Benefit from Web Services in the Mobile Internet Industry

by

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Submitted to the Engineering Systems Division
in Partial Fulfillment of the Requirements for the Degree of

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Abstract

Over the past five years, mobile Internet services in Japan have seen major expansion as a result of collaboration between mobile operators acting as mobile portal providers, and their complementors, namely, content providers. However, the content business is currently under pressure to become profitable, and major players have found it difficult to differentiate their services from competitors. In other words, service has become commoditized, which has resulted in a shift to the mature stage.

This thesis suggests Web services as a solution to overcoming the commoditization of mobile Internet services and spurring new development in the industry. This emerging technology allows users to create a combination of Web resources through two fundamental approaches that lead to an innovation.

The Web service requester approach enables integration of a variety of Web services as complementary assets from their business partners into their content. System Dynamics modeling methodology is used to examine how Web service requesters could promote product and process innovation as well as outsourcing. The analyses indicate that it is critical to adopt a different strategy under different scenarios of Web services diffusion, taking into consideration the requesters’ dependence on Web service providers.

The Web service provider approach offers an excellent opportunity to create distribution channels for services. Two case studies are analyzed in depth to understand how the subject companies took advantage of being a Web service provider—with the support of complementors as well as users—to promote innovation.

Finally, suggestions are made for how the mobile industry value chain could evolve through Web services implementations, and policy recommendations are offered for major stakeholders. Web services will likely enable close collaboration between players in the industry, including Web service providers, Web service requesters, and toolkit developers, all of which should see increasing value, which leads to further evolution of the mobile Internet industry.

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Daizo Ikeda
Cambridge, Massachusetts
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# Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abstract</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Acknowledgments</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Table of Contents</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>List of Figures</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>List of Tables</td>
<td>10</td>
</tr>
<tr>
<td>Chapter 1</td>
<td>Introduction</td>
<td>11</td>
</tr>
<tr>
<td>1.1</td>
<td>Motivation</td>
<td>13</td>
</tr>
<tr>
<td>1.2</td>
<td>Thesis Objectives</td>
<td>13</td>
</tr>
<tr>
<td>1.3</td>
<td>Organization of the Thesis</td>
<td>14</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Market and Technology Trends</td>
<td>17</td>
</tr>
<tr>
<td>2.1</td>
<td>Overview</td>
<td>17</td>
</tr>
<tr>
<td>2.2</td>
<td>Diffusion of Mobile Internet Services</td>
<td>17</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Industry Landscape</td>
<td>17</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Key Determinants of Diffusion</td>
<td>18</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Technology Adoption Life Cycle</td>
<td>22</td>
</tr>
<tr>
<td>2.3</td>
<td>Content Business Market</td>
<td>24</td>
</tr>
<tr>
<td>2.3.1</td>
<td>Complementors</td>
<td>24</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Landscape of the Content Business Market</td>
<td>25</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Strategic Positioning</td>
<td>29</td>
</tr>
<tr>
<td>2.4</td>
<td>Summary</td>
<td>32</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Web Services</td>
<td>33</td>
</tr>
<tr>
<td>3.1</td>
<td>Overview</td>
<td>33</td>
</tr>
<tr>
<td>3.2</td>
<td>An Emerging Technology</td>
<td>33</td>
</tr>
<tr>
<td>3.3</td>
<td>Basic Web Services</td>
<td>34</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Characteristics of Web Services</td>
<td>35</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Web Services Architecture</td>
<td>35</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Standards for Web Services</td>
<td>37</td>
</tr>
<tr>
<td>3.4</td>
<td>Key Determinants of Web Services Diffusion</td>
<td>38</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Technologies for Business Transaction</td>
<td>39</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Standardization Activity</td>
<td>40</td>
</tr>
</tbody>
</table>
3.4.3 Business Models ................................................................. 41
3.4.4 Positive Feedback ............................................................ 41
3.5 The Impact of Web Services on the Content Business ............ 42
  3.5.1 Two Approaches to Benefiting from Web Services .......... 42
  3.5.2 Service Integrator ......................................................... 42
  3.5.3 Horizontal and Vertical Integration ............................... 43
  3.5.4 Achieving Strategic Positions ........................................ 44
3.6 Summary ............................................................................. 47

Chapter 4 The Benefits of Web Service Requesters: Qualitative Analysis ........................................... 48
  4.1 Overview ............................................................................ 48
  4.2 Methodology ...................................................................... 48
  4.3 Base Model of the Content Business ................................. 49
  4.4 Attractiveness of Content Services .................................... 50
    4.4.1 Price ............................................................................ 50
    4.4.2 Service Differentiation ................................................. 51
  4.5 Dynamics of Innovation .................................................... 54
    4.5.1 Product Innovation ...................................................... 55
    4.5.2 Process Innovation ...................................................... 55
  4.6 Dynamics of Competition ................................................ 56
  4.7 Conceptual Model .............................................................. 56
  4.8 Policy Implications ............................................................ 58
    4.8.1 Service Differentiation through Product Innovation ...... 58
    4.8.2 Service Differentiation through Process Innovation ...... 59
    4.8.3 Cost Reduction ............................................................ 61
  4.9 Benefits Derived from Implementing Web Services .............. 63
    4.9.1 Achieving Product Innovation ...................................... 63
    4.9.2 Achieving Process Innovation ..................................... 64
    4.9.3 Promoting Outsourcing .............................................. 64
  4.10 Summary .......................................................................... 66

Chapter 5 The Benefits of Web Service Requesters: Quantitative Analysis .............................. 67
  5.1 Overview ............................................................................ 67
  5.2 Modularization ................................................................. 67
    5.2.1 Module 1: Service Attractiveness ................................. 69
    5.2.2 Module 2: Production Activity .................................... 73
    5.2.3 Module 3: Investment in R&D .................................... 76
Chapter 7

7.3.2 Mobile Operators.................................................................127
7.3.3 Infrastructure and Terminal Vendors.................................128
7.3.4 Mobile Phone Users...........................................................129

7.4 Summary..............................................................................130

Chapter 8 Conclusions................................................................132

Appendix.......................................................................................137

References....................................................................................146
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Market Size of Mobile Content Business</td>
<td>11</td>
</tr>
<tr>
<td>1-2</td>
<td>Thesis Structure</td>
<td>16</td>
</tr>
<tr>
<td>2-1</td>
<td>Mobile Internet Market in Japan</td>
<td>18</td>
</tr>
<tr>
<td>2-2</td>
<td>Mobile Internet Services</td>
<td>19</td>
</tr>
<tr>
<td>2-3</td>
<td>The i-mode Content Portfolio</td>
<td>20</td>
</tr>
<tr>
<td>2-4</td>
<td>Number of i-mode Sites</td>
<td>21</td>
</tr>
<tr>
<td>2-5</td>
<td>Technology Adoption Life Cycle</td>
<td>23</td>
</tr>
<tr>
<td>2-6</td>
<td>Content Providers as Complementors</td>
<td>24</td>
</tr>
<tr>
<td>2-7</td>
<td>Porter’s Five Forces Analysis of the Content Industry</td>
<td>27</td>
</tr>
<tr>
<td>2-8</td>
<td>Delta Model</td>
<td>30</td>
</tr>
<tr>
<td>3-1</td>
<td>Integration of Services</td>
<td>34</td>
</tr>
<tr>
<td>3-2</td>
<td>Web Services Architecture</td>
<td>36</td>
</tr>
<tr>
<td>3-3</td>
<td>Web Services Architecture Stack</td>
<td>38</td>
</tr>
<tr>
<td>3-4</td>
<td>Determinants of Web Services Diffusion</td>
<td>39</td>
</tr>
<tr>
<td>3-5</td>
<td>Emerging Web Services Standards Stack</td>
<td>40</td>
</tr>
<tr>
<td>3-6</td>
<td>Service Integrator</td>
<td>43</td>
</tr>
<tr>
<td>3-7</td>
<td>Vertical and Horizontal Integration</td>
<td>44</td>
</tr>
<tr>
<td>3-8</td>
<td>Web Services Implementation for Best Product Positioning</td>
<td>45</td>
</tr>
<tr>
<td>4-1</td>
<td>Base Model</td>
<td>49</td>
</tr>
<tr>
<td>4-2</td>
<td>Key Factors to Service Differentiation</td>
<td>52</td>
</tr>
<tr>
<td>4-3</td>
<td>The Dynamics of Innovation</td>
<td>54</td>
</tr>
<tr>
<td>4-4</td>
<td>Conceptual Model</td>
<td>57</td>
</tr>
<tr>
<td>4-5</td>
<td>Reinforcing Loop 5</td>
<td>59</td>
</tr>
<tr>
<td>4-6</td>
<td>Reinforcing Loops 3 and 4</td>
<td>60</td>
</tr>
<tr>
<td>4-7</td>
<td>Balancing Loops 3 and 4</td>
<td>62</td>
</tr>
<tr>
<td>5-1</td>
<td>Modularization</td>
<td>68</td>
</tr>
<tr>
<td>5-2</td>
<td>Module 1: Service Attractiveness</td>
<td>69</td>
</tr>
<tr>
<td>5-3</td>
<td>Attractiveness of Price Function</td>
<td>70</td>
</tr>
<tr>
<td>5-4</td>
<td>Attractiveness of Diversity Function</td>
<td>71</td>
</tr>
<tr>
<td>5-5</td>
<td>Outsourcing Effect Function</td>
<td>72</td>
</tr>
<tr>
<td>5-6</td>
<td>Module 2: Production Activity</td>
<td>73</td>
</tr>
<tr>
<td>5-7</td>
<td>Module 3: Investment in R&amp;D</td>
<td>76</td>
</tr>
<tr>
<td>5-8</td>
<td>Module 4: Intensity of Competition</td>
<td>78</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 5-1.</td>
<td>Scenarios for Simulations</td>
<td>91</td>
</tr>
<tr>
<td>Table 5-2.</td>
<td>Simulation Results at Month 36</td>
<td>93</td>
</tr>
<tr>
<td>Table 5-3.</td>
<td>Simulation Results at Month 60</td>
<td>94</td>
</tr>
<tr>
<td>Table 5-4.</td>
<td>Simulation Results at Month 120</td>
<td>95</td>
</tr>
<tr>
<td>Table 6-1.</td>
<td>Mobile Assets via Web Services Interfaces</td>
<td>121</td>
</tr>
</tbody>
</table>
In the 1990s, mobile phone services in Japan began expanding dramatically, and by the end of March 2004, the number of subscribers had reached more than 81 million, with penetration throughout the entire Japanese population of approximately 64% (TCA website, 2004). The most outstanding growth can be found in mobile Internet services launched by mobile operators in 1999. Mobile Internet has expanded the use of mobile communications services to multimedia services, including distribution services for music and electronic commerce. In other words, mobile phones become important tools for accessing the Internet. Furthermore, with the introduction of emerging technologies such as Java, a wide range of high-quality content, including games and videos, became available to users. The market size of the mobile content business is expected to grow even more, as shown in Figure 1-1.

![Figure 1-1. Market Size of Mobile Content Business](source: MCPC website, 2004)
With the migration to a third-generation (3G) mobile system, IMT-2000, it is expected that most mobile phone networks are likely to provide sufficient data transmission to meet the demands of users who wish to Web surf. Furthermore, the interest of the industry is now turning its focus from how to construct an infrastructure with high data transmission toward how to make the most of the existing infrastructure, and content providers as well as mobile portal providers are becoming major players in the market. While mobile operators have not yet entered the content market, they are trying to stimulate expansion of the content development market so they will have greater traffic on their mobile networks, which of course leads to great profits. By delivering attractive content that corresponds to the high quality and bandwidth of their mobile networks, they can show users how to take advantage of that content in their daily lives. In other words, attractive content is a key complementary asset for mobile operators. If users have no idea how to take advantage of mobile Internet services, which could eventually undermine the profitability of mobile operators as well as content providers and mobile portal providers.

While mobile operators have successfully created strong demand for mobile Internet services over the past five years, the diffusion of mobile Internet is slowly becoming more mature. Growth in the number of subscribers has slowed, and fewer mobile terminals have been shipped than expected. Content providers and mobile portal providers recognize that it is becoming more difficult to differentiate their services from competitors. Everyone can take advantage of the latest technologies and replicate competitors’ services without difficulty, which results in reducing profitability throughout the industry. To overcome this challenge, all stakeholders are being called upon to give priority to content development as a driver that will revitalize the market.
1.1 Motivation

For further development in mobile Internet services, it is necessary to consider how the content business will evolve. It is expected that one emerging technology, Web services, will overcome the creeping commoditization of the content market since that technology will provide new opportunities for developing service differentiation as well as achieving lower costs. This will lead to building robust competitive advantages through product and process innovations. Furthermore, collaboration between stakeholders in the mobile Internet industry, including content providers, mobile operators, and infrastructure and handset vendors, takes on even more importance.

Based on these points, this thesis focuses on the market for the content business, in which both content providers and mobile portal providers will play a critical role in evolving the market. I will provide suggestions for how to develop innovations that encourage further growth in the industry, even in a market that is becoming increasingly commoditized.

1.2 Thesis Objectives

The object of this thesis is to analyze the impacts and benefits to be gained from implementing Web services within the content business, especially the impact on major stakeholders in the mobile Internet industry, including content providers and mobile portal providers.

