pay for parking in a specific parking lot?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	47	35.3	35.3	*35.3*
B	A little	64	48.1	48.1	*83.5*
C	None	19	14.3	14.3	*97.7*
D	Not sure	3	2.3	2.3	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 20:

Value offered by wireless transmitters that impose and track charges as your vehicle travels through a gate?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	31	23.3	23.3	*23.3*
B	A little	56	42.1	42.1	*65.4*
C	None	28	21.1	21.1	*86.5*
D	Not sure	17	12.8	12.8	*99.2*
	Invalid Response	1	.8	.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 21:

Value offered by a robotic parking system that moves your vehicle to a storage compartment after you leave your vehicle at the entrance of the parkade?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	50	37.6	37.6	*37.6*
B	A little	31	23.3	23.3	*60.9*
C	None	35	26.3	26.3	*87.2*
D	Not sure	17	12.8	12.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Question 22:

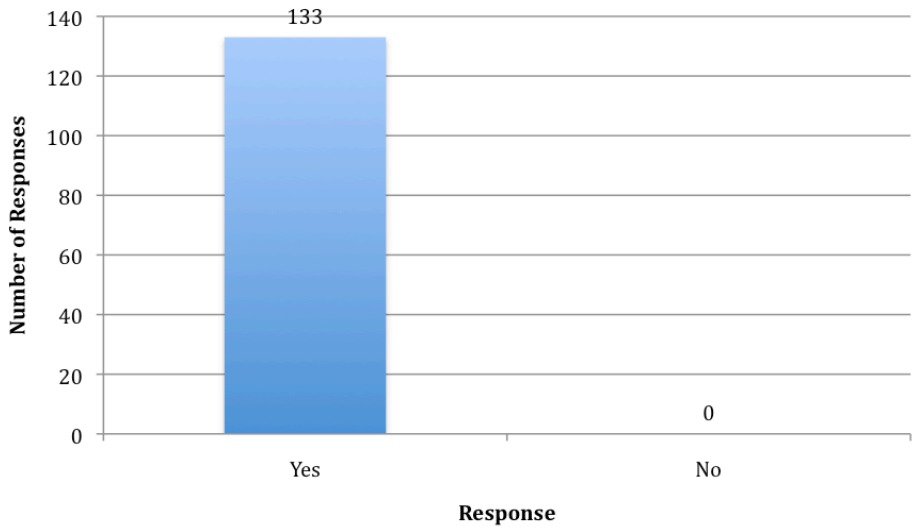
Value offered by Internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter?

Response		Frequency	Percent	Valid Percent	Cumulative Percent
A	A lot	41	30.8	30.8	*30.8*
B	A little	68	51.1	51.1	*82.0*
C	None	11	8.3	8.3	*90.2*
D	Not sure	13	9.8	9.8	*100.0*
	Total	*133*	*100.0*	*100.0*	

Appendix F - IPT Driver Survey Results (Graphical Representation)

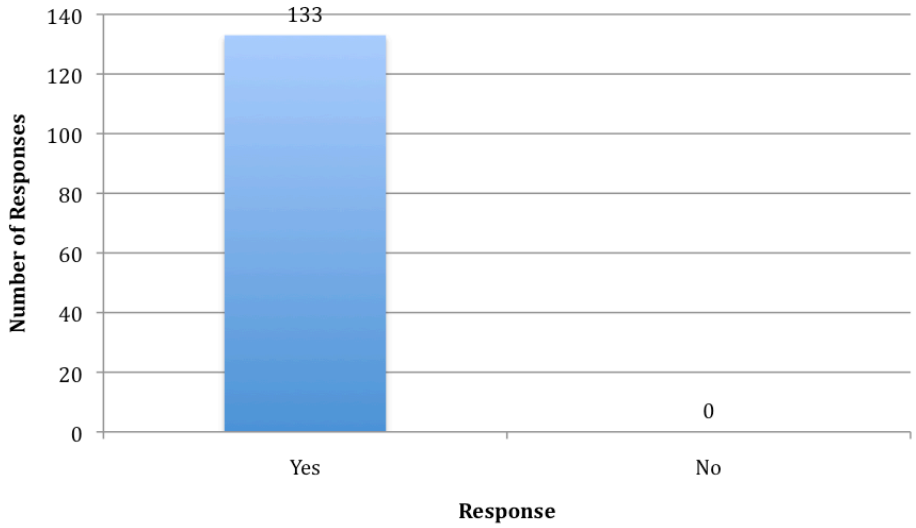
Question 1:

Do you drive a vehicle?



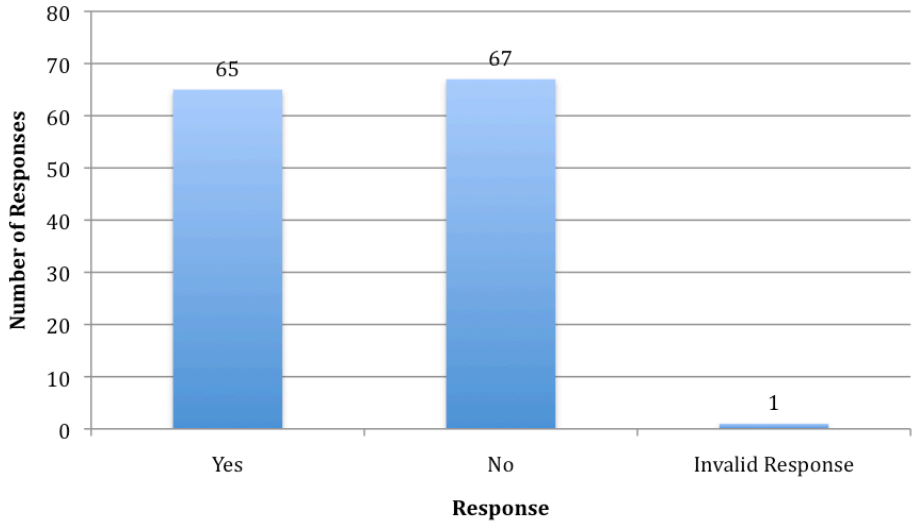
Question 2:

Have you ever paid to park a vehicle?



