AGILE BASED DEVELOPMENT METHODOLOGY FOR MOBILE COMMERCE APPLICATIONS

MUAZZAN BINSALEH

DOCTOR OF PHILOSOPHY
UNIVERSITI UTARA MALAYSIA
2012
Permission to Use

In presenting this thesis in fulfilment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the Universiti Library may make it freely available for inspection. I further agree that permission for the copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor(s) or, in their absence, by the Dean of Awang Had Salleh Graduate School of Arts and Sciences. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part, should be addressed to:

Dean of Awang Had Salleh Graduate School of Arts and Sciences
UUM College of Arts and Sciences
Universiti Utara Malaysia
06010 UUM Sintok
Abstrak

Terdapat beberapa metodologi pembangunan sistem termasuk kaedah tradisional dan tangkas yang digunakan dalam pembangunan sistem semasa. Walau bagaimanapun, ia boleh dikatakan bahawa metodologi yang sedia ada mungkin tidak sesuai untuk pembangunan aplikasi perdagangan mudah alih. Aplikasi ini digunakan dalam konteks yang berbeza dari aplikasi konvensional e-dagang tetap seperti paparan pada peranti skrin yang kecil, persekitaran yang tidak stabil atau yang dipindah-pindahkan dan keperluan kepada aspek keselamatan untuk menyampaikan transaksi kewangan melalui rangkaian mudah alih. Penyelidikan ini bertujuan untuk membina metodologi pembangunan berasaskan tangkas bagi aplikasi perdagangan mudah alih. Untuk mencapai matlamat ini, tiga objektif telah dicadangkan termasuk mengenal pasti amalan yang penting untuk membangunkan aplikasi m-dagang, pembinaan metodologi yang boleh diramal berasaskan tangkas yang digunakan untuk membangunkan aplikasi m-dagang dan penilaian untuk kesesuaian dan praktikaliti. Kaedah penyelidikan yang digunakan ialah reka bentuk penyelidikan, termasuk langkah-langkah kesedaran masalah, cadangan, pembangunan, penilaian dan kesimpulan. Kaedah penyelidikan yang digunakan untuk membantu penyelidikan metodologi yang disebutkan termasuklah analisis literatur, lawatan industri, temu bual separa struktur, kajian, penyelidikan formulatif dan penilaian eksperimen. Kaedah dibina mengandungi integrasi faktor penting dalam setiap fasa kitar hayat sistem pembangunan serta garis panduan untuk diikuti bagi menjalankan aktiviti-aktiviti dalam pembangunan aplikasi, termasuk model khusus, alat dan teknik. Dari penilaian kaedah yang dibina, keputusan menunjukkan dua perkara yang penting. Pertama, metodologi yang dibina boleh diaplikasikan dan digunakan untuk membina sistem yang dicadangkan, dan dalam kes ini aplikasi perdagangan mudah alih. Kedua, dari segi praktikalitinya, ia menunjukkan bahawa metodologi yang dibina ini adalah praktikal apabila dibandingkan dengan metodologi the traditional waterfall development dengan menggunakan sebelas ukuran tertentu, di mana didapati ia memberi lebih banyak faedah kepada proses pembangunan.

Kata kunci: Perdagangan mudah alih, Pengkomputeran mudah alih, Aplikasi mudah alih, Sistem metodologi pembangunan, Pembangunan tangkas
Abstract

There are several system development methodologies including traditional and agile methodologies which are being utilized in current systems development. However, it could be argued that existing methodologies may not be suitable for the development of mobile commerce applications as these applications are utilized in different contexts from conventional fixed e-commerce applications such as they are displayed on a small screen device, they are utilized in an unstable or movable environment and they need to be used in a secured environment to deliver financial transactions over mobile network. This study aimed to construct an agile based development methodology for mobile commerce applications. In order to achieve this aim, three objectives have been proposed including identification of essential issues for developing m-commerce applications, construction of a predictable agile based methodology used for developing m-commerce applications and evaluation for its applicability and practicality. The research methodology used in the study is the design research, which include the steps of awareness of problems, suggestion, development, evaluation and conclusion. The research methods used to assist the mentioned research methodology include literature analysis, industry visits, semi-structured interview, survey, formulative research and experimental evaluation. The methodology constructed contains the integration of essential factors in each phase of systems development life cycle as well as guidelines to follow for conducting activities in the application development, including specific models, tools, and techniques. From the evaluation of the constructed methodology, the results showed two essential outcomes. Firstly, the constructed methodology is applicable as it can be used to build the intended system, mobile commerce applications in this case. Secondly, for practicality, it showed that the constructed methodology is practical as when comparing to the traditional waterfall development by using the eleven measurements specified, it exposed more benefits to the development process.