The Systems Dynamics methodology is used in two ways: (1) to analyze the major benefits that can be derived for businesses as a result of implementation, and (2) from the simulation results, some policy implications and suggestions for how to increase and maintain
profitability of the content business. Finally, this thesis discusses policy recommendations for major stakeholders.

1.3 Organization of the Thesis

Chapter 1 describes my motivation for this study, as well as the objectives and organization of this thesis.

In Chapter 2, I outline major market and technology trends in the Japanese mobile Internet industry; areas where the number of mobile Internet subscribers has significantly increased over the past five years; and key determinants of the current diffusion of mobile Internet services in Japan.

One key factor is the diversity of content, such as transactions, databases, information, and entertainment. Content providers and mobile portal providers play a critical role in the quality and quantity of such content. However, while the diversity of content continues to drive the market, content is becoming a commodity.

In Chapter 3, one emerging technology, Web services, is suggested as a solution to overcome this challenge and to spur new development in the industry. To better understand the potential of Web services, this chapter provides some background information on the basics of Web services technology. Then two approaches to Web services are proposed: the Web service requester approach and the Web service provider approach.

In Chapter 4, the major benefits from a Web service requester approach to content business is analyzed, especially where content providers seek profitability. To evaluate the benefits for content businesses, a system dynamics model is constructed, which clarifies major cause-and-effect relationships and implies some policy recommendations.
One of the key dynamics is product innovation, which enhances service
differentiation and thus increases the attractiveness of the content service. Another critical
dynamic is process innovation, which increases productivity, thus leading to lower production
costs.

In Chapter 5, I provide a quantitative analysis of Web services using simulations of
different scenarios for Web services diffusion, including sensitivity analyses, and decision tree
analyses. Web services enable promoting service differentiation and cost reduction through
innovations as well as outsourcing. These analyses result in policy recommendations for how
to develop competitive advantages through product and process innovations, with special
emphasis on the importance of dynamic strategies.

Chapter 6 offers insight into how Web services can be expanded through a Web
service provider approach. I outline two case studies that discuss user innovation and provider
innovation, respectively. While user innovation shifts the locus of innovation to users,
provider innovation provides a solution based on observation of users at the provider’s site.
Web services make it possible to carry out service design at a sticky information site, leading
to significantly lower costs and faster development.

Chapter 7 considers how Web services will affect the mobile industry structure, by
considering the major benefits for industry stakeholders, including content providers, mobile
operators, and vendors. In particular, robust reinforcement between the content business and
mobile operators’ strategy is discussed.

Finally, in Chapter 8, I present my conclusions, with key findings derived from my
research, and a set of policy recommendations for further evolution in the mobile Internet
industry.
Chapter 1: Introduction

Chapter 2: Market and Technology Trends
1) Diffusion of Mobile Internet Services
2) Content Business Market

Chapter 3: Web Services
Basic Web Services
1) Web Services Characteristics
2) Web Services Architecture
3) Standards for Web Services
4) Key Determinants of Web Services Diffusion
The Impact of Web Services on the Content Business
1) Two Approaches to Web Services
   - Web Service Requester Approach
   - Web Service Provider Approach
2) Horizontal and Vertical Integration
3) Achieving Strategic Positions

Web Service Requester Approach
Chapter 4: Benefits of Web Service Requesters - Qualitative Analysis
1) Base Model and Conceptual Model
2) Attractiveness of Content Services
3) Service Differentiation and Cost Reduction
4) Dynamics of Innovation
5) Dynamics of Competition
6) Policy Implications
7) Benefit Derived from Implementing Web Services

Chapter 5: Benefits of Web Service Requesters - Quantitative Analysis
1) Modularization and Detailed Model
2) Scenarios for Web Services Diffusion
3) Analysis of Simulation Results
   - Scenario Analysis
   - Decision Tree Analysis
4) Dynamic Strategies for Web Services
   - Option to Wait & Option to Expand
   - Shifting Focus of Process
5) Policy Implications

Web Service Provider Approach
Chapter 6: Innovations for Web Service Providers
User Innovation
- Case Study: Google
- Lessons from Case Study
  - Toolkits
  - User Innovation Communities
  - Lead Users
Provider Innovation
- Case Study: T-Mobile
- Lessons from Case Study
  - Collaboration
  - Flexible Business Models
  - Mobile Assets

Chapter 7: Evolution in the Mobile Internet Industry
1) Web Services Value Chain
2) Policy Recommendations for Major Stakeholders

Chapter 8: Conclusions

Figure 1-2. Thesis Structure
2.1 Overview

This chapter outlines major market and technology trends in the Japanese mobile Internet industry, where expansion in the number of users has been significant. The main focus is on some key factors in the current diffusion of mobile Internet services in Japan as well as key stakeholders, especially content providers and mobile portal providers that play a critical role in evolving the market. The chapter moves on to clarify the major challenge facing the industry—commoditization of content—and address the importance of building strategic positioning under intensive competition for profitability.

2.2 Diffusion of Mobile Internet Services

2.2.1 Industry Landscape

Over the past five years, the number of mobile Internet subscribers in Japan has increased dramatically, with more than 69 million users by the end of March 2004. Mobile Internet has expanded to include multimedia services, distribution services for music and video, and e-commerce.

As a first mover, NTT DoCoMo, a leading mobile operator in Japan, launched its mobile Internet service, called i-mode, in 1999. If one considers this service from the perspective of Moore’s (1999) framework, it is clear that diffusion of this innovation moved
through early adopters to quickly take a majority position throughout Japan, reaching more than 41 million subscribers—a record for so quickly reaching majority, as shown in Figure 2-1. At the same time, the competitors, au and Vodafone, also introduced similar services shortly after NTT DoCoMo. As seen in the figure, they too enjoyed widespread diffusion of their mobile Internet services, both of which acquired more than ten million subscribers. These three major operators have been highly successful in creating innovations in mobile Internet services that have led to rapid diffusion and acceptance in the market.

![Graph showing the growth of mobile internet users in Japan](image)

Source: MCPC website, 2004

**Figure 2-1. Mobile Internet Market in Japan**

### 2.2.2 Key Determinants of Diffusion

This section discusses the major determinants in the diffusion of mobile Internet services. I used Hall’s framework (2003), which suggests ideas for identifying key determinants of diffusion. I focused particularly on NTT DoCoMo’s i-mode, the dominant and most successful service. In order to accelerate the adoption of the new service, the company was intent on achieving a “critical mass” goal, that is, one million subscribers (Rogers, 1995).
This led the company to consider a wide range of content innovations in order to meet the demands for the mobile Internet service. In the process, NTT DoCoMo has built substantial competitive advantage and received strong positive feedback as a result of its network effects and the benefits of adopting the new technology.

**Benefit from the New Technology**

**Services:** Mobile Internet services allow users to access the Internet via a mobile phone equipped with a browser, which accesses a mobile network operated by a mobile operator (see Figure 2-2). The access request from a mobile phone goes through a mobile network to a mobile portal—a portfolio containing various types of content—and on to the content provider. In most cases, a mobile portal is managed by a mobile operator, which consolidates a variety of content available over the Internet. (Note: the mobile portal provider is often the same entity as the mobile operator.) Then the requested content returns to the mobile phone. Thanks to convergence with the Internet arena, mobile Internet services enable users to send and receive e-mail over the Internet as well.

![Diagram](image)

*Source: Author, 2004*

**Figure 2-2. Mobile Internet Services**
Technology: Mobile networks based on packet-switched technology allow mobile operators to charge users for data communication on a data-amount basis, rather than connection-time basis. This leads to building flexible billing models.

Network Effects

Content: NTT DoCoMo offered, from the outset, a mobile portal that consolidated 67 kinds of content, including e-commerce, databases, entertainment, and news, all available to satisfy the diverse interests of users (Figure 2-3).

![Content Portfolio Diagram](Image)

Source: Natsuno, 2003

Figure 2-3. The i-mode Content Portfolio

This portfolio of content significantly stimulated user demand and contributed to the increased number of subscribers. In turn, more subscribers persuaded new players to enter the
content market, and thus a positive feedback loop was created (Natsuno, 2003). This feedback also encouraged the entry of a great number of voluntary content providers who were not part of the mobile portal, to enter the market in pursuit of the benefits to be gained from diffusion. Thus, the quantity of mobile content has grown significantly as the mobile Internet service has expanded (Figure 2-4).

![Graph showing number of i-mode Sites](image)

Source: NTT DoCoMo website, 2004

**Figure 2-4. Number of i-mode Sites**

*Standards:* Because it wanted to collaborate with content providers, NTT DoCoMo adopted the *de facto* standard for constructing content in the Internet domain, namely Compact HTML. This version of HTML enables content providers to easily modify already-constructed websites so that mobile phone users can access them. And with the advent of Java technology (a program language for adding animation and other actions to websites), both technologies could support the content providers’ efforts to offer creative applications to mobile phone users.
**Handsets:** The development of various types of i-mode-enabled handsets also stimulated demand for mobile Internet services. At the time i-mode was introduced, NTT DoCoMo offered four different types of handsets, and thereafter developed 17 more attractive handsets within the next year. Such a wealth of handsets styles made the mobile Internet service even more attractive to users.

**Cost of Adopting the New Service**

NTT DoCoMo pursued mobile-phone-type handsets rather than PDA-type, because mobile phones allow users to make voice calls and to access the Internet through one unified and user-friendly interface. This led to significantly lower switching costs. With the concise and compatible designs of mobile phones, users could easily step into the mobile Internet world. This compatibility was a critical factor that influenced the potential adopters of the mobile Internet service (Rogers, 1995).

**2.2.3 Technology Adoption Life Cycle**

Of the four major determinants of diffusion, diversity of content is the most critical factor. It contributed significantly to turning early adopters into mobile Internet users in the early stage of diffusion. At the same time, technological advantage and compatibility/lower cost complement mobile Internet services. Once the positive feedback associated with the networks effects kicked in, diffusion of mobile phone services increased exponentially, moving from the early adopter to the early majority stage.

NTT DoCoMo was successful in putting this strategy into practice and soon dominated the market as it pursued its clarified goal—acquiring one million subscribers. The
company's success was primarily due to strong network effects accelerated by the diversity of content, adoption of a de facto standard, and a variety of handsets. In comparison, competitors lagged far behind NTT DoCoMo even though they had launched competing mobile Internet services in the same year. This was partly because their technologies were not based on de facto standards suited to the Internet domain but on emerging standards for mobile Internet, which required their content providers to invest heavily in the market. More importantly, competitors had difficulty constructing the variety of content that NTT DoCoMo offered.

Today, however, the competitors have caught up with NTT DoCoMo. They provide similar services with a variety of content and functions. In other words, mobile Internet services have become a commodity. It seems that diffusion of this innovation has reached the late majority stage (Figure 2-5).

![Figure 2-5. Technology Adoption Life Cycle](image)

Source: Moore, 1999, adapted by author, 2004
2.3 Content Business Market

2.3.1 Complementors

As noted in Section 2.2, the diffusion of mobile Internet services was triggered by positive feedback. Among the factors accelerating positive feedback, content as a complementary asset was a source of success for the mobile Internet services (Teece, 1986). Mobile operators have successfully built attractive mobile portals by incorporating a wide range of content available over the Internet. Furthermore, a huge amount of independent content—what NTT DoCoMo calls “voluntary sites”—has also encouraged mobile phone users to enter the mobile Internet world. In other words, for mobile operators, content providers are crucial complementors, reinforcing their competitive advantage (see Figure 2-6).

![Diagram of the Business Model Canvas](image)

Source: Brandenburger and Nalebuff, 1996, adapted by author, 2004

**Figure 2-6. Content Providers as Complementors**
Most users in Japan are enjoying web surfing via mobile phones as well as downloading ring tones, characters, and games. This works as an excellent motivation for subscribing to a mobile Internet service. Thus, content providers as well as mobile portal providers have played a critical role in stimulating greater demand among users and increasing the attractiveness of the mobile Internet.

For these reasons, all stakeholders in the industry, including content providers and mobile operators that build mobile portals by aggregating the complementary assets from content providers, should take into account the future landscape of the content business market as well as its current status. This approach is indispensable and effective in promoting further development in mobile Internet services.

For this reason, this thesis focuses specifically on the evolution of the content business in the mobile Internet arena, where content providers as well as mobile portal providers play a critical role.

2.3.2 Landscape of the Content Business Market

The market size of the content business has expanded continually for the past five years, as described in Chapter 1. As it has grown, the market structure has become dynamic and more complicated. The stakeholders, especially content providers and mobile portal providers, must make tough decisions for building a robust strategic position.

From a content provider’s point of view, it is not easy to survive in the content business. Content providers seek to incorporate huge amounts of information into their content and then provide it to customers through a mobile operator’s network. From a mobile
operator’s point of view, it becomes even more difficult to differentiate their mobile portals from other competitors.

For these reasons, content providers and mobile portal providers need to build a robust strategy that will result in sustainable profits. According to Porter (1985), in order to evaluate potential profitability, the attractiveness of individual industries as well as individual companies must be taken into consideration. The attractiveness of an industry is determined by five underlying forces of competition (see Figure 2-7):

1. the barriers to entry for new competitors,
2. the threat of substitute products or services,
3. the bargaining power of buyers,
4. the bargaining power of suppliers, and
5. the intensity of rivalry among existing competitors.