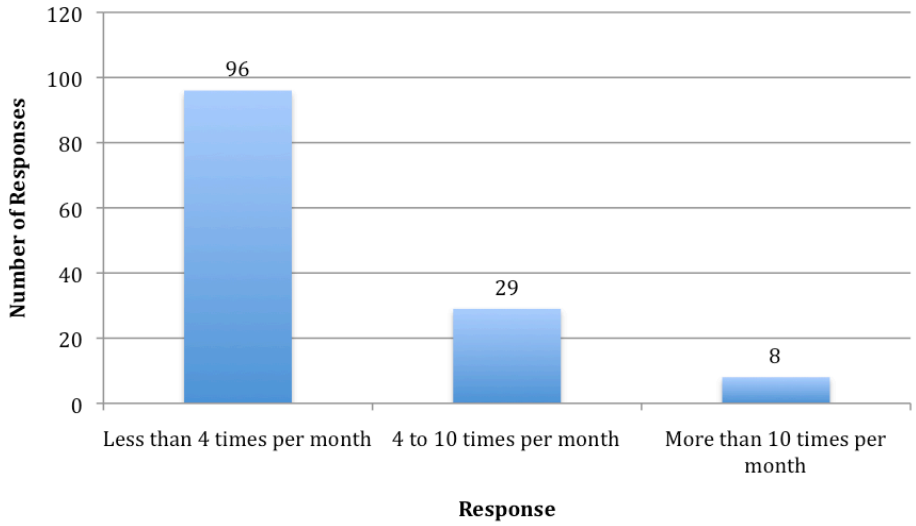
Question 3:

Do you pay for parking on either a weekly, monthly or annual basis?



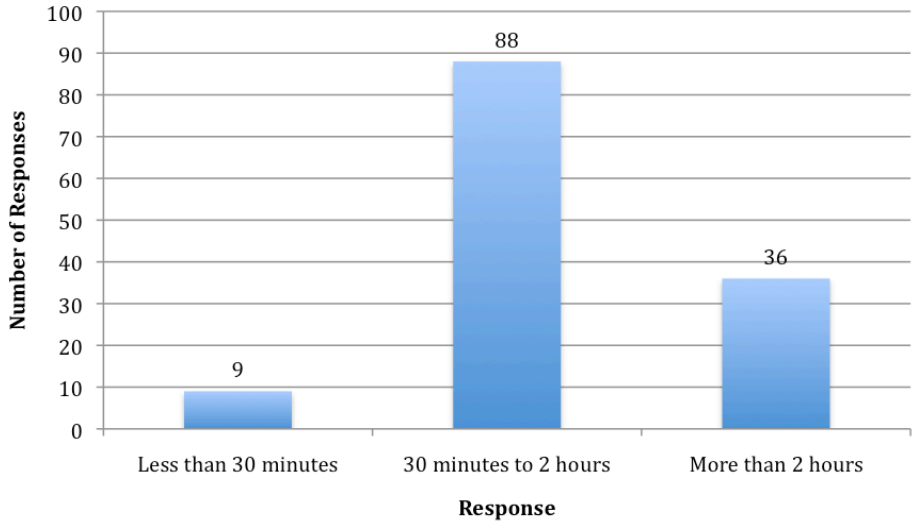
Question 4:

How often on average do you pay to "casually" park a vehicle? (e.g. when you are shopping, running errands, parking at the airport, etc.)



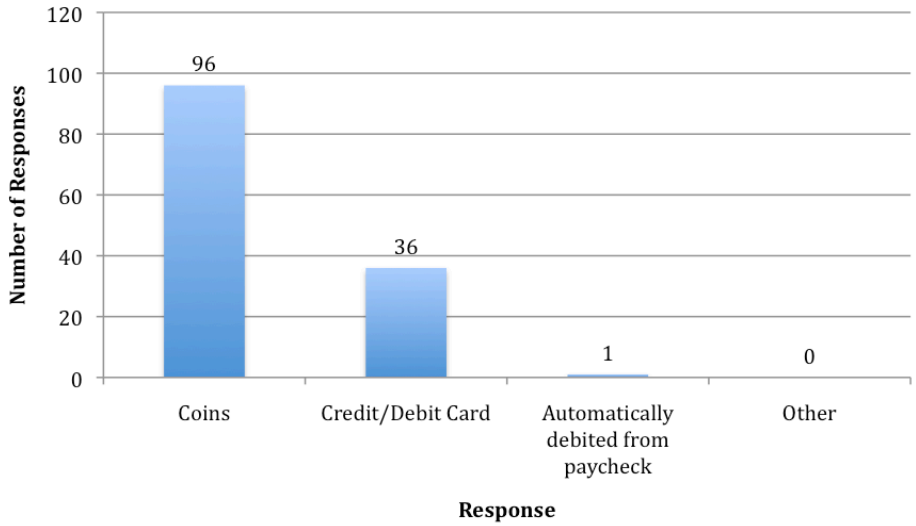
Question 5:

When you pay to "casually" park a vehicle, how long on average would you say you park each time? (e.g. when you are shopping, running errands, at the airport, etc.)