**Keywords:** Mobile commerce, Mobile computing, Mobile applications, Systems development methodology, Agile development
Acknowledgement

In the name of Allah, the Most Gracious and the Most Merciful.

I would like to extend my thanks and gratitude to:

Allah the Almighty for giving me the excellent health and mind for doing the research;

My supervisor, Associate Professor Dr. Shahizan Hassan for his wonderful support and efforts in assisting me formulating and constructing this thesis. Without his admirable encouragement and suggestions, this thesis would not become reality;

Staff members of School of Computing, College of Arts and Sciences (CAS UUM) for their kindness and welcome support;

The Universiti Utara Malaysia for the facilities and resources provided;

Faculty of Communication Sciences and Prince of Songkla University for the financial and grateful support;

My beloved wife, Sariya for her love, courage and patient; my son, Nasri for being an amazing companion; my daughter, Haneen for giving me such colorful days; both of my parents and parents-in-law for being there;

And all individuals involved in the establishment of this thesis.
Table of Contents

Permission to Use ........................................................................................................... i
Abstrak ........................................................................................................................... ii
Abstract ........................................................................................................................... iii
Acknowledgement ......................................................................................................... iv
Table of Contents ........................................................................................................... v
List of Tables ................................................................................................................... x
List of Figures ............................................................................................................... xii
List of Appendices ........................................................................................................ xvi
List of Abbreviations ..................................................................................................... xv

CHAPTER ONE  INTRODUCTION .............................................................................. 1
  1.1 Background ............................................................................................................. 1
  1.2 Problem Statement ............................................................................................... 3
  1.3 Research Question ............................................................................................... 6
  1.4 Research Objectives .............................................................................................. 6
  1.5 Scope of Study ....................................................................................................... 7
  1.6 Significance of the Study .................................................................................... 7
  1.7 General Research Framework ............................................................................ 8
  1.8 Structure of Thesis ............................................................................................... 10

CHAPTER TWO  LITERATURE REVIEW ................................................................. 11
  2.1 Introduction .......................................................................................................... 11
  2.2 Focused Areas .................................................................................................... 12
      2.2.1 Systems Development Methodologies and Systems Development Life Cycle ........................................................................................................... 12
      2.2.2 M-commerce Applications ......................................................................... 16
      2.2.3 Mobile Hardware Devices ......................................................................... 20
      2.2.4 Mobile Networking ...................................................................................... 21
      2.2.5 Implications of the Reviewed Subject on the Study .................................... 22
  2.3 Related Works ..................................................................................................... 23
      2.3.1 Agile Methods .......................................................................................... 24
      2.3.2 The User Interface Design for Small Screen Devices ................................. 31
      2.3.3 M-commerce Framework ........................................................................... 35
2.3.4 Mobile Settings Considerations ......................................................... 40
2.3.5 Security over Mobile Network ............................................................. 43
2.4 Suitable Methodologies Framework for M-commerce Applications .......... 47
  2.4.1 Comparison between Traditional and Agile Methodologies ................. 47
  2.4.2 Dynamic Capabilities Theory to Justify "Change Management Capability of System Development Methodology in Dynamic Environment" ............. 52
  2.4.3 Single-loop and Double-loop learning Theory to Justify "Learning in Application Development" ............................................................ 56
2.5 Practices of Leading Agile Development Methodology ............................ 61
  2.5.1 Extreme Programming (XP) ................................................................. 62
    2.5.1.1 Description .................................................................................... 62
    2.5.1.2 Practices of XP ............................................................................. 63
  2.5.2 Scrum .................................................................................................. 66
    2.5.2.1 Description .................................................................................... 66
    2.5.2.2 Practices of Scrum ........................................................................ 66
  2.5.3 Feature-Driven Development (FDD) ...................................................... 69
    2.5.3.1 Description .................................................................................... 69
    2.5.3.2 Practices of FDD .......................................................................... 70
2.6 Implications of the Investigated Methodologies on M-Commerce Application Development ................................................................. 71
2.7 Chapter Summary ..................................................................................... 76

