Presentations based on this dissertation include the following:

Western Academy of Management

Bilodeau, V, Soar, J, & Cater-Steel, A, 2010, *Intelligent Parking Technologies - Do the Benefits Outweigh the Costs?*, Kailua-Kona, Hawaii, March 24 to March 28, 2010.

Administrative Sciences Association of Canada

Bilodeau, V, Soar, J, 2008, *Intelligent Parking Technology Adoption by the Parking Industry*, Halifax, Nova Scotia, Canada, May 24 to May 27, 2008.

Intelligent Parking Technology Adoption

A Dissertation submitted by

Victor P. Bilodeau

B.Sc. (Biochemistry), B.Ed. (Sciences), MBA (Technology Commercialization)

In partial fulfilment of the award of

Doctor of Business Administration
Faculty of Business, University of Southern Queensland

July 2010

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

_____ _____

_____ _____

Signature of Supervisor/s Date

Acknowledgements

I would like to give a sincere thank you to Dr. Jeffrey Soar and Dr. Aileen Cater-Steel for their sincere support, patience, encouragement and guidance. I am also grateful for the contributions of Dr. Ronel Erwee and all staff at USQ I have been in contact with. They have all worked as an empathetic and cohesive unit to make my experience at USQ a positive one.

The administration at the MacEwan School of Business – Grant MacEwan University also deserve recognition for not only giving me a stable teaching/research position that I truly enjoy, but also for their genuine encouragement and support for me pursuing this doctorate degree.

My peers deserve special thanks for their support. They have consistently answered my questions in a straightforward and honest way. I appreciate this very much.

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.