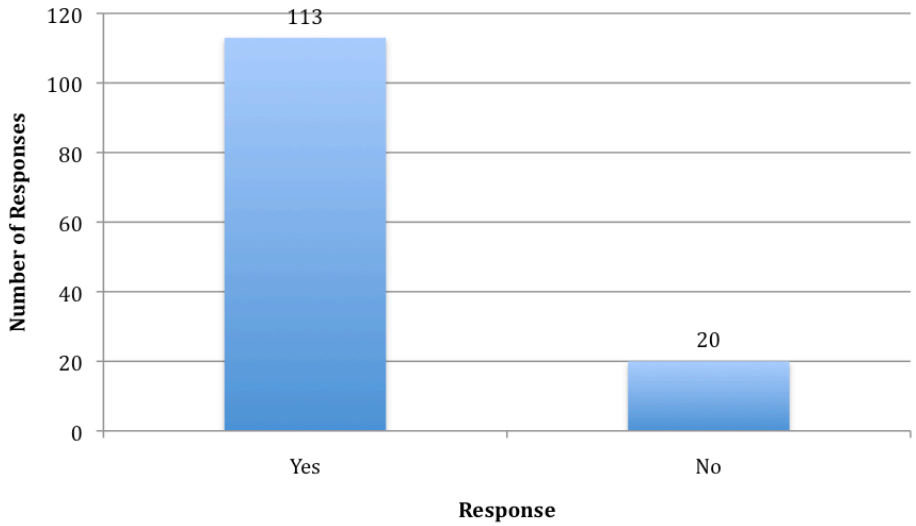
Question 6:

How do you typically pay to park a vehicle?



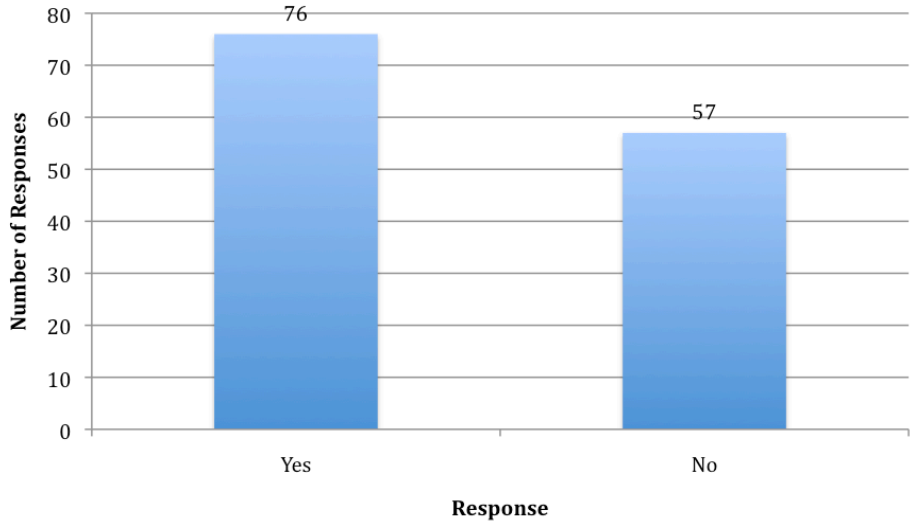
Question 7:

Have you, in the last 3 years, ever felt rushed to get back to your vehicle because you knew time was running out on your meter/parking permit?



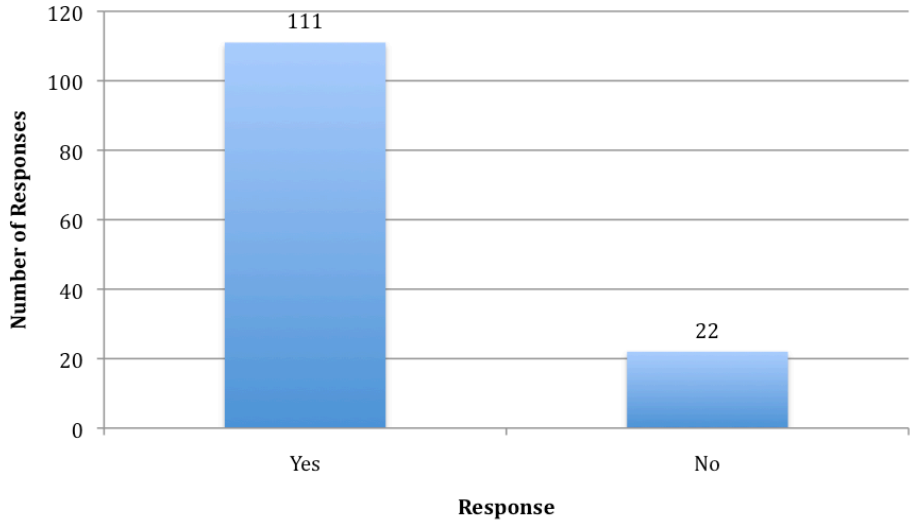
Question 8:

Have you, in the last 3 years, received a parking ticket because the time ran out on your meter/parking permit while you were away from the vehicle?