CHAPTER THREE RESEARCH METHODOLOGY .......................................... 81
  3.1 Research Theoretical Framework: User Centered Design ....................... 81
  3.2 Research Methodology ........................................................................... 84
  3.3 Chapter Summary .................................................................................... 89

CHAPTER FOUR INVESTIGATION OF DEVELOPMENT
  METHODOLOGIES FOR M-COMMERCE APPLICATIONS ....................... 91
  4.1 Introduction ............................................................................................ 91
  4.2 The Semi-Structured Interviews and Surveys .......................................... 92
  4.3 Existing Development Methodologies for M-commerce Applications from Practitioner's Perspectives ............................................................. 95
    4.3.1 Perspective 1 Company A ................................................................. 95
    4.3.2 Perspective 2 Company B ................................................................. 99
    4.3.3 Perspective 3 Freelance Developer ................................................... 101
III. Prove the Design with Code ................................................................. 143
IV. Refactor .................................................................................................. 144
  5.5.4 Observation on the Development Progress .................................... 145
  5.5.5 Essential Issues Addressed in the Development ............................... 146
5.6 Productionizing Phase .......................................................................... 146
  5.6.1 Productionizing Activities ................................................................. 146
  5.6.2 Observation on the Productionizing Progress ................................... 148
  5.6.3 Essential Issues Addressed in the Productionizing Phase ............... 149
5.7 Maintenance Phase ................................................................................ 149
5.8 Chapter Summary .................................................................................. 150

CHAPTER SIX  EVALUATION OF THE CONSTRUCTED METHODOLOGY .................................................. 153

  6.1 Introduction ........................................................................................... 153
  6.2 Pre-Evaluation ....................................................................................... 154
    6.2.2 Revision of the Methodologies for Comparison .............................. 154
    6.2.2 Preparation of the Measurements Framework .............................. 160
  6.3 Experimental based Evaluation ............................................................ 167
  6.4 Post Evaluation ..................................................................................... 169
    6.4.1 Evaluation Results and Findings for Goal 1 ................................. 170
      6.4.1.1 Evaluation Results for Goal 1 .................................................. 170
      6.4.1.2 Findings for Goal 1 ................................................................. 173
    6.4.2 Evaluation Results and Findings for Goal 2 ................................. 173
      6.4.2.1 Evaluation Results for Goal 2 .................................................. 174
      6.4.2.2 Findings for Goal 2 ................................................................. 175
    6.4.3 Evaluation Results and Findings for Goal 3 ................................. 176
      6.4.3.1 Evaluation Results for Goal 3 .................................................. 176
      6.4.3.2 Findings for Goal 3 ................................................................. 178
    6.4.4 Evaluation Results and Findings for Goal 4 ................................. 178
      6.4.4.1 Evaluation Results for Goal 4 .................................................. 178
      6.4.4.2 Findings for Goal 4 ................................................................. 180
    6.4.5 Evaluation Results and Findings for Goal 5 ................................. 180
      6.4.5.1 Evaluation Results for Goal 5 .................................................. 180
      6.4.5.2 Findings for Goal 5 ................................................................. 182
    6.4.6 Evaluation Results and Findings for Goal 6 ................................. 182
<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4.6.1 Evaluation Results for Goal 6</td>
</tr>
<tr>
<td>6.4.6.2 Findings for Goal 6</td>
</tr>
<tr>
<td>6.4.7 Evaluation Results and Findings for Goal 7</td>
</tr>
<tr>
<td>6.4.7.1 The Results for Goal 7</td>
</tr>
<tr>
<td>6.4.7.2 Findings for Goal 7</td>
</tr>
<tr>
<td>6.4.8 Evaluation Results and Findings for Goal 8</td>
</tr>
<tr>
<td>6.4.8.1 Evaluation Results for Goal 8</td>
</tr>
<tr>
<td>6.4.8.2 Findings for Goal 8</td>
</tr>
<tr>
<td>6.4.9 Evaluation Results and Findings for Goal 9</td>
</tr>
<tr>
<td>6.4.9.1 Evaluation Results for Goal 9</td>
</tr>
<tr>
<td>6.4.9.2 Findings for Goal 9</td>
</tr>
<tr>
<td>6.4.10 Evaluation Results and Findings for Goal 10</td>
</tr>
<tr>
<td>6.4.10.1 Evaluation Results for Goal 10</td>
</tr>
<tr>
<td>6.4.10.2 Findings for Goal 10</td>
</tr>
<tr>
<td>6.4.11 Evaluation Results and Findings for Goal 11</td>
</tr>
<tr>
<td>6.4.11.1 Evaluation Results for Goal 11</td>
</tr>
<tr>
<td>6.4.11.2 Findings for Goal 11</td>
</tr>
<tr>
<td>6.5 Chapter Summary</td>
</tr>
</tbody>
</table>