The collective strength of these five competitive forces determines the ability of firms in an industry to earn profits (Porter, 1985). This framework makes it easy to identify the underlying drivers of average industry profitability and to gain insight into how profitability will evolve in the future. The following paragraphs discuss the attractiveness of the content business market using Porter’s Five Forces analysis.
Figure 2-7. Porter’s Five Forces Analysis of the Content Industry

**Threat of New Entrants**

Entry into the content market requires little capital investment since both content providers and mobile portal providers can take advantage of the Internet and mobile networks as significantly lower cost distribution channels. In addition, it is not necessary to employ marketing or sales personnel. At the same time, new entrants can easily implement the latest technology in their products or services. Furthermore, regulation of the Internet is minor due to the traditional policy of maintaining the web as an open, global infrastructure (Dodd, 2001).
These factors make the barriers to entry quite low. However, rapid growth in the industry makes it more difficult for new entrants to enjoy a proprietary technology.

**Threat of Substitute Products or Services**

The rapid development of technology in most cases creates new threats of substitutes since they accelerate the content production cycle at a lower cost. The emergence of new technologies also allows content providers and mobile portal providers to replicate their competitors’ offering so they can catch up with rivals. Furthermore, for buyers, switching costs are very low so content providers and mobile portal providers have lower bargaining power over buyers. As a result, the threat of substitute products or services is high.

**Bargaining Power of Buyers**

Mobile Internet services allow users to gain easy access to a variety of content, including detailed information, which makes it easier to compare among many options and make purchasing decisions easier (Porter, 2001). This leads to significantly low switching costs. In most cases, users are very sensitive to the cost for accessing content, which may force content providers into a price war. This is primarily due to the difficulty of service differentiation for content providers and mobile portal providers. For these reasons, the bargaining power of buyers is very high.

**Bargaining Power of Suppliers**

The open, public infrastructure of the Internet enables suppliers to offer their products or services directly to customers at lower costs. At the same time, it enables suppliers to choose
among a variety of distribution channels. Furthermore, content providers and mobile portal providers tend to regard the quality of supplier’s information as very important, which leads to service differentiation. However, the commoditization of the content business makes it difficult to differentiate the information given to content providers and mobile portal providers. Hence, the bargaining power of suppliers is modest.

**Rivalry among Existing Firms**

Growth in the industry makes it more difficult for content providers and mobile portal providers to differentiate their products or services, but it also allows them to catch up with their competitors relatively easily. Consequently, content providers and mobile portal providers tend to shift their focus to the price of content. Moreover, expansion of the Internet and mobile networks allows a greater number of new entrants to start a business in the market, which results in many diverse competitors. In addition, the bargaining power of content providers and mobile portal providers over buyers and suppliers is low so they are sensitive to the interests of buyers and suppliers. For these reason, the intensity of competition is very high.

2.3.3 *Strategic Positioning*

As discussed in the previous section, the content business market is generally under pressure in terms of profitability. Therefore, it is important for content providers and mobile portal providers to create a distinct strategic positioning. As a model for analyzing the value position of a player in the content market, I have used Hax’s Delta Model, which describes three distinct strategic options (Hax, 2001). These include Best Product, Total Customer Solutions, and System Lock-In positioning (see Figure 2-8), which are summarized as follows.
**Best Product**

The focus of this strategic positioning is on the characteristics of the product itself. Most content providers and mobile portal providers have adopted this option, and have sought product differentiation by introducing unique features, or lower costs which mean a price advantage to customers. Both tend to look closely at competitors. Competitive advantages are achieved through efficient production and development within process management.

**Total Customer Solutions**

This positioning strategy focuses on customers rather than products. Content providers, or mobile portal providers that have chosen this options, strive to establish strong
relationships with customers and to reduce customer costs while increasing the company’s profits. This results in enhancing the attractiveness of their products. Hence, a deep understanding of customer behaviors and favorites is essential when pursuing this positioning strategy. Content providers that have adopted this position include Amazon.com and Yahoo!, both of which provide personalized information for consumers as well as a wide range of products, such as books, electronics, healthcare, and art. Examples of mobile portal providers include SK Telecom in Korea, which offers called NATE GPS Service, which provides customized mobile content specifically related to a user’s location (SK Telecom website, 2004).

**System Lock-In**

This position strategy requires the widest corporate scope and involves all the key external players, such as customers, suppliers and, most important, complementors. Support from complementors promotes development in products or services while locking out competitors in the market.

Another way of achieving this strategy is adoption of de facto proprietary standards. A mobile portal provider that has done this is NTT DoCoMo, which has successfully collaborated with content providers to build a mobile portal, while also encouraging them to enter the market. However, this strategy is changing owing to a furious battle because most of the content available over the Internet can easily be incorporated into mobile portals even by competitors.

Content providers and mobile portal providers should develop any one of the strategic positions if they wish to achieve and maintain profitability in this intense industry. However, it
will not be not easy due in large part to the commoditization of mobile Internet services. Content providers and mobile portal providers recognize that it is becoming difficult to differentiate their services from competitors. Every player in the market can take advantage of the latest technologies and replicate competitors’ services without difficulty, thereby reducing profitability in the industry. As shown earlier in Figure 2-4, the growth of mobile content might enter the late majority stage like the diffusion of mobile Internet users, which means that new innovations will be required for further expansion.

2.4. Summary

This chapter discussed market trends in the mobile Internet industry. The following key issues were described:

- The diffusion of mobile Internet services in Japan is dependent on content providers as well as mobile portal providers that integrate a variety of content into a portfolio. They are crucial complementors for mobile operators.

- Mobile Internet services have become a commodity due to the difficulty in creating innovative content services, which is the most critical factor for success. In other words, the diffusion of mobile Internet services has reached the late majority stage.

- The content business market is under pressure to increase profitability, and the intensity of competition is very high. Thus key players—the content providers and mobile portal providers—must strive to differentiate their services from competitors.

- Owing to fierce rivalry, it is critical for content providers and mobile portal providers to build a robust strategic position, such as Best Product, Total Customer Solutions, or System Lock-In.
3.1 Overview

This chapter discusses Web services and their potential contributions to content development. It is expected that the use of Web services will enable integrators to differentiate themselves from their competitors by creating a set of commoditized content. I also discuss how Web services enhance the strategic positioning of service integrators, namely content providers and mobile portal providers that serve as Web service requesters. This chapter provides a basic overview of Web services and how they work.

3.2 An Emerging Technology

In order for the content business to develop further, content providers and mobile portal providers need to develop innovations, even as their product becomes more of a commodity. It is expected that a new technology, Web Services, will be sufficient to overcome this challenge because this technology offers ways to develop new functions and therefore meet the needs of users. More specifically, the new technology enables users to take advantage of the variety of resources available on the Internet by integrating those resources in standardized ways (see Figure 3-1).
I believe Web services offer a number of new opportunities for creating robust strategic positions, and that a combination of commoditized content can be a breakthrough that will differentiate the integrator from its competitors. Content providers and mobile portal providers can establish differentiated services that will shift users’ attention to the quality of their products or services and away from price concerns. This will encourage further development in the content business, thereby advancing mobile Internet services.

### 3.3 Basic Web Services

This section provides an overview of basic Web services, including the characteristics, architecture, and standards of Web services.
3.3.1 Characteristics of Web Services

While traditional technologies allowed users to talk to applications, Web services enable applications to talk to applications (Manes, 2003). To do this, Web services provide a mechanism for application-to-application communication between different software applications that runs on heterogeneous platforms. This implies that Web services have great potential to promote content development in an innovative way. Web services have the following characteristics:

- Web services are Web resources that users are able to access without human intervention. To facilitate the search for a Web service that matches a user’s needs, a Web service registry is utilized, where most Web services are registered and can be located.

- To enable application-to-application interaction rather than human-to-application, Web services provide an interface—a Web API—that can be accessed from any type of application. The Web API provides access to the application logic that implements the service.

- To make Web services available to the widest range of users, Web services support loosely coupled connections between systems. That is, Web services communicate by passing XML messages to each other via a Web API. Thus, users can take advantage of localized adaptation at low costs and make the most of legacy systems (Weick, 1976).

3.3.2 Web Services Architecture

The architecture for a Web service has been developed and standardized by the World Wide Web Consortium (W3C), a standards body for Web-related technologies. According to W3C, the basic Web services architecture defines an interaction between software agents as
an exchange of messages between service requesters and providers. Service requesters are software agents that request the execution of a service, while service providers are software agents that provide a service. Agents can be both service requesters and providers. A sequence of events where a service requester can take advantage of a Web service is shown in Figure 3-2.

Source: W3C website, 2004

**Figure 3-2. Web Services Architecture**

Service providers are responsible for publishing a description of the Web service they provide through a discovery agency, which is a registry of Web services. Then a service requester can find the description of a Web service that matches its needs through the discovery agency. After the discovery agency returns the information about the description and the address of the Web service that meet the needs, the service requester can request
execution of the service to the provider that offers the service. As a consequence, a service requester benefits from the Web service.

3.3.3 Standards for Web Services

Web services technologies are capable of exchanging messages, describing Web services, and publishing and discovering Web services descriptions. These functions are defined by open standards that ensure interoperability between software agents—SOAP (Simple Object Access Protocol), WSDL (Web Service Description Language), and UDDI (Universal Description, Discovery and Integration). These standards make use of XML, or Extensible Markup Language, which is a syntax for marking-up data with simple, human-readable tags in a standard format (Means and Harold, 2001). The following paragraphs describe these key standards and Figure 3-3 illustrates the Web services architecture stack.

**SOAP (Simple Object Access Protocol)** provides a standard, extensible, composable framework for packaging and exchanging XML messages. SOAP messages can be carried by a variety of network protocols such as HTTP, SMTP, FTP, RMI/IIOP, or a proprietary messaging protocol (W3C website, 2004).

**WSDL (Web Service Description Language)** describes Web services beginning with the messages that are exchanged between the requester and provider agents. The messages themselves are described abstractly and then bound to a concrete network protocol and message format (W3C website, 2004).
**UDDI (Universal Description, Discovery, and Integration)** provides a platform-independent way of describing and discovering Web services and Web service providers. The UDDI data structures provide a framework for the description of basic service information, and an extensible mechanism to specify detailed service access information using any standard description language (UDDI Project website, 2004).

![Web Services Architecture Stack Diagram](source: W3C website, 2004)

**Figure 3-3. Web Services Architecture Stack**

### 3.4 Key Determinants of Web Services Diffusion

To benefit from Web services, diffusion in the Web services market needs to move to the growth stage. In this regard, three factors—technologies, standardization, and business models—have a significant effect on accelerating diffusion.
The following paragraphs describe these three factors (see Figure 3-4), namely strong triggers of a positive feedback, and analyze their current status and challenges they may face for further development.

![Diagram](image)

Source: Author, 2004

**Figure 3-4. Determinants of Web Services Diffusion**

### 3.4.1 Technologies for Business Transaction

Although some well-defined standards, such as SOAP and WSDL, have been established, there is a still need for common rules for business transaction between Web service users. Hence, vendors and enterprises are working to address this issue by adding additional layers to the Web services stack (see Figure 3-5). These include security, transaction management, user interface development, collaborative and peer-to-peer
environments, business-to-business interactions and more (Smith, Andrews, and Abrams, 2003)

<table>
<thead>
<tr>
<th>Need</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business Semantics</strong></td>
<td></td>
</tr>
<tr>
<td>Identifying</td>
<td>Liberty, Passport</td>
</tr>
<tr>
<td>Workflow/Business Process Modeling</td>
<td>BPEL4WS, BPML, WSCI</td>
</tr>
<tr>
<td>Building Trust</td>
<td>WS-Security, SAML, XrML</td>
</tr>
<tr>
<td>User Interface</td>
<td>WSRP, WSIA</td>
</tr>
<tr>
<td>Reliability</td>
<td>WS-Reliable Messaging</td>
</tr>
<tr>
<td>Search and Find</td>
<td>UDDI</td>
</tr>
<tr>
<td>Description</td>
<td>WSDL</td>
</tr>
<tr>
<td>Messaging</td>
<td>SOAP</td>
</tr>
<tr>
<td>Format</td>
<td>XML</td>
</tr>
<tr>
<td>Transport</td>
<td>Common Internet Protocols (for example, TCP/IP, HTTP)</td>
</tr>
</tbody>
</table>


**Figure 3-5. Emerging Web Services Standards Stack**

### 3.4.2 Standardization Activity

Standards allow a technology to become ubiquitous. Regarding Web services, a number of industry initiatives, such as W3C and OASIS (Organization for the Advancement of Structured Information Standards), play a key role in the standards-setting process. Both W3C and OASIS have gained strong industry support from most of the major players in the Internet and software industries, including Microsoft, Oracle, and Sun Microsystems, all of which keep abreast of standardization activities in order to consolidate their ideas into *de facto* industrial standards (OASIS website, 2004).
This fact is accelerating migration toward distributed computing. In the mobile Internet domain, OMA (Open Mobile Alliance) is taking the initiative in setting Web services standards to ensure seamless interoperability between mobile networks and the Internet. A number of mobile operators, content providers, and vendors have been collaborating to foster further growth in mobile Internet services (OMA website, 2004).

3.4.3 Business Models

Business models are indispensable for enabling users to take advantage of Web services. This means that all the stakeholders, including Web service requesters and Web service providers, should find business opportunities that result in profitability. To do this, however, issues of trust need to be handled, as players must be reliable when entering a business relationship. In addition, service quality is a major factor influencing business partnerships. Equally important, revenue models must also be established. These issues are being considered by vendors.