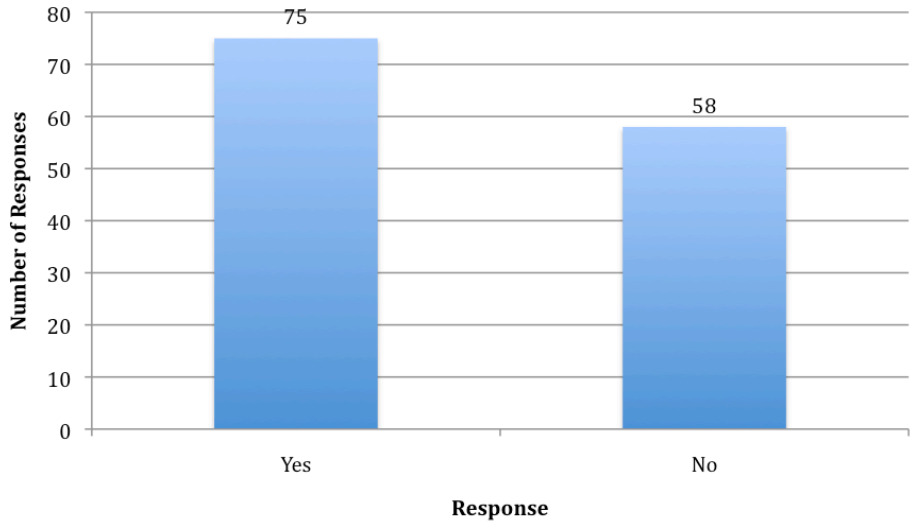
Question 9:

Have you, in the last 3 years, found that you had no coins with you when you were wanting to park at a parking meter (or in a lot accepting only coins at the payment machine)?



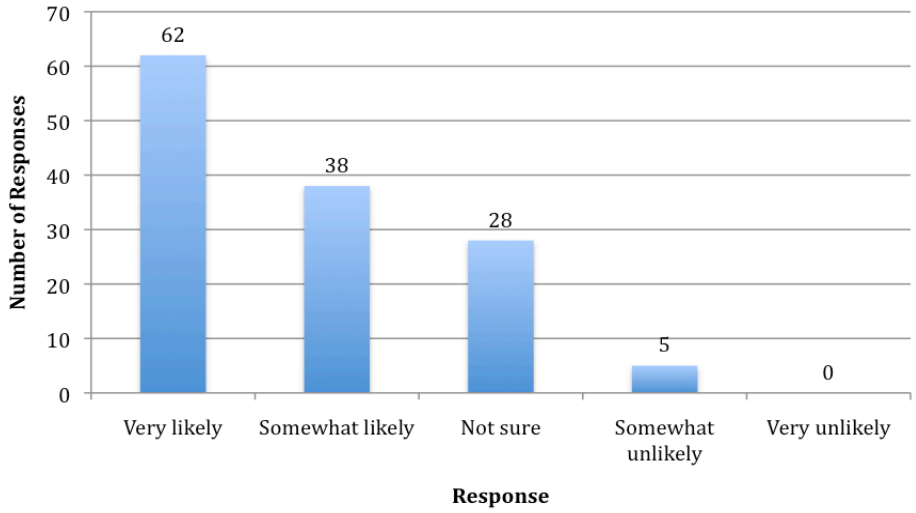
Question 10:

Have you, in the last 3 years, ever felt unsafe in a parking lot/parkade?



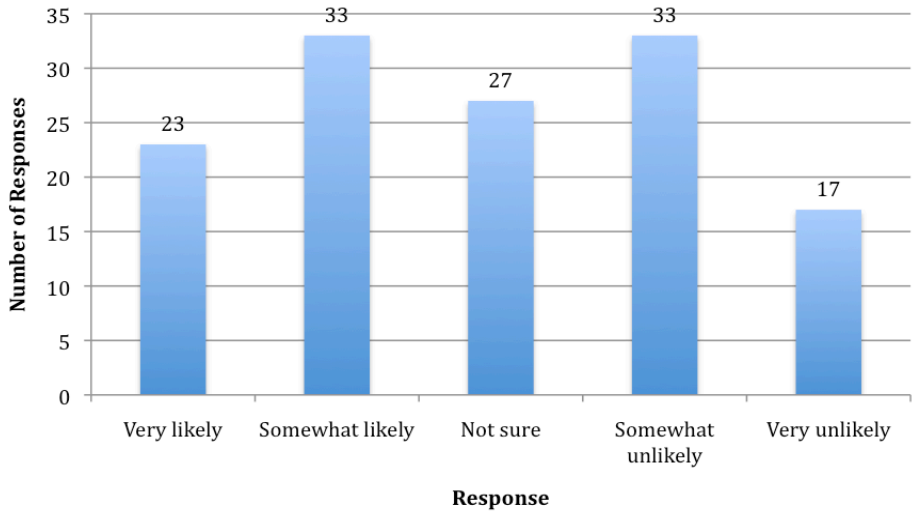
Question 11:

Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose a lot offering intelligent parking technology over the other which does not? (All other variables being equal - including price)