**CHAPTER SEVEN CONCLUSIONS AND FUTURE WORKS**

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1 Thesis Summary</td>
</tr>
<tr>
<td>7.2 The Achievement of Research Objectives and Discussions</td>
</tr>
<tr>
<td>7.3 Contributions of the Study</td>
</tr>
<tr>
<td>7.4 Limitation and Future Works</td>
</tr>
</tbody>
</table>

**REFERENCES**

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFERENCES</td>
</tr>
</tbody>
</table>

**FURTHER READING**

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>FURTHER READING</td>
</tr>
</tbody>
</table>
List of Tables

Table 1.1: General Research Framework ................................................................. 9
Table 2.1: Classification of M-commerce Applications ............................................. 19
Table 2.2: Mapping Agile Practices along Three Dimensions (People, Process, Product) .................................................................................................................. 26
Table 2.3: Representative Characteristics for the Context Model ................. 42
Table 2.4: M-commerce Challenges and Potential Solutions ......................... 42
Table 2.5: Differences between Traditional and Agile Methodologies .......... 48
Table 2.6: Mapping M-commerce Characteristics with Traditional and Agile Methodologies ........................................................................................................... 50
Table 2.7: Mapping Traditional and Agile Practices with M-Commerce Characteristics ............................................................................................................. 51
Table 2.8: The Comparison between Moderately Dynamic Environment and High-Velocity Environment ......................................................................................... 54
Table 2.9: Comparison of M-commerce Application Environment to Moderately Dynamic and High-Velocity Environment ......................................................... 55
Table 2.10: Single- and Double-Loop Learning in Software Development .......... 58
Table 2.11: Comparison of M-commerce Application Action Strategies with Single and Double Loop Action Strategies ........................................................................ 60
Table 2.12: Situation Appropriateness and Empirical Evidence ....................... 73
Table 3.1: Tasks Included in Identifying Current Methodologies .................. 86
Table 3.2: Tasks Included in Proposing Suitable Development Methodology ...... 87
Table 3.3: Tasks Included in the System Prototype Development ..................... 89
Table 4.1: Strengths and Weaknesses of Two Development Methodologies .... 105
Table 4.2: Strengths and Weaknesses of Lightweight/Agile Development Methodologies ................................................................................................................. 110
Table 5.1: Identification of Essential Issues in the Development Process of M-commerce Application ................................................................................................. 119
Table 5.2: Requirements for Each Essential Issue of M-commerce Application Development ............................................................................................................. 125
Table 5.3: Agile Modelling Practices in the Design Process of Extreme Programming ................................................................................................................. 135
Table 6.1: Differences in Practices between Traditional and Agile methodologies 155
Table 6.2: Essential Phases and Steps for the Constructed M-commerce Development ................................................................................................................................. 156
Table 6.3: Essential Phases and Steps for Traditional Waterfall Development ............................... 159
Table 6.4: A High-Level Summary the Goals/Questions/Metrics Paradigm ....................... 160
Table 6.5: A Summary of the SEI Recommended Initial Core Measures .................. 162
Table 6.6: Measurement Goals of M-commerce Application Development ............... 163
Table 6.7: Measurements for Methodology Assessment ................................................. 164
Table 6.8: The Results for Goal 1 ...................................................................................... 171
Table 6.9: The Results for Goal 2 ...................................................................................... 174
Table 6.10: The Results for Goal 3 ..................................................................................... 177
Table 6.11: The Results for Goal 4 ..................................................................................... 179
Table 6.12: The Results for Goal 5 ..................................................................................... 181
Table 6.13: The Results for Goal 6 ..................................................................................... 183
Table 6.14: The Results for Goal 7 ..................................................................................... 185
Table 6.15: The Results for Goal 8 ..................................................................................... 186
Table 6.16: The Results for Goal 9 ..................................................................................... 188
Table 6.17: The Results for Goal 10 ................................................................................... 190
Table 6.18: The Results for Goal 11 ................................................................................... 190
Table A.1: Terms and Definitions for the System Prototype ......................................... 225
Table A.2: Stand Up Meeting and Its Contents ................................................................. 230
List of Figures