Table of Contents

Abstract ..... **i**

Certification of Dissertation ..... **iii**

Acknowledgements ..... **iv**

Table of Contents ..... **v**

List of Appendices ..... **xi**

List of Tables ..... **xii**

List of Figures ..... **xiv**

1 INTRODUCTION **1**

1.1 Background and Significance of the Research **1**

1.2 Research problem, research issues and contributions **3**

1.2.1.1 Customer Factors Affecting IPT Adoption by the Parking Industry ...6

1.2.1.2 Parking Provider Factors Affecting IPT Adoption by the Parking Industry 6

1.2.1.3 Technological Factors Affecting IPT Adoption by the Parking Industry 7

1.2.1.4 Other Factors Affecting IPT Adoption by the Parking Industry 7

1.3 Justification for the research **9**

1.3.1 Importance of parking technology research 9

1.3.2 Gaps in literature 9

1.3.3 Benefits of outcomes 11

1.4 Brief Overview of Research Methodology **12**

1.5 Outline of this dissertation **14**

1.6 Key Definitions and Terminology **16**

1.7 Delimitations of scope and key assumptions, with their justifications **18**

1.8 Summary 19

2 LITERATURE REVIEW AND RESEARCH ISSUES 20

2.1 Introduction 20

2.2 Parent theories and classification models 24

2.2.1 Historical Development 24

2.2.2 Parent Theory 24

2.2.2.1 Major Adoption Models 25

2.2.2.2 Major Diffusion Models 27

2.3 Research problem theory 28

2.3.1 Theoretical Frameworks 28

2.3.2 Relationships 37

2.3.3 Propositions 39

2.3.4 Constructs 41

2.3.4.1 Customer Factors Affecting IPT Adoption by the Parking Industry 43

2.3.4.2 Parking Provider Factors Affecting IPT Adoption by the Parking Industry 44

2.3.4.3 Technological Factors Affecting IPT Adoption by the Parking Industry 44

2.3.4.4 Other Factors Affecting IPT by the Parking Industry 44

2.3.5 Research issues 45

2.3.5.1 Customer Factors Affecting IPT Adoption by the Parking Industry 46

2.3.5.2 Parking Provider Factors Affecting IPT Adoption by the Parking Industry 47

2.3.5.3 Technological Factors Affecting IPT Adoption by the Parking Industry 49

2.3.5.4 Other Factors Affecting IPT by the Parking Industry 50

2.4 Summary 51

3 ANALYTICAL FRAMEWORK 54

3.1 Introduction 54

3.2 Interviews: Refinement of the Research Focus 54

3.2.1 Interview Design and Preparation 55

3.2.2 Data Analysis 57

3.3 Identification of Relevant Determinants 57
3.4 Presentation of Analytical Model 59
3.5 Summary 64
4 RESEARCH METHODOLOGY 66
4.1 Introduction 66
4.2 Justification for the research paradigm and methodology 66
4.2.1 Ontology 66
4.2.2 Epistemology 67
4.2.3 Methodology 67
4.2.4 Validity 71
4.2.5 Role of prior theory 71
4.3 Justification of the Delphi Method 71
4.4 Presenting the sample 72
4.5 Data collection procedures 74
4.5.1 Sources of Data 74
4.5.2 General Data Collection Protocol 75
4.5.2.1 Interviews 75
4.5.2.2 Surveys 76
4.5.3 Data Collection Instruments 76
4.6 Data processing and analysis 76
4.6.1 Industry Expert Interviews (Qualitative Data) 76
4.6.2 Assumptions 77
4.6.3 Limitations 77
4.6.4 Ethical considerations and clearance 78
4.7 Summary 78
5 ANALYSIS OF DATA 79
5.1 Introduction 79
5.2 Subjects 80
5.3 Initial Interviews 80
5.4 Driver Surveys 82

5.4.1 Question categories, research issues and related previous research 82
5.5 Analysis of Survey Data (Quantitative) 88
5.5.1 Introduction 88
5.5.2 Survey Results and Findings 89
5.5.3 Driver Attitudes towards Intelligent Parking Technology (IPT) 101
5.5.3.1 Driver willingness to pay extra for specific parking technologies. 101
5.6 Analysis of Interview Data (Qualitative) 113
5.6.1 Introduction 113
5.6.2 Summary of Qualitative Data 114
5.6.2.1 Summary of Data from Content Experts (Parking Providers) 114
5.6.2.2 Summary of Data from Senior Level Manager for Parking Technology Company 114
5.6.3 Results and Findings for Research Issue 1 115
5.6.4 Results and Findings for Research Issue 2 117
5.6.5 Results and Findings for Research Issue 3 117
5.6.6 Results and Findings for Research Issue 4 118
5.6.7 Results and Findings for Research Issue 5 118
5.6.8 Results and Findings for Research Issue 6 119
5.6.9 Results and Findings for Research Issue 7 119
5.6.10 Results and Findings for Research Issue 8 120
5.6.11 Results and Findings for Research Issue 9 120
5.6.12 Results and Findings for Research Issue 10 121
5.6.13 Results and Findings for Research Issue 11 122
5.7 Summary 123
6 CONCLUSIONS AND IMPLICATIONS 124
6.1 Introduction 124
6.2 Cross-Method Synthesis 126
6.2.1 Research Issue 1: What can intelligent parking technology offer to the customer? 127

6.2.2 Research Issue 2: Are parking customers willing to adopt intelligent parking technology? 128
6.2.3 Research Issue 3: What can intelligent parking technology offer to the parking providers? 128
6.2.4 Research Issue 4: Are parking providers willing to license intelligent technology? And why? 130
6.2.5 Research Issue 5: How might future technological advances render newly implemented parking technology obsolete? 130
6.2.6 Research Issue 6: What intelligent technologies are available and accessible by the majority of parking customers? 131
6.2.7 Research Issue 7: What are suitable technology interfaces for customers and parking provider employees? 132
6.2.8 Research Issue 8: How will intelligent parking technology integrate with the various parking methods available to drivers? 132
6.2.9 Research Issue 9: Who *really* makes the decisions to adopt new technologies for the parking provider? 133
6.2.10 Research Issue 10: What motivates a parking provider to follow through on adoption of a new parking technology? 134
6.2.11 Research Issue 11: What are the real and perceived relationships between technology companies, parking providers and customers? 135
6.3 Conclusions about the Research Problem 137
6.4 Implications for Theory 139
6.5 Implications for Management Practice 141
6.5.1 Parking Providers 141
6.5.2 Parking Technology Companies 141
6.5.3 Reflection and learning 141
6.6 Limitations of the Research 142
6.6.1 Interviewee Selection 142
6.6.2 Quality of Qualitative Data 142
6.6.3 Consistency of Qualitative Data 143
6.6.4 Quality of Quantitative Driver Survey Data 144