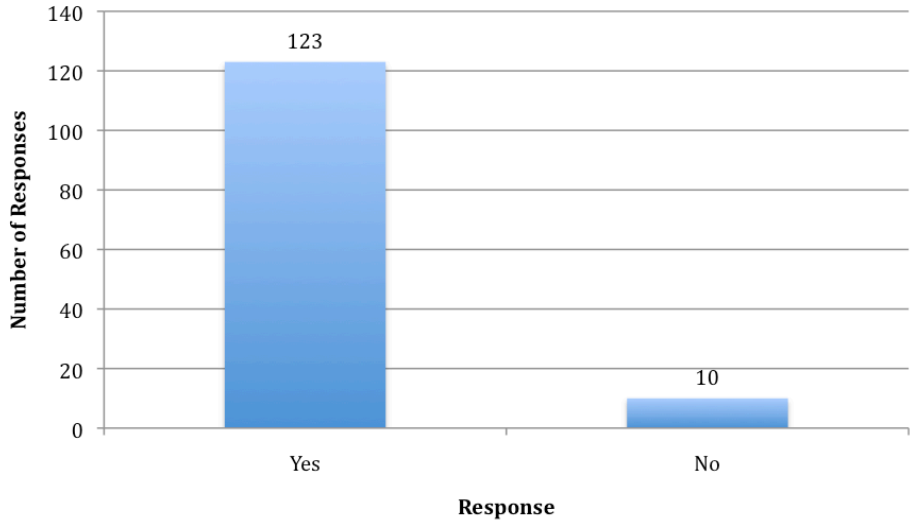
Question 12:

Given the choice to park in either of two parking lots side-by-side, how likely would you be to choose the lot offering intelligent parking technology over the other which does not? (Given that parking charges are slightly higher in the lot offering intelligent parking technology)



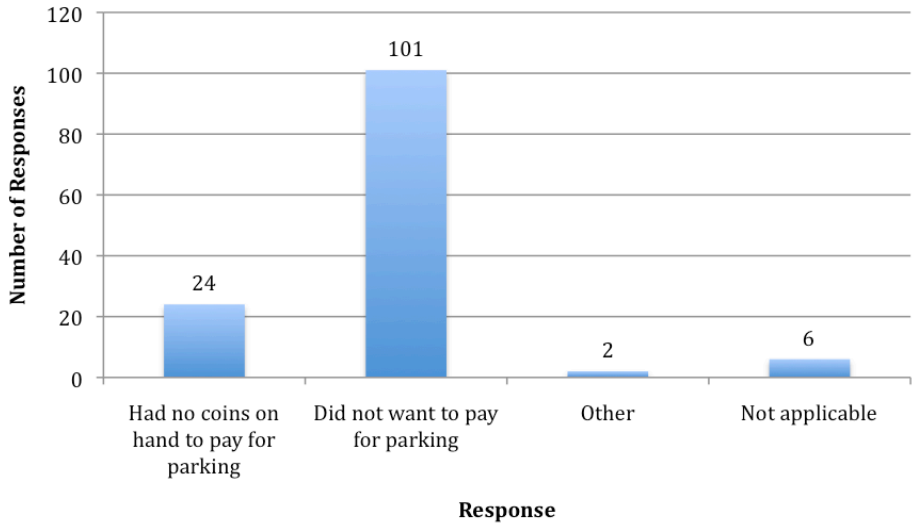
Question 13:

Have you, in the last 3 years, ever driven "around the block" looking for a no-charge parking spot when a parking lot or parking meter was readily available?



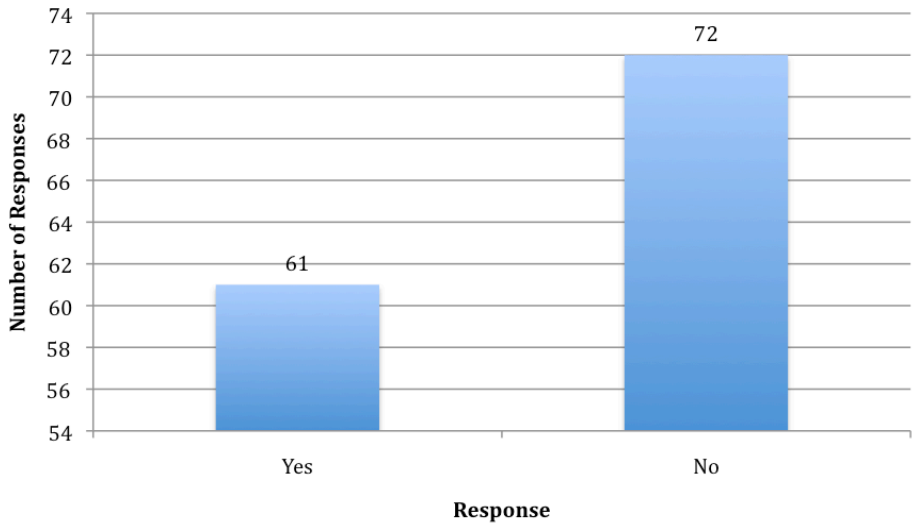
Question 14:

If the answer to Question 13 was "Yes", what was your reason for searching for a no-charge parking spot?