Figure 1.1: Structure of Thesis ................................................................. 10
Figure 2.1: Research Focused Areas .......................................................... 14
Figure 2.2: The Goal-Driven Methodology for Eliciting B2C Application
Requirements ......................................................................................... 28
Figure 2.3: Modern SDLC vs. Proposed Human-Centred Systems Development
Lifecycle Methodology ......................................................................... 32
Figure 2.4: The Extended Framework for the Study of M-commerce Interface Design
............................................................................................................ 33
Figure 2.5: A Framework for M-commerce .................................................. 36
Figure 2.6: The Fit-Viability Framework ....................................................... 39
Figure 2.7: Graphical Representation of Context Model ................................. 41
Figure 2.8: Secure Web application Development Process ............................ 44
Figure 2.9: Single- and Double-Loop Learning ............................................. 57
Figure 2.10: Rules and Practices of XP ......................................................... 63
Figure 2.11: Overview of XP Project ............................................................ 64
Figure 2.12: Overview of Iteration Part of XP Project .................................... 64
Figure 2.13: Overview of Development Part of XP Project .............................. 65
Figure 2.14: Overview of Collective Code Ownership of XP Project ............... 65
Figure 2.15: Scrum Management Practices ................................................... 67
Figure 2.16: Scrum Management Approach .................................................. 69
Figure 2.17: Illustration of FDD Process ....................................................... 72
Figure 2.18: Comparing Life-Cycle, Project Management and Concrete Guidance
Support .................................................................................................... 73
Figure 2.19: Integration of Scrum Approach to XP Practices ........................... 75
Figure 3.1: General Methodology for Design Research (GMDR) ................... 84
Figure 5.1: Construction of the Development Methodology for M-Commerce
Applications ............................................................................................ 115
Figure 5.2: XP Project Lifecycle and Activities ............................................. 118
Figure 5.3: User stories for searching flights of online ticket .......................... 121
Figure 5.4: A Sketch Drawn while Identifying a Metaphor for the System ..... 124
Figure 5.5: Example Task Cards Pertaining to Searching for Items ............... 128
Figure 5.6: A Hand-Drawn Sketch Representing What Needs to be built for the Item Search Page .............................................................. 128

Figure 5.7: The XP Iteration Lifecycle .......................................................... 130

Figure 5.8: The typical day of an XP Developer .............................................. 133

Figure 5.9: Conceptual Framework of the Constructed Development Methodology for M-commerce Applications .................................................. 152

Figure A.1: User Stories for the System Prototype ........................................... 226

Figure A.2: Architectural Spike for the System Prototype ............................ 227

Figure A.3: System Release 1 ...................................................................... 228

Figure A.4: System Release 2 ...................................................................... 228

Figure A.5: System Release 3 ...................................................................... 229