3.4.4 Positive Feedback

Once the diffusion of Web services accelerates as a result of these key determinants, all the players, Web service providers, and requesters can benefit from the ensuing network effect. That is, as more Web service providers begin to offer their innovations to the public, more Web service requesters will begin taking advantage of Web services. This will also lead to an increase in Web service providers, which attempt to gain profitability in the market. Thus, it is expected that a strong positive feedback will occur in the Web services area.
3.5 The Impact of Web Services on the Content Business

3.5.1 Two Approaches to Benefiting from Web Services

With the implementation of Web services, the players offering content to users, namely, content providers and mobile portal providers, can proceed to the next stage where they can take advantage of the resources that are available over the Internet.

There are two types of approaches: the Web Service Requester approach, which takes advantage of innovations offered by other players, or the Web Service Provider approach, which seeks additional distribution channels for providing its services. Both approaches are robust for content providers as well as mobile portal providers in that they typically lead to building a dynamic business value chain while making the most of their core businesses.

I will focus primarily on the Web Service Requester approach since most content providers and mobile portal providers can benefit from this approach, which enables them to enhance their strategic positioning and maintain or increase their profitability.

3.5.2 Service Integrator

In the Web service requester approach, content providers and mobile portal providers can integrate innovations published by Web service providers into their own service portfolio. Furthermore, even if Web service providers’ offerings are commodities, a combination of Web services can be an innovation (The Economist, 2003). As a consequence, they are able to develop new functions for users while achieving cost reductions. Content providers or mobile portal providers that act as Web service requesters and integrate offerings from Web service providers into their content services are called in this thesis “Service Integrators.” Figure 3-6 illustrates this integration process.
3.5.3 Horizontal and Vertical Integration

Service integrators accelerate both horizontal integration and vertical integration, as shown in Figure 3-7. For content providers, it becomes easier to aggregate related services into their content in the same market field or across market fields. Equally important, they can integrate their value chain vertically even more easily with Web services implementation. Compared to large-scale proprietary systems, such as Electronic Data Interchange (EDI), content providers can benefit from cost savings since Web services come from the use of a unified interface rather than a different interface technology for each specific interface. The standard nature of the interfaces significantly reduces integration costs, both internally and externally (Hansen, Madnick, and Siegel, 2002).
The same benefit also applies to mobile portal providers. For them, it is even easier to consolidate content across market fields, such as transactions and information, into one specific service by serving as a service integrator. In other words, they can promote horizontal integration while making the integrated content look like a single service to users.

To implement Web services, mobile operators fundamentally have two options: serve as a service integrator, or encourage an independent mobile portal provider to become a service integrator through an alliance.

3.5.4 Achieving Strategic Positions

Taking these points into consideration, it is expected that the characteristics and architecture of Web services will make it possible for service integrators to seek either of
three distinct strategic positions: Best Product, Total Customer Solutions, or System Lock-In, as discussed in Chapter 2. The following sections discuss how Web services enhance these strategic positions.

**Best Product**

Best Product can be achieved through product and process innovation, which creates robust competitive advantages in the market. Web services offer new opportunities for innovation by consolidating a variety of content into one specialized service while also achieving cost reductions through standardized processes. In other words, service integrators such as Web service requesters can incorporate robust complementary assets into their service portfolio from a wealth of Web service providers, thereby leading to differentiation among competitors (see Figure 3-8).

![Diagram](image)

*Source: Author, 2004*

**Figure 3-8. Web Services Implementation for Best Product Positioning**
**Total Customer Solutions**

Web services will likely allow service integrators to increase their customers’ profits as well as reduce customers’ costs by customizing the content offered to users who have specific needs. This becomes a reality through horizontal integration, which enriches content to meet users’ needs.

Another approach for achieving Total Customer Solutions positioning is to provide a Web service for mobile phone users as a complementary asset by taking a Web service provider approach. In this case, the service provider can expect a customer to take user-based design, which serves as a Web service requester, in order to consolidate Web services into their favorite software environments. Chapter 6 details how this approach promotes innovation and leads to increasing customer satisfaction.

**System Lock-In**

The System Lock-In option is the most robust of these three positions. Web services make it possible to collaborate between software systems throughout the Internet by adopting global standards and taking advantage of a wealth of resources. That is, with the implementation of Web services, service integrators can create robust competitive advantages in collaboration with complementors—a wide range of content providers.

It should be emphasized that competitors who provide their innovations might be considered as complementors in the Web services arena. If service integrators successfully lock in complementors as strong partners, they will be able to create a robust value position in the content market.
3.6 Summary

This chapter discussed the characteristics of Web services and suggested how to overcome the commoditization of the content business by making use of Web services as an emerging technology. This technology allows users to create a combination of Web resources, which lead to innovation. The following key issues were described:

- To benefit from Web services, there are two approaches. One approach is to serve as a Web service requester, which takes advantage of innovations made available by other players. The other approach is to serve as a Web service provider, which seeks additional distribution channels for its services.

- Web service requesters make content providers or mobile portal providers become service integrators who integrate a variety of Web services as complementary assets from Web service providers into their content. Service integrators can pursue either horizontal integration—a source for service differentiation, or vertical integration, which leads to efficient process management.

Chapters 4 and 5 will discuss how service integrators can seek robust strategic positioning by taking a Web service requester approach, which is invaluable in considering the benefits derived from the implementation of Web services. Chapter 6 discusses another way to benefit from Web services, namely a Web service provider approach.
CHAPTER 4

The Benefits of Web Service Requesters: Qualitative Analysis

4.1 Overview

This chapter analyzes the major benefits that can accrue taking a Web service requester approach to the content business, where content providers as well as mobile portal providers pursue robust strategies.

To evaluate the benefits for content businesses, a System Dynamics model is constructed, with particular focus on several key factors. The reason I created a System Dynamics model is to examine how Web services will promote product and process innovations under different scenarios and how those innovations will have an impact on content service attractiveness. Through analysis of key dynamics of content development, I also propose some policy recommendations for how to develop competitive advantages by applying Web services.

4.2 Methodology

I used System Dynamics modeling as the methodology for examining the benefits of Web services implementation. I did this because System Dynamics provides a perspective and a set of conceptual tools that allow us to understand the structure and dynamics of complex systems (Sterman, 2000). It also clarifies major cause-and-effect relationships and implies some policy recommendations. Furthermore, a System Dynamics model enables both
qualitative and quantitative analysis, which are effective when examining to what extent product and process innovations lead to profitability as well as how much outsourcing should be carried out to take advantage of Web services.

4.3 **Base Model of the Content Business**

One of the common content business models shows acquisition of users who pay access fees. Figure 4-1 shows my base model, which captures the dynamics of this type of content business. An increasing number of users allows a service integrator, i.e., a content provider or mobile portal provider, either serving as a Web service requester, to gain profit which could then be invested in R&D to pursue the development of further innovations. This is true in large part because every product eventually becomes a commodity, so periodic innovations are essential for enhancing productivity, thus resulting in service differentiation (von Hippel, 1988).

![Base Model](image)

*Source: Author, 2004*

**Figure 4-1. Base Model**
This base model serves as a foundation from which to construct a conceptual model for qualitative analysis (presented here in Chapter 4), as well as detailed model for quantitative analysis (to be done in Chapter 5).

To construct a conceptual model for qualitative analysis based on the base model shown above, some key dynamics that have a great effect on the content business must be considered. Two in particular—attractiveness of content and innovation—are essential in qualitative analysis since they are strong triggers of positive feedback in the base model. Also, the dynamics of competition is another key determinant affecting the value position of a service integrator in the market, which should also be incorporated into a conceptual model.

4.4 Attractiveness of Content Services

I began by looking at the base model to consider what factors contribute to growth in the number of subscribers to mobile Internet services. The model examines how product and process innovations create strong positive feedback which leads to improvement in the attractiveness of the content business and thus to the acquisition of more users. Among possible factors, two key determinants are emphasized: Price and Service Differentiation. These two determinants trigger the diffusion of mobile Internet services, so to pursue them is regarded as a fundamental content business strategy. The following sections describe these two determinants of the content attractiveness in detail.

4.4.1 Price

In most cases, mobile phone users are sensitive to the price for content access. They tend to compare prices among competing services and then choose one of the less expensive
ones. Some content providers or mobile portal providers, on behalf of content providers, charge mobile phone users certain access fees depending on the kind of content being accessed. Such access fees are typically charged on a monthly basis, such as content for news or magazines. In contrast, other content providers or mobile portal providers, on behalf of content providers, allow users to access the content and use their services free of charge. In that case, the content providers that operate the site often get their profits through commission fees for transactions, such as book purchases and stock trading, or through advertising revenues.

In constructing my System Dynamics model, I used the former case, a billing model of content business based on a monthly charge for content access.

4.4.2 Service Differentiation

Service integrators must differentiate their services from competitors in order to acquire more mobile phone users. Service differentiation increases the attractiveness of the content service so that users will regularly access the site to obtain useful information. There are three major determinants that lead to service differentiation: product innovation, diversity of content, and the content update rate. At the same time, service differentiation may be undermined by outsourcing to third parties, which makes it difficult for service integrators to differentiate their content services from various competitors. That is, production innovation, the diversity of content, and the content update rate reinforce service differentiation, while outsourcing may make it difficult to maintain it (Figure 4-2). The following paragraphs discuss these three positive and one negative factor determining service differentiation.
Product innovation

Product innovation usually provides opportunities to create new product designs that are not yet available in the market. This makes it possible to differentiate one’s services from competitors, and thus lead to the “Best Product” strategic positioning, as discussed in Chapter 3.5.4. Chapter 4.5.1 details how product innovation leads to service differentiation.

Diversity of Content

This is defined as the various kinds of content being offered to mobile phone users. The introduction of a variety of content should stimulate greater demand among mobile phone users for mobile Internet services. Diversity of content makes it possible for service integrators to meet the specific needs of mobile phone users, and in turn accelerate the activities of content construction. For this reason, service integrators are motivated to focus on investment in content development, which will result in greater diversity of content.

Diversity of content is achieved mainly by high productivity, which is driven by process innovation. Consequently, a focus on developing diverse content will result in
increasing customer profits and building the robust strategic positioning, Total Customer Solutions.

**Content Update Rate**

Update Rate is defined as how often the content is updated. In some cases, mobile phone users access content regularly to obtain updated information. This means that the update rate is a critical factor for keeping users sufficiently interested to pay attention to the content so they will not switch to another provider. Mobile phone users are likely to expect that news content will be updated at least daily, more realistically, hour-by-hour. In this case, only content providers that update their content often will survive. From an organizational standpoint, the update rate is enhanced through higher productivity, which is driven by process innovation.

**Outsourcing**

Outsourcing is effective for reducing production costs as well as controlling the volume of work taken on by employees. Hence, service integrators can focus on their core businesses rather than worry about expanding their business fields. Outsourcing can be promoted by developing strong relationships with business partners who then become complementors. This strategy will likely result in System Lock-In positioning, which leads to building a robust competitive advantage by locking in complementors.

A note of caution: heavy outsourcing may undermine service differentiation since it may mean less control by service integrators over programs built by third parties. Clients may then have to rely on the decisions of third parties as to how often products or services should be

53
updated or what features should be incorporated into existing products or services (Ross and Weill, 2002). For this reason, service integrators need to consider carefully the tradeoffs involved in outsourcing.

4.5 Dynamics of Innovation

Utterback (1994) suggests that there are two forms of innovation: product innovation and process innovation. Product innovation is defined as a radical development in a product; process innovation is defined by incremental improvements in process management. The authors’ model shows that the rate of product and process innovation follows a general pattern over time and the two share an important relationship (Figure 4-3). These innovations are essential in considering the dynamics of the content business because they can be strong drivers for price reduction and service differentiation.

![Diagram showing the rate of major innovation across fluid, transitional, and specific phases with Product Innovation and Process Innovation curves.]

Source: Utterback, 1994

Figure 4-3. The Dynamics of Innovation
4.5.1 Product Innovation

Investment in R&D promotes product innovation, which makes it possible to create competitive assets and sources of service differentiation. Product innovation offers a great opportunity for service integrators to attract more users. In the early stages of a product life cycle, most of the investment goes into product design since the company strives to create competitive advantage by differentiating its products from competitors. However, at some point, every product may be undermined by substitutes or replicated by competitors who have spent enough time to accumulate the know-how to catch up with the first movers in the market. Thus, the advantages of product innovation begin to decrease and most products become a commodity.

4.5.2 Process Innovation

Investment in R&D also accelerates process innovation, which increases productivity. Increasing productivity leads to a higher content update rate as well as diversified content, both of which are important for enabling service differentiation. At the same time, higher productivity also has a positive effect on cost reduction. During the growth stage of a product life cycle, a few product designs become dominant and meet the needs of targeted users. Reduced uncertainty over product design will lead service integrators to switch their attention to price, which could result in a price war. As service integrators accumulate know-how about such designs, process management becomes more efficient, which enables mass production. Learning and economies of scale bring about a reduction in production costs. Thus, investment in product innovation shifts to process innovation once a few product designs survive, since service integrators tend to pay attention to cost reduction in product design.
4.6 Dynamics of Competition

As service integrators acquire more subscribers, additional competitors will enter the content market, which leads to intense rivalry. This is also accelerated by the fact that the barrier to entry is relatively low due to low capital investment and low switching costs for customers, as discussed in Chapter 2.3.2. The intensity of competition is sufficiently high that it is difficult for service integrators to maintain their competitive advantages so that they can survive in the market.