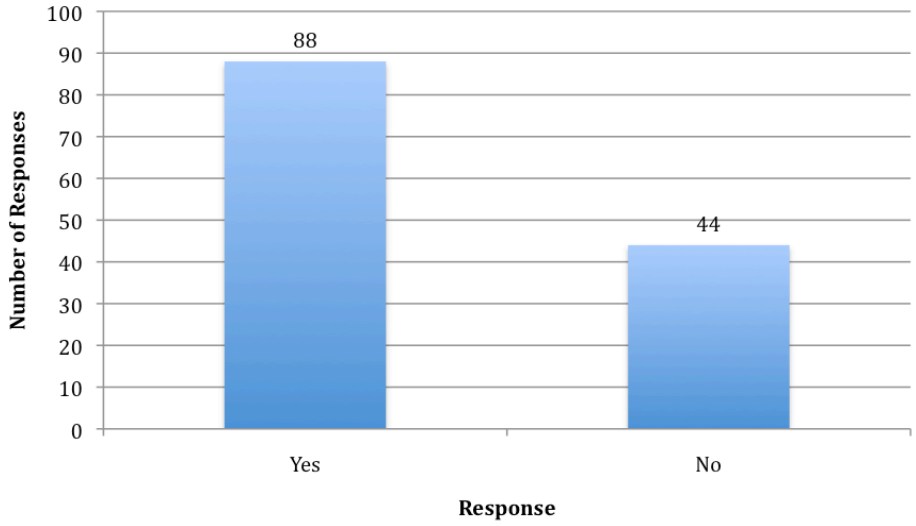
Question 15:

Have you, in the last 3 years, ever driven "around the block" for more than 10 minutes looking for a parking spot?



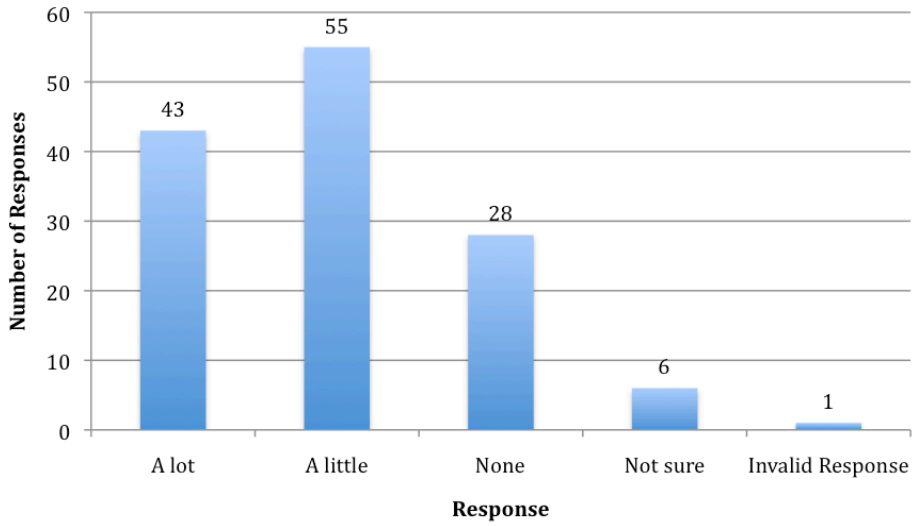
Question 16:

Would you be willing to pay more for a parking space if intelligent parking technology added value for you? (e.g. increased convenience, quicker navigation to an empty spot, etc.)



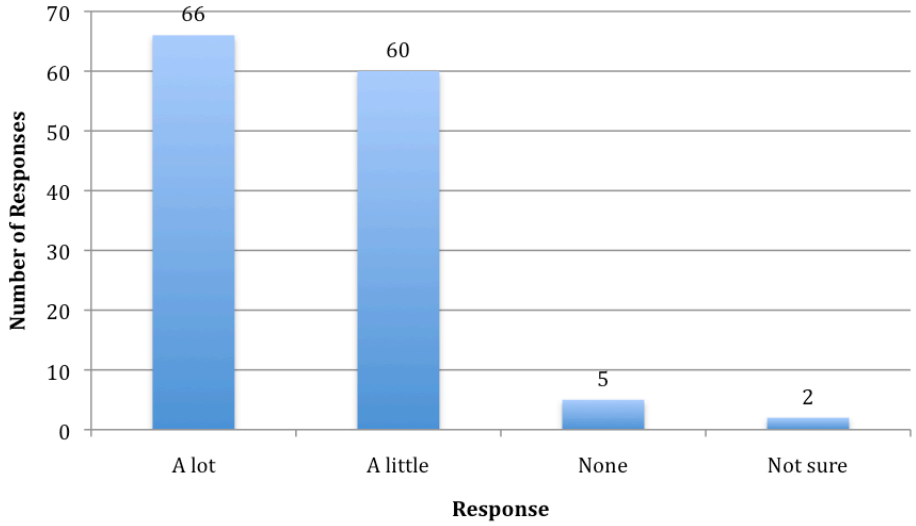
Question 17:

Value offered by payment by cellular telephone?



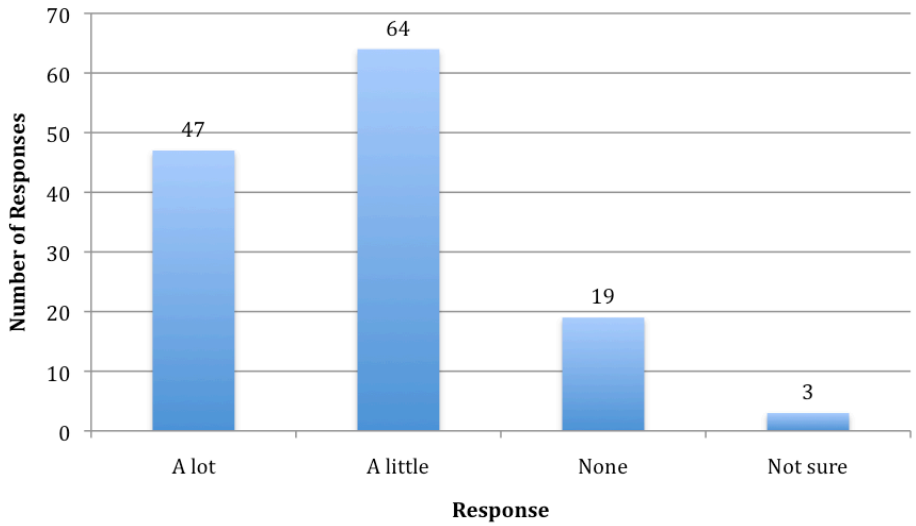
Question 18:

Value offered by a system that could direct you to empty parking spaces?