Figure A.6: Architecture Design of m-commerce Application Prototype ....... 232

Figure A.7: Interface Design for the 4th release of the System Prototype ...... 234

Figure A.8: Context Diagram for the System Prototype: Mobile MLM Membership System ........................................................................ 235

Figure A.9: Dataflow Diagram Level 0 for the System Prototype ................. 236

Figure A.10: Data Flow Diagram Level 1 for Process 4 of the System Prototype .. 237

Figure A.11: Physical Entity Relationship Diagram for the System Prototype ..... 239

Figure A.12: The Midlet source files for the system prototype from m-commerce agile development team ........................................................................................................ 249

Figure A.13: The Servlet source files for the system prototype from m-commerce agile development team ........................................................................................................ 250

Figure A.14: Demonstration on how to access Java document from the Netbeans project ........................................................................................................ 251

Figure B.1: Schedule Plan for the System Development .................................. 253

Figure B.2: Use case Number 1 “Login” ...................................................... 256

Figure B.3: Use case Number 2 “View Personal Details” ............................. 256

Figure B.4: Use case Number 3 “View Down Lines Details” ......................... 257

Figure B.5: Context Diagram for Mobile MLM Membership System ............ 258

Figure B.6: Dataflow Diagram Level 0 for Mobile MLM Membership System .... 260

Figure B.7: The Entity Relationship Diagram for the System Prototype .......... 261

Figure B.8: Architecture Design of m-commerce Application Prototype .......... 262

Figure B.9: Interface Structure .................................................................. 263

Figure B.10: Interface Prototyping for the System Prototype ...................... 265
Figure B.11: Physical Data Flow Diagram for m-commerce Application Prototype .............................................................................................................................................. 267

Figure B.12: Physical Entity Relationship Diagram for m-commerce Application Prototype ........................................................................................................................................... 270

Figure B.13: The Midlet source files for the system prototype from traditional waterfall development team ..................................................................................................................................... 275

Figure B.14: The Servlet source files for the system prototype from traditional waterfall development team ..................................................................................................................................... 276

Figure B.15: Demonstration on how to access Java document from the Netbeans project ............................................................................................................................................... 277

Figure C.1: Project’s Location on the Author’s Machine ........................................................................................................ 279
List of Appendices