6.6.5 Consistency of Quantitative Driver Survey Data 144
6.7 Implications for Methodology 145
6.8 Directions for Future Research 145
7 GLOSSARY 147
8 REFERENCES 148
Appendix A - Consent form 168
Appendix B - Interview Guide for Parking Providers 170
Appendix C - Interview Guide - Parking Technology Company ... 171
Appendix D - IPT Driver Survey 172
Appendix E - IPT Driver Survey Results 178
Appendix F - IPT Driver Survey Results (Graphical Representation) 189
Appendix G – Summary of Data from Content Expert Interviews 200
Appendix H – Summary of Data from Parking Technology Company 204

List of Appendices

APPENDIX A - CONSENT FORM 168
APPENDIX B - INTERVIEW GUIDE FOR PARKING PROVIDERS 170
APPENDIX C - INTERVIEW GUIDE - PARKING TECHNOLOGY COMPANY 171
APPENDIX D - IPT DRIVER SURVEY 172
APPENDIX E - IPT DRIVER SURVEY RESULTS 178
APPENDIX F - IPT DRIVER SURVEY RESULTS (GRAPHICAL REPRESENTATION) 189
APPENDIX G – SUMMARY OF DATA FROM CONTENT EXPERT INTERVIEWS 200
APPENDIX H – SUMMARY OF DATA FROM PARKING TECHNOLOGY COMPANY 204

List of Tables

TABLE 1.1 – ADOPTION MODELS 5
TABLE 1.2 – DIFFUSION MODELS 5
TABLE 2.1 - ADOPTION MODELS 25
TABLE 2.2 - DIFFUSION MODELS 27
TABLE 2.3 - MORE RECENT RESEARCH & MODELS 30
TABLE 2.4 – CONSTRUCT AND RESEARCH ISSUE RELATIONSHIPS 45
TABLE 5.1 - CATEGORIES FOR TYPES AND PURPOSE OF SURVEY QUESTIONS TO ASK DRIVERS 81
TABLE 5.2 - DRIVER SURVEY QUESTIONS AS THEY RELATE TO CATEGORY, RESEARCH ISSUES AND PREVIOUS RESEARCH 83
TABLE 5.4 – CHI-SQUARE TEST FOR RELATEDNESS OF FIT BETWEEN WILLINGNESS TO PAY FOR IPT AND VALUE RECEIVED FROM PAYMENT BY CELLULAR TELEPHONE 102
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 103
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 105
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 107
TABLE 5.8 – CHI-SQUARE TEST FOR RELATEDNESS OF FIT BETWEEN WILLINGNESS TO PAY FOR IPT AND VALUE RECEIVED FROM ROBOTIC PARKING SYSTEM 109
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 111
TABLE 5.10 – SUMMARY OF HYPOTHESIS TESTING 112

TABLE 6.1 - VALUE OFFERED BY IPT'S THAT FACILITATE PAYMENT FOR A PARKING SPACE 127
TABLE 6.2 - VALUE OFFERED BY OTHER IPT'S 127
TABLE 6.3 – DRIVER WILLINGNESS TO PAY MORE FOR IPT THAT ADDS VALUE 133

List of Figures

FIGURE 1.1 - OUTLINE OF THE STUDY 14
FIGURE 2.1 - ANALYTICAL STRUCTURE OF THE LITERATURE REVIEW 23
FIGURE 2.2 – DIFFUSION OF INNOVATION 28
FIGURE 2.3 - VISUAL REPRESENTATION OF PARKING TECHNOLOGY COMPANIES USING DRIVERS TO "PULL" THEIR PRODUCTS THROUGH PARKING PROVIDERS 40
FIGURE 2.4 – VISUAL REPRESENTATION OF PARKING TECHNOLOGY COMPANIES "PUSHING" THEIR PRODUCTS ON PARKING PROVIDERS 40
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 41
FIGURE 2.6 – VISUAL REPRESENTATION OF THEORETICAL FRAMEWORK 42
FIGURE 3.1 – STEPS TAKEN DURING INITIAL INTERVIEWS WITH PARKING PROVIDERS 56
FIGURE 3.2 – FILTERS TO IPT ADOPTION 58
FIGURE 3.3 – REVISED VISUAL REPRESENTATION OF ANALYTICAL FRAMEWORK 62
FIGURE 4.1 - PARTIES INVOLVED IN ADOPTION OF INTELLIGENT PARKING TECHNOLOGIES 68
FIGURE 4.2 - SUMMARY OF PRIMARY DATA COLLECTION PROCEDURE 74
FIGURE 6.1 - PARTIES INVOLVED IN ADOPTION OF INTELLIGENT PARKING TECHNOLOGIES 136