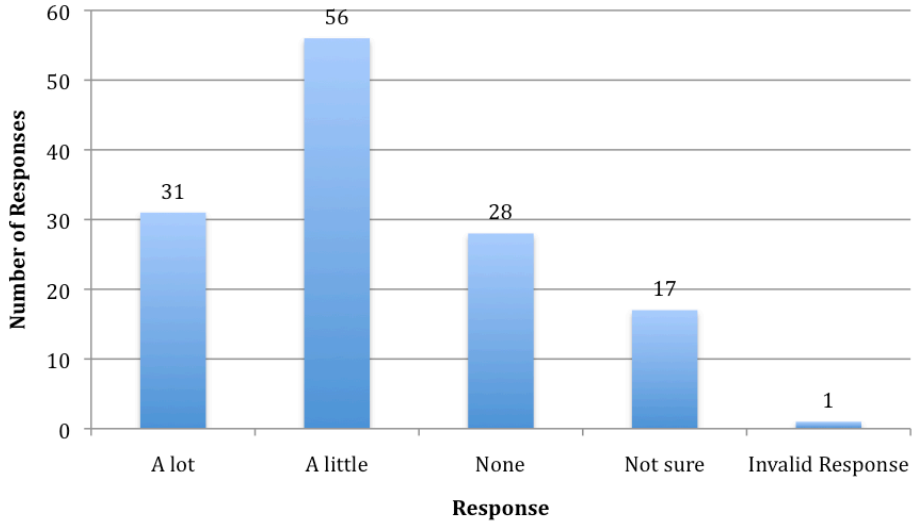
Question 19:

Value offered by a system that allows for you to load value onto smart cards that you can then use to pay for parking in a specific parking lot?



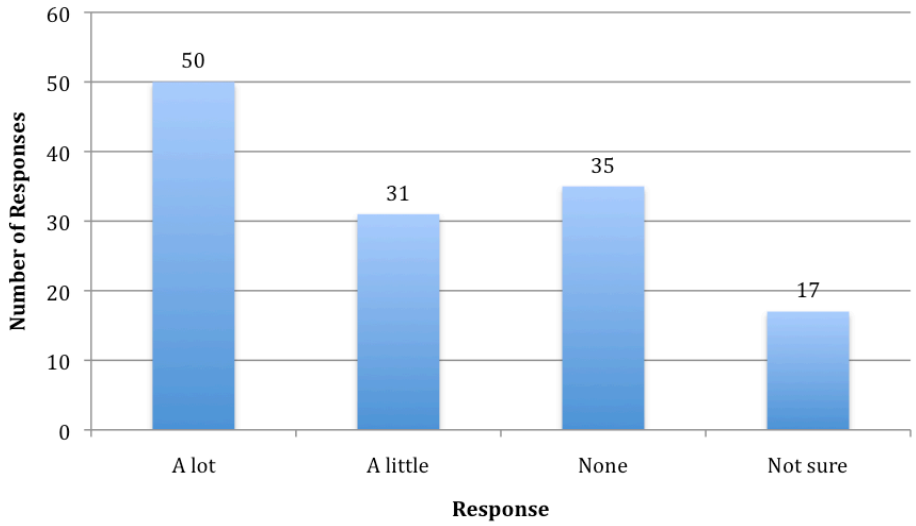
Question 20:

Value offered by wireless transmitters that impose and track charges as your vehicle travels through a gate?



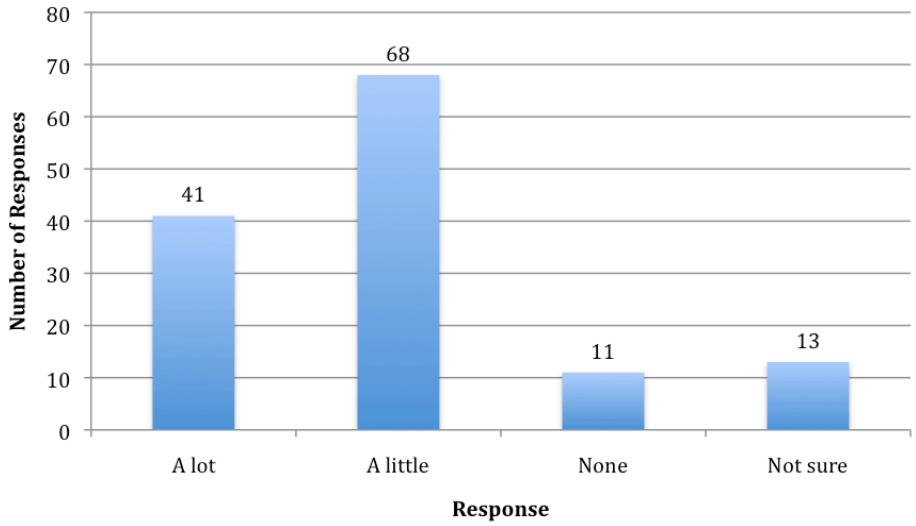
Question 21:

Value offered by a robotic parking system that moves your vehicle to a storage compartment after you leave your vehicle at the entrance of the parkade?