Appendix A Deliveries and Documentations from m-commerce Agile Development Methodology .................................................................................................................. 223
Appendix B Deliveries and Documentations from Waterfall Development Methodology .......................................................................................................................... 252
Appendix C Source Code and Development Tools .................................................. 278
Appendix D Interview and Survey Documents ....................................................... 280
Appendix E Expert Reviews in the Evaluation Phase ............................................. 299
Appendix F Time Scales ......................................................................................... 311
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G</td>
<td>3rd Generation Mobile Network</td>
</tr>
<tr>
<td>ASD</td>
<td>Adaptive Software Development</td>
</tr>
<tr>
<td>B2B</td>
<td>Business to Business</td>
</tr>
<tr>
<td>B2C</td>
<td>Business to Consumer</td>
</tr>
<tr>
<td>BV</td>
<td>Business Value</td>
</tr>
<tr>
<td>CAS</td>
<td>Complex Adaptive Systems</td>
</tr>
<tr>
<td>CDC</td>
<td>Connected Device Configuration</td>
</tr>
<tr>
<td>CDP</td>
<td>Customer Decision Process</td>
</tr>
<tr>
<td>CLDC</td>
<td>Connected Limited Device Configuration</td>
</tr>
<tr>
<td>CRC</td>
<td>Class, Responsibilities, and Collaboration</td>
</tr>
<tr>
<td>DBMS</td>
<td>Database Management System</td>
</tr>
<tr>
<td>DFD</td>
<td>Dataflow Diagram</td>
</tr>
<tr>
<td>DSDM</td>
<td>Dynamic System Development Method</td>
</tr>
<tr>
<td>EC</td>
<td>Electronic Commerce</td>
</tr>
<tr>
<td>ECVM</td>
<td>E-commerce Value Matrix</td>
</tr>
<tr>
<td>EDGE</td>
<td>Enhanced Data rates for GSM Evolution</td>
</tr>
<tr>
<td>ERD</td>
<td>Entity Relationship Diagram</td>
</tr>
<tr>
<td>FDD</td>
<td>Feature-Driven Development</td>
</tr>
<tr>
<td>G/Q/M</td>
<td>Goal/Questions/Metrics</td>
</tr>
<tr>
<td>GPRS</td>
<td>General Packet Radio Service</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>HCI</td>
<td>Human Computer Interaction</td>
</tr>
<tr>
<td>HCSDLC</td>
<td>Human-Centered Systems Development Methodology</td>
</tr>
<tr>
<td>HTML</td>
<td>Hypertext Mark-up Language</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transport Protocol</td>
</tr>
<tr>
<td>IDE</td>
<td>Integrated Development Environment</td>
</tr>
<tr>
<td>J2EE</td>
<td>Java2 Enterprise Edition</td>
</tr>
<tr>
<td>J2ME</td>
<td>Java2 Micro Edition</td>
</tr>
<tr>
<td>M-commerce</td>
<td>Mobile Commerce</td>
</tr>
<tr>
<td>MIDP</td>
<td>Mobile Information Device Profile</td>
</tr>
<tr>
<td>MLM</td>
<td>Multi Level Marketing</td>
</tr>
<tr>
<td>MS</td>
<td>Microsoft</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>PV</td>
<td>Point Value</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RAD</td>
<td>Rapid Application Development</td>
</tr>
<tr>
<td>RMS</td>
<td>Record Management System</td>
</tr>
<tr>
<td>RUP</td>
<td>Rational Unified Process</td>
</tr>
<tr>
<td>SA&amp;D</td>
<td>Systems Analysis &amp; Design</td>
</tr>
<tr>
<td>SDLC</td>
<td>Systems Development Life Cycle</td>
</tr>
<tr>
<td>SEI</td>
<td>Software Engineering Institute</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>UI</td>
<td>User Interface</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modelling Language</td>
</tr>
<tr>
<td>VCC</td>
<td>Virtual Value Chain</td>
</tr>
<tr>
<td>VMD</td>
<td>Visual Mobile Designer</td>
</tr>
<tr>
<td>WAP</td>
<td>Wireless Application Protocol</td>
</tr>
<tr>
<td>WML</td>
<td>Wireless Mark-up Language</td>
</tr>
<tr>
<td>WSA</td>
<td>Web Services Architecture</td>
</tr>
<tr>
<td>XP</td>
<td>Extreme Programming</td>
</tr>
<tr>
<td>ZFR</td>
<td>Zero-feature Release</td>
</tr>
</tbody>
</table>
CHAPTER ONE
INTRODUCTION

1.1 Background

Mobile commerce or commonly known as m-commerce, typically designates the use of wireless devices (particularly mobile phones) to conduct electronic business transactions, such as product ordering, fund transfer, and stock trading, (Kalakota & Robinson, 2002). According to Liang, Huang, Yeh, and Lin (2007), m-commerce refers to any transactions, either direct or indirect, via mobile devices, such as phones or Personal Digital Assistants (PDAs). While many different definitions of m-commerce exist in the literature (Turel & Yuan, 2006), these usually refer to e-commerce activities conducted through mobile devices such as mobile phones and Personal Digital Assistants (PDAs).

Liang et al. (2007) stated that the most significant features of mobile technology are mobility which is the state of being in motion and portability which is the ability to be carried or moved easily. It is therefore essential for m-commerce application developers to develop applications carefully to conform to the significant features of m-commerce as mentioned, which are mobility and portability. Some prominent examples of m-commerce include mobile financial services (e.g. m-banking, m-payment, and m-brokering), mobile shopping (e.g. m-retailing, m-auctions), mobile entertainment (e.g. m-gaming, m-music, m-video, and m-betting), and mobile information (e.g. mobile access to sports news, weather forecasts, maps, and so on.) (Khalifa & Shen, 2008).
The contents of the thesis is for internal user only
REFERENCES


209


**FURTHER READING**