To overcome this challenge, service integrators must increase and maintain their revenues by building a highly attractive product, or else reduce production costs by developing added productivity, or by promoting outsourcing.

4.7 Conceptual Model

By integrating content service attractiveness and the dynamics of product and process innovations, a System Dynamics model was constructed, as shown in Figure 4-4. This conceptual model, along with its associated positive and negative feedback loops, clarifies the key dynamics of the content business. In the model, a positive feedback, or reinforcing, loop is marked with an “R”, while a negative feedback, or balancing, loop is marked with a “B”, both surrounded with a loop.
(Reinforcing Loops)
R1: Price Adjustment
R2: Productivity
R3: Content Update Rate
R4: Diversity of Content
R5: Product Innovation

(Balancing Loops)
B1: Competition
B2: Investment in R&D
B3: Expense for production
B4: Expense for Human Resources

Source: Author, 2004

Figure 4-4. Conceptual Model
4.8 Policy Implications

By constructing this conceptual model, it becomes possible to consider how a number of dynamics work together to form the complex content business and thus how a service integrator should formulate its policies to build competitive advantage through creating reinforcing positive feedbacks and balancing negative feedbacks. The following paragraphs discuss key policy implications, focusing on positive and negative feedbacks, which are closely correlated.

4.8.1 Service Differentiation through Product Innovation

Clearly, a service integrator should create and maintain service differentiation to increase the attractiveness of its content service. There are a number of factors involving in developing service differentiation, which have a positive or negative impact on it. By paying attention to the strong positive feedbacks leading to service differentiation, some policy implications become apparent.

One policy is to promote product innovation. An innovative content design that is driven by the promotion of product innovation will lead to further service differentiation of the content service compared to competitors (Reinforcing Loop: R5) (see Figure 4-5).

Thus, investment in product innovation should be a strong trigger for service differentiation.
4.8.2 Service Differentiation through Process Innovation

Another policy to consider is the pursuit of process innovation, which increases productivity. This will lead to a higher content update rate (Reinforcing Loop: R3) as well as
diversity of content (Reinforcing Loop: R4) (see Figure 4-6). These two strong positive feedback loops imply that it is important to consider how to assign human resources to each production activity, rather than try to achieve both at the same time. This is because increasing human resources results in higher expenses, which could undermine profits obtained from the content business.

Source: Author, 2004

**Figure 4-6. Reinforcing Loops 3 and 4**
The feasibility of these two policies depends on the product lifecycle. In other words, if a product lifecycle is in its early development stages, a service integrator can seek product innovation rather than process innovation. During the growth stage, it may be more effective to shift investment from product innovation to process innovation. In the later development stages, a service integrator should focus on process innovation since product differentiation becomes too difficult.

4.8.3 Cost Reduction

If a service integrator wants to reduce production costs or limit in-house program volume to a specified amount, it can outsource development to third parties. Product development in most cases requires more human resources, which contributes to increased production costs (Balancing Loop: B4). Moreover, in-house production volume also increases production costs due to an increase in operating time, such as software and hardware for developing services (Balancing Loop: B3) (see Figure 4-7). Under such conditions, outsourcing is effective for reducing production costs. Furthermore, it allows a service integrator to concentrate on its core business without allocating its human resources to numerous projects (Quinn, 1999).

However, a service integrator should keep in mind the potential negative effect of outsourcing on service differentiation. Heavy outsourcing to third parties is likely to make it even more difficult for a service integrator to differentiate its product from competitors due to commoditization of packaged software or hardware.
Figure 4-7. Balancing Loops 3 and 4
From these three policy implications, it is reasonable to conclude that a service integrator should try to achieve a balance between service differentiation and cost reduction. In particular, it is important to address how to invest in and accelerate product and process innovation in pursuit of service differentiation, as well as how to optimize outsourcing so as to maintain service differentiation.

4.9 Benefits Derived from Implementing Web Services

In order to explore the impact of Web services implementation on the content business, it is useful to consider how implementation would affect each factor in the conceptual model. In the model, implementation of Web services would have an impact on the variables discussed below. Whether service integrators will actually experience this scenario depends on the diffusion of Web services, which determines the extent to which feedback loops become dominant in the dynamics of the content business.

4.9.1 Achieving Product Innovation

Web services are likely to provide opportunities for service integrators to develop product innovation because they enable service integrators to collaborate with other players in the mobile Internet industry and incorporate their innovations into a service for customers. Some service integrators might want to incorporate updated information from Web service providers to differentiate their content from competitors. At the same time, service integrators can enrich their content portfolio by aggregating a variety of innovations toward horizontal integration. This might lead to extending the market boundary and acquiring another segments of customers, such as businessmen or students.
Currently, the product lifecycle of Web services is still in the early development stages, so no dominant product design has emerged. Thus, it can be expected that service integrators will benefit from product differentiation by using Web services, which enable them to meet the particular needs of users.

4.9.2 Achieving Process Innovation

Web services might also lead service integrators to pursue process innovation. One vision of Web services is to establish global standards for interoperability between users so that Web services can run on any kind of heterogeneous platform. This means that service integrators can accelerate process innovation either internally or externally by adopting unified standards for Web services. Such standards allow users to reduce production costs and to benefit from accumulated learning about how to take advantage of Web services through user communities. Although the production lifecycle of Web services is still in the early stages, it is expected that some service integrators will promote process innovation within a company or between business partners by implementing standards for Web services in pursuit of vertical integration (Hargel and Brown, 2002).

4.9.3 Promoting Outsourcing

Service integrators can take advantage of Web service providers’ businesses to outsource via Web services interfaces. Web services are likely to accelerate outsourcing since they provide a standard mechanism of communications between users. The mechanism reduces costs for business-to-business transactions, which enables legacy systems to interact with newly established systems over standardized interfaces. Even in the early development
stages of the Web services adoption life cycle, where a few Web service providers publish their innovations, service integrators can take advantage of Web services in collaboration with business partners through alliances for outsourcing. In the later stages, a number of Web services users are likely to provide opportunities for outsourcing, which allows service integrators to rely on third parties. Thus, it becomes possible to promote workforce reduction, leading to reduced production costs. However, although outsourcing is expected to be effective in balancing the negative effect of increased production costs, it is likely to offset the positive effect on service attractiveness, which is driven by process and product innovation. Thus, in some cases, it could be better to limit the volume of outsourcing, namely, the dependence on Web service providers, and still not lose competitive advantage when implementing Web services.
4.9 Summary

In this chapter I conducted a qualitative analysis to identify the major benefits available from adopting a Web service requester approach, in which a content provider or mobile portal provider serves as a service integrator. The analyses found:

- Service differentiation can be achieved by product innovation, diversity of content, and a quick content update rate. However, service differentiation could be offset by heavy outsourcing, which is effective for controlling in-house production and reducing costs.

- In the construction of content services, there are two key dynamics. One is product innovation, which enhances service differentiation and thereby increases the attractiveness of the content services. The other is process innovation, which increases productivity and leads to lower production costs. Both product and process innovation are driven by investment in R&D.

- Web services allow service integrators to achieve service differentiation through product and process innovation as well as cost reduction. On the other hand, Web services are likely to require outsourcing, which may undermine the profitability of the content business.
5.1 Overview

While qualitative analysis is effective for understanding the key dynamics of the content business, quantitative analysis makes it possible to evaluate the extent to which Web services will promote service differentiation and cost reductions under the various scenarios of Web services diffusion. It is critical for service integrators to pursue several different policies taking into consideration the market expansion. Furthermore, quantitative analysis can address how much investment in R&D is needed and how much outsourcing should be carried out.

This chapter discusses key considerations for conducting quantitative analysis and suggests a detailed analytical model of profitability for the content business. I used Vensim, a software package specifically designed for System Dynamics simulations, which enabled me to conduct sensitivity analyses and then identify policy recommendations for how to balance the tradeoffs between service differentiation and outsourcing.

5.2 Modularization

The approach for creating a detailed model suitable for quantitative analysis begins by developing a conceptual model and then evolving it by increments into a more detailed model.
The first step in creating a detailed model is to break down the conceptual model (presented earlier as Figure 4-4) into separate modules that make it easier to elaborate the conceptual model. Figure 5-1 shows the breakdown of the conceptual model into four modules: (1) Service Attractiveness, (2) Production Activity, (3) Investment in R&D, and (4) Intensity of Competition.

Source: Author, 2004

Figure 5-1. Modularization
The next step is to explore each module to determine the extent to which it consists of completed positive and negative feedbacks and additional effective variables. Then, the modules can be incorporated into one large model for running simulations. The following sections describe how to quantify variables in the conceptual model and the relationships between the variables in each module.

### 5.2.1 Module 1: Service Attractiveness

Module 1 (shown in Figure 5-2) shows how the service attractiveness of the content business leads to an adoption rate of users. The following paragraphs describe the qualification of key variables, such as attractiveness and the determinants.

![Diagram of Module 1: Service Attractiveness](source: Author, 2004)

**Figure 5-2. Module 1: Service Attractiveness**
**Attractiveness** is determined by two weighted factors, “Attractiveness of Price” and “Service Differentiation”. Attractiveness has a positive effect on the adoption rate of users. For simplicity, Attractiveness, as well as the direct and indirect determinants, are scaled from 0 to 1, with 0 meaning no effect on attractiveness, and 1 meaning attractiveness is established well enough to attract users to the content service.

\[
\text{Attractiveness} = \omega_1 \cdot \text{Attractiveness of Price} + \omega_2 \cdot \text{Service Differentiation} \\
[\text{Units: dimensionless (Scale 0-1)}]
\]

where \( \omega_1 + \omega_2 = 1 \)

**Attractiveness of Price** falls as price increases (See Figure 5-3). For very high prices, demand falls to zero. Up to a certain value, the attractiveness of content will fall toward zero. Some mobile portals determine the maximum price for content. Since this is a kind of indicator, the input is defined as the relative price to the maximum price.

\[
\text{Attractiveness of Price} = \frac{\text{Table for Price (Price / Maximum Price)}}{\text{[Units: dimensionless (Scale 0-1)]}}
\]

Source: Author, 2004

**Figure 5-3. Attractiveness of Price Function**
Service Differentiation is determined by four factors. Three are positive factors, “Attractiveness of Diversity”, “Attractiveness of Update”, and “Product Innovation”, and one is a negative factor, “Outsourcing Volume.” More specifically, Service Differentiation is weighted by the three positive factors, and then multiplied by the negative effect of the fourth factor, Outsourcing Volume.

\[
\text{Service Differentiation} = (\omega_1 \times \text{Attractiveness of Diversity} + \omega_2 \times \text{Attractiveness of Update} + \omega_3 \times \text{Production Innovation}) \times \text{Outsourcing Effect}
\]

[Units: dimensionless (Scale 0-1)]

where \(\omega_1 + \omega_2 + \omega_3 = 1\)

Attractiveness of Diversity rises with the amount of content (See Figure 5-4). The relationship is sharply nonlinear. The more diversity a content provider offers, the more possibilities the company will have to increase its attractiveness. The diversity of content is determined by the amount of "In-House Content" and "Outsourcing Content".

\[
\text{Attractiveness of Diversity} = \frac{\text{Table for Diversity ((In-House Content} + \text{Outsourcing Content)} / \text{Desired Diversity)}\right)}{[\text{Units: dimensionless (Scale 0-1)]}}
\]

Source: Author, 2004

Figure 5-4. Attractiveness of Diversity Function
**Attractiveness of Update** rises with a faster update rate and is determined by “In-House Update Rate” and “Outsourcing Update Rate”. For simplicity, the same table function as Attractiveness of Diversity is used, which shows that the growth curve is S-shaped.

\[
Attractiveness\ of\ Update\ = \text{Table for Update} \left(\frac{(\text{In-House Update Rate} + \text{Outsourcing Update Rate})}{\text{Desired Update Rate}}\right) \\
\text{[Units: dimensionless (Scale 0-1)]}
\]

**Outsourcing Effect on Differentiation** is determined by how much outsourcing is carried out relative to the total of “Production Volume”. The more outsourcing is used by a service integrator, the greater the negative effect on service differentiation (See Figure 5-5).

\[
Outsourcing\ Effect\ on\ Differentiation\ = \text{Table for Outsourcing Effect} \left(\frac{\text{Outsourcing Volume}}{\text{Production Volume}}\right) \\
\text{[Units: dimensionless]}
\]

Source: Author, 2004

**Figure 5-5. Outsourcing Effect Function**
5.2.2 Module 2: Production Activity

Module 2 (shown in Figure 5-6) models the factors that have an impact on total cost for developing content services. This module captures the fact that process innovation leads to higher productivity and accelerates cost reduction. Furthermore, how outsourcing reduces cost is also implied in this module. The qualification of key variables is described below.