Question 22:

Value offered by Internet enabled parking meters that wirelessly verify an account and activate it when a driver waves a key fob in front of the meter?



Appendix G – Summary of Data from Content Expert Interviews

Initial Interview questions

- Question 1 (Q1): How many parking spaces does your organization manage?
- Question 2 (Q2): What type of parking spaces does your organization manage?
- Question 3 (Q3): Has your organization adopted any "intelligent" technologies? If so, what are they? (e.g. pay by cell, equipment to direct drivers to empty stalls, RFID tags for regular parkers, monitoring equipment, internet based metering, etc…)
- Question 4 (Q4): If not, have you considered it? Why or Why not?
- Question 5 (Q5): Does your organization have a "mission/vision" statement with regards to parking services?
- Question 6 (Q6): Do you feel your organization is in a competitive market (e.g. other local parkades, etc.)
- Question 7 (Q7): Have you developed any relationships with parking technology companies? If so, have they contacted you or have you contacted them?
- Question 8 (Q8): How important is it for the parking services department in your organization to maximize efficiency with regards to delivery of parking services?

Follow-up interview questions

- Question 1F (Q1F): Do any of the survey responses surprise you?
- Question 2F (Q2F): Why do you think parking providers (organizations that manage parking spaces) haven't pushed for more intelligent parking technology implementation? – Survey shows customers would feel the value added.

#	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q1F	Q2F
A	Over 7,000	• Cashier Kiosk	No	"Looking into it"	Yes	"Not really"	No contact	Important to maximize efficiency	"A lot of people said they would pay extra for IPT yet they'll drive around the block because they don't want to pay!" Q12, Q13 & Q14	"Parking providers may make more money giving tickets than they do charging for a space"
B	Over 8,000	• Meters • Cashier Kiosk	No	"We are considering it"	Yes	"Not really"	Received 2 cold calls, but no follow up from parking technology company	Important to maximize efficiency	"Question 10 on feeling safe surprised me. That tells us something." Q10	"Managers are already busy enough and having to research and then risk an implementation is asking a lot"

C	Over 3,000	• RFID Cards for monthly pass holders • Meters • Remote payment station	Only RFID cards for monthly pass holders	"Looking into smart card to charge other things to"	Yes	Yes	No contact	Important to maximize efficiency	"A lot of people felt unsafe at one point or another in a parking lot!" Q10	"Governments are keeping a close eye on budgets and expenses"
D	Over 15,000	• Meters • Remote payment station • Cashier Kiosk	Yes	"Always keeping an eye out for this sort of stuff"	Yes	Yes	"No comment"	Important to maximize efficiency	"No real surprises, interesting to see how they value different technologies though."	"No comment"

E	Over 20,000	• Meters • Cashier Kiosk	No	"We are currently considering it"	Yes	Yes	Are in talks with Parking Technology Company	Important to maximize efficiency	"That's a lot of people driving around for nothing." Q15	"I think they are, they are maybe just waiting to see what others do first"
F	Over 2,000	• Meters • Cashier Kiosk	"In a limited way, we have"	"We're always evaluating new technologies"	Yes	"A bit"	No contact	Important to maximize efficiency	"More people got parking tickets in the last 3 years than I would have expected." Q8	"I think they are still evaluating which technologies will work best with the spaces they manage"

Appendix H – Summary of Data from Parking Technology Company

Initial interview with senior manager from Parking Technology Company

- Question 1 (PTQ1): What type of parking technology does your company offer?
- Question 2 (PTQ2): Do you licence the technology, sell it or both?
- Question 3 (PTQ3): What benefits do you feel your intelligent parking technology offers the customer? The parking provider?
- Question 4 (PTQ4): Have you been in touch with many parking providers to communicate what you have to offer them?
- Question 5 (PTQ5): Have you communicated what you offer with drivers directly?
- Question 6 (PTQ6): Do you feel your organization is in a competitive market (i.e. Are there other technologies you are competing with?)
- Question 7 (PTQ7): Have you developed any relationships with other companies involved in the parking industry? For example, parking meter manufacturers, etc.
- Question 8 (PTQ8): Why do you think the parking providers appear reluctant to adopt intelligent parking technologies?

Follow-up interview with senior manager from Parking Technology Company to review survey results

- Question 1 (PTQ1F): Do any of the survey responses surprise you?
- Question 2 (PTQ2F): Why do you think parking providers (organizations that manage parking spaces) haven't pushed for more intelligent parking technology implementation? – Survey shows customers would feel the value added

#	PTQ1	PTQ2	PTQ3	PTQ4	PTQ5	PTQ6	PTQ7	PTQ8	PTQ1F	PTQ2F
1	*The researcher has hidden the answer to this question to protect the identity of the company*	"We primarily license the technology although we might be interested in selling the whole company if the price is right"	"Easier for the customer, more profits for the parking provider."	"We have been in touch with all of the major ones and continue to communicat e with them."	"No, but many of them have seen this technology in a limited way. A parking lot here and there."	"There is competition in the parking technology industry, but our patents give us a competitive advantage over the others"	"We are discussing the possibility of some sort of partnership with a company that manufacture s…" (older parking technologies)	"Many of them haven't crunched the numbers to see how beneficial this would be for them. That and they're waiting for someone else to move first so they can make sure it works"	"Not at all."	"Most of them are old and lazy and waiting for their pensions to kick-in! They don't want to rock the boat."