Source: Author, 2004

Figure 5-6. Module 2: Production Activity
*Production Volume* consists of “In-House Volume” and “Outsourcing Volume”. In-House Volume is determined by “In-House Update Rate” and “Production Rate”, both of which are driven by “Productivity”. On the other hand, Outsourcing Volume is defined as constant.

\[
\begin{align*}
\text{Production Volume} & = \text{In-House Volume} + \text{Outsourcing Volume} \\
& \quad \text{[Units: \ lines/month]} \\
\text{In-House Volume} & = \text{In-House Update Rate} + \text{Production Rate} \\
& \quad \text{[Units: \ lines/month]} \\
\text{Outsourcing Volume} & = \text{Constant} \\
& \quad \text{[Units: \ lines/month]}
\end{align*}
\]

*Productivity* depends largely on “Process Innovation”. Productivity enables a service integrator to achieve high “In-House Update Rate” as well as high “Production Rate”.

\[
\begin{align*}
\text{Productivity} & = \text{Base Productivity} \ast (1 + \text{Process Innovation} \ast \text{Innovation Elasticity}) \\
& \quad \text{[Units: \ lines/staff/hour]} \\
\text{In-House Update Rate} & = \text{Productivity} \ast \text{Hours worked for Update} \ast \text{Human Resources} \\
& \quad \text{[Units: \ lines/month]} \\
\text{Production Rate} & = \text{Productivity} \ast \text{Hours worked for Diversity} \ast \text{Human Resources} \\
& \quad \text{[Units: \ lines/month]}
\end{align*}
\]

*Total Costs* consists of “Expenses” and “Total Investment in R&D”. Expenses is determined by “Human Resource Costs” and “Production Costs”, both of which are defined as follows. On the other hand, Total Investment in R&D is defined as constant.

\[
\begin{align*}
\text{Total Costs} & = \text{Expenses} + \text{Total Investment in R&D} \\
& \quad \text{[Units: \ dollars/month]} \\
\text{Expenses} & = \text{Human Resource Costs} + \text{Production Costs} \\
& \quad \text{[Units: \ dollars/month]} \\
\text{Human Resource Costs} & = \text{Human Resources} \ast \text{Total Working Time} \ast \text{Payment for Work} \\
& \quad \text{[Units: \ dollars/month]} \\
\text{Production Costs} & = \text{In-House Volume} \ast \text{Operation Unit Costs} + \text{Outsourcing Volume} \ast \text{Outsourcing Unit Costs} \\
& \quad \text{[Units: \ dollars/month]} \\
\text{Total Investment in R&D} & = \text{Constant} \\
& \quad \text{[Units: \ dollars/month]}
\end{align*}
\]
**Human Resources** is determined by “Hiring Rate”. Hiring Rate is influenced by “Adjustment to Human Resources”, which depends on the difference between “Target Production Volume” and “Production Volume”.

<table>
<thead>
<tr>
<th><strong>Human Resources</strong></th>
<th>= INTEG (Hiring Rate, initial)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Units: staff]</td>
</tr>
<tr>
<td><strong>Hiring Rate</strong></td>
<td>= Adjustment to Human Resources / Adjustment Time</td>
</tr>
<tr>
<td></td>
<td>[Units: staff/month]</td>
</tr>
<tr>
<td><strong>Adjustment to Human Resources</strong></td>
<td>= (Target Production Volume – Production Volume) / Productivity / Total Working Time</td>
</tr>
<tr>
<td></td>
<td>[Units: staff]</td>
</tr>
</tbody>
</table>
5.2.3 Module 3: Investment in R&D

Module 3 (shown in Figure 5-7) shows how investment in R&D accelerates process and product innovation. This module also shows how to allocate the budget for investment in R&D to product design and process management. In this model, it is assumed that a content provider or mobile portal provider makes a decision about when to shift from product design to process management by observing actual penetration of mobile Internet users. The following paragraphs describe the qualification of key variables.

![Diagram of Module 3: Investment in R&D]

Source: Author, 2004

Figure 5-7. Module 3: Investment in R&D
**Investment in R&D** is extracted from “Cumulative Profits”, which simply means a cumulative amount of “Profits”. Based on “Fraction to Process”, which is defined on the basis of the penetration in the market, the amount of “Investment in Product” and “Investment in Process” can be obtained.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profits</td>
<td>$\text{Revenues} - \text{Total Costs}$&lt;br&gt; [Units: dollars/month]</td>
</tr>
<tr>
<td>Cumulative Profits</td>
<td>$\text{INTEG} (\text{Profits} - \text{Product R&amp;D Rate} - \text{Process R&amp;D Rate, initial})$&lt;br&gt; [Units: dollars]</td>
</tr>
<tr>
<td>Fraction to Process</td>
<td>$\text{Table for Fraction (Actual Penetration} / \text{Target Penetration)}$&lt;br&gt; [Units: dimensionless]</td>
</tr>
<tr>
<td>Product R&amp;D Rate</td>
<td>$\text{Total Investment in R&amp;D} \times (1 - \text{Fraction to Process})$&lt;br&gt; [Units: dollars/month]</td>
</tr>
<tr>
<td>Process R&amp;D Rate</td>
<td>$\text{Total Investment in R&amp;D} \times \text{Fraction to Process}$&lt;br&gt; [Units: dollars/month]</td>
</tr>
<tr>
<td>Investment in Product</td>
<td>$\text{INTEG} (\text{Product R&amp;D Rate, initial})$&lt;br&gt; [Units: dollars]</td>
</tr>
<tr>
<td>Investment in Process</td>
<td>$\text{INTEG} (\text{Process R&amp;D Rate, initial})$&lt;br&gt; [Units: dollars]</td>
</tr>
</tbody>
</table>

**Process and Product Innovation** are driven by the effort to promote R&D, which is defined by the amount of investment in R&D. It is reasonable to assume that the relationship between effort put in R&D and innovations achieved forms an S-shaped curve (Foster, 1986). This is also supported by the Utterback model, as shown in Figure 4-3, which indicates the tendency of the innovation rate. Moreover, it is expected that the shape of the S-curve depends on the diffusion of Web services, and thus some different scenarios are used to run simulations. Chapter 5.3 details how to define the scenarios.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Innovation</td>
<td>$\text{Table for Product Innovation} (\text{Investment in Product} / \text{Desired Investment})$&lt;br&gt; [Units: dimensionless (Scale 0-1)]</td>
</tr>
<tr>
<td>Process Innovation</td>
<td>$\text{Table for Process Innovation} (\text{Investment in Process} / \text{Desired Investment})$&lt;br&gt; [Units: dimensionless (Scale 0-1)]</td>
</tr>
</tbody>
</table>
5.2.4 Module 4: Intensity of Competition

Module 4 (shown in Figure 5-8) shows how the intensity of competition undermines the “Adoption Rate” of users, while increasing the “Churn Rate”. In addition, the profitability of the content business is defined as the trigger of competition. This module also defines the determinants of “Price”, including Intensity of Competition, Installed Base, and Total Costs. The following paragraphs describe the qualification of key variables.

![Figure 5-8. Module 4: Intensity of Competition](source: Author, 2004)
Intense of Competition is trigged by increased “Cumulative Profits” of a service integrator, which is determined by “Revenues” and “Total Costs”. Revenues is determined by multiplying “Installed Base” times “Price”. This definition assumes that charging a monthly fee for access to the content is the business model.

\[
\begin{align*}
\text{Intensity of Competition} &= \text{Table for Intensity (Cumulative Profits / Desired Profitability)} \\
&\quad [\text{Units: dimensionless (Scale 0-1)}] \\
\text{Cumulative Profits} &= \text{INTEG (Profits – Product R&D Rate– Process R&D Rate, initial)} \\
&\quad [\text{Units: dollars}] \\
\text{Profits} &= \text{Revenues – Total Costs} \\
&\quad [\text{Units: dollars/month}] \\
\text{Revenues} &= \text{Installed Base} \times \text{Price} \\
&\quad [\text{Units: dollars/month}]
\end{align*}
\]

Adoption and Churn Rate: Adoption Rate is influenced by “Attractiveness” and “Intensity of Competition”. Churn Rate is determined by multiplying “Installed Base” times “Churn Fraction”, which is influenced by Intensity of Competition.

\[
\begin{align*}
\text{Adoption Rate} &= \text{Desired Adoption Rate} \times \text{Attractiveness Effect} \times \text{Intensity Effect} \\
&\quad [\text{Units: users/month}] \\
\text{Attractiveness Effect} &= \text{Table for Attractiveness Effect (Attractiveness)} \\
&\quad [\text{Units: dimensionless}] \\
\text{Intensity Effect} &= \text{Table for Intensity Effect (Intensity of Competition)} \\
&\quad [\text{Units: dimensionless}] \\
\text{Churn Rate} &= \text{Installed Base} \times \text{Churn Fraction} \\
&\quad [\text{Units: users/month}] \\
\text{Churn Fraction} &= \text{Base Churn Fraction} \times \text{Table for Churn Fraction (Intensity of Competition)} \\
&\quad [\text{Units: 1/month}]
\end{align*}
\]

Price is determined by “Target Price”, which is the planned monthly fee for content service. Price is also influenced by “Total Costs” and “Gap Effect,” the gap between “Target Installed Base” and actual “Installed Base”. Equally important, Price is responsive to Intensity of Competition, which could force content providers into a price war.
<table>
<thead>
<tr>
<th><strong>Price</strong></th>
<th>( = \text{Target Price} \times (1 + \text{Change in Costs} \times \text{Cost Elasticity} + \text{Gap of Base} \times \text{Gap Elasticity}) \times \text{Price War Effect} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Units: dollars/month/user]</td>
</tr>
<tr>
<td><strong>Change in Costs</strong></td>
<td>( = \text{TREND (Total Costs, 1, 0)} )</td>
</tr>
<tr>
<td></td>
<td>[Units: dimensionless]</td>
</tr>
<tr>
<td><strong>Cost Elasticity</strong></td>
<td>( = \text{Constant} )</td>
</tr>
<tr>
<td></td>
<td>[Units: dimensionless]</td>
</tr>
<tr>
<td><strong>Gap of Base</strong></td>
<td>( = (\text{Target Installed Base} - \text{Installed Base}) / \text{Target Installed Base} )</td>
</tr>
<tr>
<td></td>
<td>[Units: dimensionless]</td>
</tr>
<tr>
<td><strong>Gap Elasticity</strong></td>
<td>( = \text{Constant} )</td>
</tr>
<tr>
<td></td>
<td>[Units: dimensionless]</td>
</tr>
<tr>
<td><strong>Price War Effect</strong></td>
<td>( = \text{Table for Price War Effect (Intensity of Competition)} )</td>
</tr>
<tr>
<td></td>
<td>[Units: dimensionless]</td>
</tr>
</tbody>
</table>

### 5.2.5 Detailed Model for Quantitative Analysis

Figure 5-9 below incorporates all four modules and is used for quantitative analysis.

Appendix lists all the equations, which were defined in Chapter 5.2.
Figure 5-9. Detailed Model for Quantitative Analysis
5.3 Scenarios for the Diffusion of Web Services

Implementation of Web services would have a significant effect on product and process innovation. Furthermore, Web services diffusion determines the extent to which service integrators can take advantage of the implementation, as discussed in Chapter 4.9. I ran some simulations to evaluate the effects of the implementation of Web Services. To do this I assumed three scenarios for the diffusion of Web services (see Figure 5-10).

![Scenarios for the Diffusion of Web Services](image)

Source: Author, 2004

**Figure 5-10. Scenarios for the Diffusion of Web Services**

One scenario shows that Web services prevail in the content market so that content providers or mobile portal providers, as service integrators, can benefit from collaboration with third parties or business partners through Web services interfaces. In this model, this is called the “High Diffusion” scenario. The curve of this scenario is assumed to be an S-shape. In addition, the “Moderate Diffusion” scenario is identified, where Web services are available
for users at a moderate level. On the other hand, there is a possibility that the diffusion of Web services will be insufficient so that even if a service integrator attempts to incorporate third-party innovations into their services in pursuit of service differentiation, the benefit from Web services implementation is not significant. This is the “Low Diffusion” scenario. The curve of this scenario is assumed to be a goal-seeking shape.

It is also assumed that Web services offer opportunities for a service integrator to develop product innovation to the same extent as process innovation, and that it is possible to pursue service differentiation and cost reduction. These three scenarios are reflected in the variables “Product Innovation” and “Process Innovation” in the detailed model for quantitative analysis.
5.4 Analysis of Simulation Results

5.4.1 Scenario Analysis

Based on the scenarios where the degree of Web services diffusion differs, the Net Present Value (NPV) of the content business under each scenario can be obtained by running simulations on the detailed System Dynamics model. Regardless of which scenario was run, the NPV of investment follows a similar shape (see Figure 5-11). In the beginning, the NPV continues to decrease largely due to the investment in R&D and content production costs.

![Scenario Analysis - Net Present Value](image)

Source: Author, 2004

Figure 5-11. Scenario Analysis – Net Present Value

However, once product and process innovation are achieved through major investment in R&D, service differentiation is increased (see Figure 5-12). There are two stages in which service differentiation increases significantly. In the first stage, service
integrators tend to promote development in content services (i.e., product innovation), leading to a sharp rise approximately between Month 0 and Month 30. At the same time, service integrators concentrate on production activity in order to develop more diversity of content as well as a higher rate of updating content. This leads to a significant increase in service differentiation. In the later stages, the R&D efforts accelerate process innovation, which triggers incremental development in service differentiation. Consequently, the service integrator should attract a larger number of users, leading to an increase in the NPV.

![Scenario Analysis - Service Differentiation](image)

**Figure 5-12. Scenario Analysis – Service Differentiation**

Increased productivity also reinforces the attractiveness of the content business while reducing production costs. This tendency can be seen in Figure 5-13, which shows that there
is a decrease in total costs for each scenario approximately between Month 65 and Month 120.

![Scenario Analysis - Total Costs](image)

Source: Author, 2004

**Figure 5-13. Scenario Analysis – Total Costs**

In the later stages, as revenues for the content business rise, the intensity of competition becomes severe so that the churn rate rises and the price of content falls into a price war (Figure 5-14). This lead to a significant decrease in revenues (Figure 5-15), and thereafter the growth of the NPV starts to decrease, as seen in the High and Moderate Diffusion scenario in Figure 5-11. In the Low Diffusion scenario, even though the NPV grows significantly as time passes, it is expected to follow a similar tendency in the later stages following Month 120. The differences between these scenarios are in the degree of product and process innovation. This means that Web services diffusion will have a strong effect on the benefits derived from Web services implementation, namely, increased service
differentiation and reduced production costs, both of which will lead to an increase in the NPV of the content business.

Source: Author, 2004

**Figure 5-14. Scenario Analysis – Price**

Source: Author, 2004

**Figure 5-15. Scenario Analysis – Revenues**
5.4.2 Sensitivity Analysis

Sensitivity analysis makes it possible to address strategic decision making for investment or operation management. The following sensitivity analyses were done to examine such issues under the Moderate Diffusion scenario: sensitivity of Investment in R&D, and sensitivity of Outsourcing.

**Sensitivity Analysis for Investment in R&D**

The simulation result (see Figure 5-16) suggests that a certain amount of investment in R&D enables a service integrator to benefit from a higher NPV. Under the Moderate Diffusion scenario, R&D infusions of $100,000 per month would be the most suitable amount for achieving higher profitability of the content business.

![Sensitivity Analysis for Investment in R&D](image)

*Source: Author, 2004*

**Figure 5-16. Sensitivity Analysis for Investment in R&D**
However, too much investment in R&D, i.e., beyond $100,000 per month, would undermine profitability. This is because while R&D activity accelerates product and process innovation, it is one of the factors contributing to total costs. Furthermore, although a large amount of investment in R&D allows a service integrator to achieve product and process innovation during the early stages, there is a limit to the degree of innovation. This means the amount of investment in R&D must be carefully considered.

**Sensitivity Analysis for Outsourcing**

Figure 5-17 shows NPVs under different outsourcing volumes. The outsourcing volume is described as the percentage of outsourcing volume relative to the target production volume, including in-house production volume. As the outsourcing volume increases from 10% to 30% to 50%, the NPV also increases gradually.

![Sensitivity Analysis for Outsourcing](image)

Source: Author, 2004

**Figure 5-17. Sensitivity Analysis for Outsourcing**
However, if the outsourcing volume goes beyond 50%, say, to 70% to 90%, the NPV starts to decrease. Heavy outsourcing, such as 90%, could decrease the NPV more than if outsourcing was only 10% or 30% in the later stages.

This simulation result suggests that outsourcing might undermine service differentiation while product innovation drives it. Furthermore, service integrators should take advantage of process innovation, leading to significant cost reduction. Thus, it is critical for a service integrator to consider how much outsourcing should be carried out when implementing Web services.

5.4.3 Decision Tree Analysis

The simulation results for the sensitivity analysis for outsourcing as described above suggest that service integrators will make decisions on outsourcing volume under a scenario of Web services diffusion. Furthermore, it is expected that there would be a difference between the outsourcing volumes that should be optimized under different scenarios. This expectation is based on the assumption that service differentiation can be achieved through product and process innovations, which are influenced by the Web services diffusion scenario. Thus, it becomes important for service integrators to follow different policies under different scenarios of Web services diffusion by investigating to what extent it depends on innovations offered by third parties or business partners, taking into consideration the outsourcing volume.

In order to examine the optimal choices for outsourcing, I conducted a decision tree analysis along with the three scenarios. This made it easier to compare NPVs in different time frames, since decision tree analysis visualizes the decision points in the investment,
which is determined by the expected NPVs in different scenarios, which is most likely outcome (de Neufville, 1990).

In the decision tree analysis, it is assumed that the content market has an equal probability of following the High Diffusion, Moderate Diffusion, or Low Diffusion scenarios. In addition, it is also assumed that service integrators have three options of outsourcing volume: small, moderate, and large amounts. From these points, the nine scenarios shown in Table 5-1 were used for doing a decision tree analysis.

**Table 5-1. Scenarios for Simulations**

<table>
<thead>
<tr>
<th>Implementation of Web Services</th>
<th>Outsourcing Volume</th>
<th>Scenario No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Implementation (Low Diffusion)</td>
<td>Small (10%)</td>
<td>Scenario 1-1</td>
</tr>
<tr>
<td>2</td>
<td>Middle (30%)</td>
<td>Scenario 1-2</td>
</tr>
<tr>
<td>3</td>
<td>Large (80%)</td>
<td>Scenario 1-3</td>
</tr>
<tr>
<td>4 Implementation (Moderate Diffusion)</td>
<td>Small (10%)</td>
<td>Scenario 2-1</td>
</tr>
<tr>
<td>5</td>
<td>Middle (30%)</td>
<td>Scenario 2-2</td>
</tr>
<tr>
<td>6</td>
<td>Large (80%)</td>
<td>Scenario 2-3</td>
</tr>
<tr>
<td>7 Implementation (High Diffusion)</td>
<td>Small (10%)</td>
<td>Scenario 3-1</td>
</tr>
<tr>
<td>8</td>
<td>Middle (30%)</td>
<td>Scenario 3-2</td>
</tr>
<tr>
<td>9</td>
<td>Large (80%)</td>
<td>Scenario 3-3</td>
</tr>
</tbody>
</table>

Source: Author, 2004

In this analysis, three different time frames were selected to determine the NPVs of the content business at 36 months, 60 months, and 120 months. The decision tree model, shown in Figure 5-18, was constructed using the software package DATA (Decision Analysis by TreeAge).
The following tables and the decision tree models show the results for each scenario. The tables include the values of service differentiation, total costs, and NPVs that can be determined mainly by these two variables. Also, the highest NPVs in each scenario are highlighted to check how much outsourcing should be carried out under a diffusion scenario and whether there are any changes in the tendency between time frames.
Time Frame at Month 36

Table 5-2. Simulation Results at Month 36

<table>
<thead>
<tr>
<th>Scenario No.</th>
<th>Implementation of Web Services</th>
<th>Outsourcing Volume</th>
<th>Service Differentiation</th>
<th>Total Costs ($/Month)</th>
<th>Present Value ($/Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1-1</td>
<td>Implementation (Low Diffusion)</td>
<td>Small</td>
<td>0.217271</td>
<td>457,554</td>
<td>-7,627,000</td>
</tr>
<tr>
<td>Scenario 1-2</td>
<td></td>
<td>Middle</td>
<td>0.224743</td>
<td>402,097</td>
<td>-6,347,320</td>
</tr>
<tr>
<td>Scenario 1-3</td>
<td></td>
<td>Large</td>
<td>0.144249</td>
<td>263,416</td>
<td><strong>-4,285,330</strong></td>
</tr>
<tr>
<td>Scenario 2-1</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Small</td>
<td>0.382741</td>
<td>457,753</td>
<td>-5,640,050</td>
</tr>
<tr>
<td>Scenario 2-2</td>
<td></td>
<td>Middle</td>
<td>0.383069</td>
<td>402,248</td>
<td>-4,460,180</td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td></td>
<td>Large</td>
<td>0.227063</td>
<td>263,428</td>
<td><strong>-3,132,850</strong></td>
</tr>
<tr>
<td>Scenario 2-2</td>
<td>Implementation (High Diffusion)</td>
<td>Small</td>
<td>0.548729</td>
<td>457,905</td>
<td>-3,950,980</td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td></td>
<td>Middle</td>
<td>0.541941</td>
<td>402,362</td>
<td>-2,839,950</td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td></td>
<td>Large</td>
<td>0.310362</td>
<td>263,454</td>
<td><strong>-2,063,610</strong></td>
</tr>
</tbody>
</table>

Source: Author, 2004

![Decision Tree Model at Month 36](image)

Source: Author, 2004

Figure 5-19. Decision Tree Model at Month 36
**Time Frame at Month 60**

**Table 5-3. Simulation Results at Month 60**

<table>
<thead>
<tr>
<th>Scenario No.</th>
<th>Implementation of Web Services</th>
<th>Outsourcing Volume</th>
<th>Service Differentiation</th>
<th>Total Costs (S/Month)</th>
<th>Present Value (S/Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1-1</td>
<td>Implementation (Low Diffusion)</td>
<td>Small</td>
<td>0.292046</td>
<td>461,022</td>
<td>-5,611,910</td>
</tr>
<tr>
<td>Scenario 1-2</td>
<td>Implementation (Low Diffusion)</td>
<td>Middle</td>
<td>0.300496</td>
<td>403,213</td>
<td>-2,901,510</td>
</tr>
<tr>
<td>Scenario 1-3</td>
<td>Implementation (Low Diffusion)</td>
<td>Large</td>
<td>0.189366</td>
<td>258,741</td>
<td><strong>-405,199</strong></td>
</tr>
<tr>
<td>Scenario 2-1</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Small</td>
<td>0.458808</td>
<td>460,698</td>
<td>1,419,410</td>
</tr>
<tr>
<td>Scenario 2-2</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Middle</td>
<td>0.460635</td>
<td>402,962</td>
<td><strong>3,790,120</strong></td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Large</td>
<td>0.272069</td>
<td>258,734</td>
<td>3,584,220</td>
</tr>
<tr>
<td>Scenario 2-1</td>
<td>Implementation (High Diffusion)</td>
<td>Small</td>
<td>0.626602</td>
<td>461,162</td>
<td>7,242,270</td>
</tr>
<tr>
<td>Scenario 2-2</td>
<td>Implementation (High Diffusion)</td>
<td>Middle</td>
<td>0.622404</td>
<td>403,278</td>
<td><strong>9,372,160</strong></td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td>Implementation (High Diffusion)</td>
<td>Large</td>
<td>0.356120</td>
<td>258,694</td>
<td>7,257,910</td>
</tr>
</tbody>
</table>

Source: Author, 2004

**Figure 5-20. Decision Tree Model at Month 60**
Time Frame at Month 120

Table 5-4. Simulation Results at Month 120

<table>
<thead>
<tr>
<th>Scenario No.</th>
<th>Implementation of Web Services</th>
<th>Outsourcing Volume</th>
<th>Service Differentiation</th>
<th>Total Costs ($/Month)</th>
<th>Present Value ($/Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1-1</td>
<td>Implementation (Low Diffusion)</td>
<td>Small</td>
<td>0.554704</td>
<td>428,411</td>
<td>25,061,400</td>
</tr>
<tr>
<td>Scenario 1-2</td>
<td>Implementation (Low Diffusion)</td>
<td>Middle</td>
<td>0.545642</td>
<td>377,448</td>
<td>29,558,700</td>
</tr>
<tr>
<td>Scenario 1-3</td>
<td>Implementation (Low Diffusion)</td>
<td>Large</td>
<td>0.301240</td>
<td>251,673</td>
<td>24,593,200</td>
</tr>
<tr>
<td>Scenario 2-1</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Small</td>
<td>0.723620</td>
<td>400,783</td>
<td>40,182,600</td>
</tr>
<tr>
<td>Scenario 2-2</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Middle</td>
<td>0.707548</td>
<td>356,806</td>
<td>42,127,200</td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td>Implementation (Moderate Diffusion)</td>
<td>Large</td>
<td>0.389583</td>
<td>248,068</td>
<td>34,870,100</td>
</tr>
<tr>
<td>Scenario 2-1</td>
<td>Implementation (High Diffusion)</td>
<td>Small</td>
<td>0.892195</td>
<td>376,195</td>
<td>47,061,900</td>
</tr>
<tr>
<td>Scenario 2-2</td>
<td>Implementation (High Diffusion)</td>
<td>Middle</td>
<td>0.868155</td>
<td>337,723</td>
<td>48,333,000</td>
</tr>
<tr>
<td>Scenario 2-3</td>
<td>Implementation (High Diffusion)</td>
<td>Large</td>
<td>0.475888</td>
<td>243,513</td>
<td>41,606,800</td>
</tr>
</tbody>
</table>

Source: Author, 2004

![Decision Tree Model at Month 120](image)

Source: Author, 2004

Figure 5-21. Decision Tree Model at Month 120
With results in Time Frame at 36 Months, as shown in Table 5-2 and Figure 5-19, service integrators would be in the process of developing service differentiation from the beginning through R&D activities, and all the NPVs under different scenarios are below zero. In such stages, cost reduction due to outsourcing is a dominant factor contributing to a higher NPV. Furthermore, Web services also allow service integrators to take advantage of outsourcing. Thus, in the short run, service integrators should decide to do a large amount of outsourcing in pursuit of profitability in the content business.

Regarding the results of the Time Frame at Month 60, shown above in Table 5-3 and Figure 5-20, service integrators should look closely at the negative effect of outsourcing. That is, as service integrators increase their profits through Web services implementation, more competitors are likely to enter the market and replicate the service integrator’s business in order to pursue profitability. This means players in the content market must build and maintain strong service differentiation, which thereby becomes an even more critical factor for profitability. In such a situation, outsourcing might make it difficult for service integrators to differentiate themselves from competitors. This happens under the Moderate and High Diffusion scenarios (refer back to Table 5-3). However, under the Low Diffusion scenario, service integrators would still develop service differentiation from the outset through R&D activities and thus large amounts of outsourcing would lead to higher profits. Overall, a large amount of outsourcing is still a recommended strategy in the stages.

However, intense competition in the content business would encourage service integrators to reconsider the volume of outsourcing. From the results of the Time Frame at Month 120, shown in Table 5-4 and Figure 5-21, it is clear that in all the scenarios a middle amount of outsourcing turns out to be the best strategy.
As mentioned earlier, service differentiation becomes a dominant factor in the later stages, which determines profitability for content services, rather than cost reduction. Thus, while outsourcing greatly reduces production costs, service integrators should balance the tradeoffs between the positive and negative effects of outsourcing by adjusting outsourcing volume, even though Web services require and stimulate outsourcing.

Ultimately, the decision tree analysis clarifies likely strategic paths that a service integrator can take in the future. It also implies that service integrators should consider outsourcing volume as well as targeted time frames in implementing Web services.

5.5 Dynamic Strategies for Web Services

5.5.1 Delayed Implementation Strategy: The Option to Wait

There is fundamental uncertainty regarding the diffusion of Web services, which may be influenced by such factors as standardization activities and the establishment of relevant business models. For this reason, although the decision tree analysis suggests a likely strategy for the volume of outsourcing, service integrators may face difficulties when trying to estimate profitability due to the volatility of the NPV under different scenarios.

One way to reduce the risk and maximize profitability is to consider the option of waiting and seeing whether or not Web services prevail. Content development requires considerable labor costs as well as production costs, and there is uncertainty about the growth in the number of customers (Yamamoto, 2001). For this reason, it may be better to delay the decision on investment until the picture is clearer, since the delay will provide a better chance of selecting the outsourcing volume that will capture the maximum value offered by Web services.
To evaluate the value of the option to wait, another decision tree model was constructed and is shown in Figure 5-22. Its fundamental difference from the decision tree models shown in Figures 5-19, 5-20, and 5-21 lies in the decision points which come after Web services follow the High Diffusion, Moderate Diffusion, or Low Diffusion scenario. The Non-Implementation scenario was also used, where the service integrator decides not to implement Web services and merely attempts to update or enrich existing content services rather than pursue radical development in product design by implementing Web services. In this model the goal was to examine the value of the option of delaying action for one year in the 60-month period under consideration.

Source: Author, 2004

Figure 5-22. Decision Tree Analysis for the Option to Wait (at Month 60)
Figure 5-22 shows that the overall NPV if service integrators pursue the option to wait is approximately 17 percent greater than the equivalent NPV in the case of the decision analysis shown in Figure 5-20. In cases where the NPV under a scenario such as Low Diffusion are expected to be negative, the option to wait is extremely useful for avoiding loss of profits, even though this option requires a relatively high investment under the High Diffusion scenario.

5.5.2 Dynamic Outsourcing Strategy: The Option to Expand

The decision tree analysis for the option to wait was conducted on the assumption that service integrators determine the desired outsourcing volume at some decision point, and then keep it the same as the content business grows. The main reason for this assumption is that a change of decision on outsourcing might require huge transaction costs. However, dynamic outsourcing strategies, which define how to change the outsourcing volume at some stage in the future, could be another way of maximizing profitability in spite of incurring some transaction costs. In particular, it is expected that an option of expanding the outsourcing volume depending on the diffusion of Web services would be an effective way of achieving profitability. Hence, another decision tree analysis was also undertaken to evaluate the value of such an option, providing expansion under different scenarios. Figure 5-23 below shows two dynamic outsourcing strategies used in the analysis of the option to expand. I assume that a moderate amount of outsourcing in some time frame is considered an appropriate target for maximizing profitability on the basis of the simulation results shown in Figure 5-19, 5-20, and 5-21. The option to expand fundamentally aims to adjust to an optimized volume using one of these two dynamic outsourcing strategies at 12 months, when
the diffusion of Web services turns out to follow one of the three diffusion scenarios. It is also assumed that a change in outsourcing volume from a large amount to a moderate amount would require some transaction costs, including re-investment in facilities as well as training working staff. The goal in this model is to examine the option of expanding by choosing between these two dynamic strategies, depending on the market expansion of Web services.

![Dynamic Outsourcing Strategies](image)

**Assumptions on Transaction Costs for Dynamic Outsourcing Strategy 2**

- Transaction Costs: $30,000/month
- Discount Rate: \((1+0.05)(1/12)-1 = 0.4074\)
- NPV: 377,878 dollars

Source: Author, 2004

**Figure 5-23. Dynamic Outsourcing Strategies**

According to the simulation results shown in Figure 5-24, the option to expand according to the two dynamic outsourcing strategies results in obtaining an approximately 4 percent greater NPV at Month 60 than the option to wait shown in Figure 5-22. In particular, while NPVs derived from Dynamic Outsourcing Strategy 1 are below those of the option to wait, under the Low or Moderate Diffusion scenarios the service integrator can take advantage of choosing Dynamic Outsourcing Strategy 2, which offers higher NPVs than the
option of waiting. Furthermore, in the case where Web services diffusion turns out to follow the High Diffusion scenario at Month 12, the service integrator should decide to pursue Dynamic Outsourcing Strategy 1, whose benefit exceeds that of Dynamic Outsourcing Strategy 2.

This result implies that dynamic outsourcing strategies lead to achieving greater NPVs. This is in large part due to the increase in opportunities to adopt suitable outsourcing volumes, which brings service integrators higher profitability, even though Dynamic Outsourcing Strategy 2 will require greater transaction costs as mentioned earlier. While heavy outsourcing provides better NPVs in the early stages of the Web services adoption life cycle, it results in a reduction in service differentiation, which is one of the dominant factors affecting the NPV. On the other hand, a moderate amount of outsourcing turns out be the desired target in the later stages. The option to expand captures these dynamics and maximizes the profits of the content business.

Source: Author, 2004

**Figure 5-24. Decision Tree Analysis for the Option to Expand (at Month 60)**
Based on these results, the best approach for promoting dependence on Web service providers would be to aim at a moderate amount of outsourcing in the beginning and then adjust to an appropriate volume by increasing it gradually as Web services start to prevail. Once it turns out that the Web services market is expanding, service integrators could reduce the final goal without huge transaction costs. In most cases, changing their strategies from significant dependence on business partners or third parties to seeking in-house production requires significant transaction costs due to the investment in human resources as well as in production activity. On the other hand, in the case of low growth, service integrators could increase the outsourcing volume with the aim of reducing costs.

Thus, service integrators should establish dynamic outsourcing strategies to take advantage of innovations offered by third parties, namely Web service providers, because there is significant uncertainty in the diffusion of Web services, which leads to great volatility in the NPV of the content business.

5.5.3 Investment Allocation Strategy

One of the challenges facing service integrators is how to shift from a focus on product innovation to a focus on process innovation (See Figure 5-25). While product innovation enhances service differentiation to a great extent, process innovation increases productivity, promoting cost reduction as well as incremental development in service differentiation. However, since there is a limit to the degree of innovation achieved, service integrators should carefully consider the investment allocation.
To examine how a service integrator should shift to process development, I conducted a sensitivity analysis in the Moderate Diffusion scenario using three different policies for changing the amount of investment in process innovation on the basis of the penetration in the market (See Figure 5-26).
According to the simulation result shown in Figure 5-27, Investment Shift Strategy 1 results in a greater NPV than the base strategy, while Investment Shift Strategy 2 brings about a lower NPV. This result implies that a service integrator should promote product design in the early stages of the Web services adoption life cycle, and thereafter shift to process management in pursuit of maximizing profits of the content business once it has acquired a certain penetration through product innovation.

![Sensitivity Analysis for Fraction of Investment in Process Innovation](image)

Source: Author, 2004

**Figure 5-27. Sensitivity Analysis for Fraction of Investment in Process Innovation**

5.5.4 Internal Focus on Process Innovation

Some service integrators may seek only to invest in process innovation rather than both product and process innovation. Such a policy will increase productivity and reduce production costs while accelerating diversity and the rate of updating content, leading to an increase in service differentiation. To examine the impact of the volume of outsourcing on
the NPV of the content business under the policy, another sensitivity analysis was conducted. Figure 5-28 shows the simulation results.

According to the simulation, if a service integrator plans to do a greater amount of outsourcing, say 50% or 70% relative to the target production volume, the NPV of the content business will increase. This is because cost reduction is one of the dominant factors affecting the NPV. Although process innovation improves service differentiation, a service integrator is likely to have more difficulty in increasing revenues by attracting more users, on account of insufficient service differentiation. In such a situation, it is effective to do more outsourcing than in the case of promoting both product and process innovation in gaining profitability as shown in Figure 5-17.

![Sensitivity Analysis for Outsourcing - Internal Focus on Process Innovation](image)

Source: Author, 2004

**Figure 5-28. Sensitivity Analysis for Outsourcing: Internal Focus on Process Innovation**
5.6 Policy Implications

Web services allow a service integrator, i.e., a content provider or mobile portal provider serving as a Web service requester, to achieve service differentiation as well as cost reduction. At the same time, Web services make it possible to collaborate with other players in the market. This means there is a need to do outsourcing in order to incorporate Web services into the business because Web services require external resources from Web service providers.

However, there is a tradeoff between in-house production and outsourcing. While in-house production increases production costs, outsourcing may undermine service differentiation. Thus, it is critical for a service integrator to consider how much outsourcing should be carried out when implementing Web services and to what extent outsourcing is acceptable.

The simulation results imply that a service integrator should take into consideration the diffusion of Web services, which significantly affect the profitability of the content business. If Web services prevail in the market, content providers or mobile portal providers should concentrate on developing service differentiation along with modest amounts of outsourcing by serving as service integrators. In such a situation, Web services implementation that requires heavy outsourcing may reduce the profitability of the content business. On the other hand, if for some reason Web services do not prevail in the content market, service integrators should pursue cost reduction driven by Web services implementation as well as outsourcing. In either case, service integrators should evaluate to what extent they should rely on innovations offered by third parties or business partners, taking into consideration the outsourcing volume. That is, they should adopt different
strategic positions regarding the amount of outsourcing, taking account of Web services diffusion as well as the targeted time frame.

In particular, the option of waiting and seeing whether Web services will prevail or not would be effective in dealing with uncertainty in the diffusion of Web services since it reduces the risk of losing profits if Web services do not prevail in the market. In contrast, the option of expanding the volume of outsourcing by increments taking account of Web services diffusion enables the maximization of profitability by avoiding a situation where heavy outsourcing undermines the profitability. These options allow service integrators to deal with the great volatility of the profitability offered by Web services.

Furthermore, the sensitivity analyses shows that service integrators can maximize their profitability by looking at key indicators, such as the amount of investment in R&D and the shifting focus of process development.

5.7 Summary

In this chapter I conducted a quantitative analysis for the purpose of determining to what extent Web service requesters will be able to promote service differentiation and cost reductions in pursuit of profitability. The analyses found:

- Web services diffusion has a significant impact on accelerating development in service differentiation and achieving cost reductions that lead to higher profitability. The reason is that both service differentiation and cost reduction are driven by product and process innovation, which are determined by the market expansion of Web services.
- Two key dynamics, product and process innovation, are triggered by large investments in R&D. However, there is a limit to the degree of innovation achieved. Thus, Service
integrators should maximize their profitability by having strategy options, such as how much investment in R&D to promote and how to shift from a focus on product innovation to a focus on process development.

- Under a growth scenario of Web services diffusion, service integrators should seek service differentiation through product and process innovation with a modest amount of outsourcing. On the other hand, under a gradual-growth scenario, service integrators should concentrate on cost reduction through process innovation as well as outsourcing, which can have a strong effect on the profitability of the content business.

- Regardless of scenarios, outsourcing to Web service providers will become a major factor contributing to higher profits in the early stages of the Web services adoption life cycle, while having a negative effect on service differentiation, which largely determines the profitability of the content business in a growth stage. Thus, it is critical to adopt different strategies for receiving support from business partners based on the market situation as well as targeted time frame.

- One way of dealing with uncertainty in the diffusion of Web services is to adopt the option of waiting, observing market trends, and then making a decision on the appropriate outsourcing volume. This option is valuable since it reduces the risk of losing profits if Web services do not prevail in the market.

- Another way of dealing with volatility in the profitability of the content business is the option to expand, which enables adjustment to an optimized outsourcing volume using dynamic outsourcing strategies taking account of the diffusion of Web services. This option captures the dynamics of the Web services adoption life cycle and thereby maximizes the profits.
6.1 Overview

This chapter discusses how to benefit from Web services by taking a Web service provider approach. Fundamentally, this approach requires innovations that should be made available to Web service requesters. However, such innovations can be developed in collaboration with other players, including Web service requesters or complementors, by carrying out content design at a sticky information site (von Hippel, 1988).

One way is to shift the locus of innovation to users – User Innovation. To promote this type of innovation, it is effective to provide toolkits for users to carry out assigned tasks. Another way is to provide a solution based on users’ observations at the provider’s site – Provider Innovation.

This chapter focuses on two case studies: Google and T-Mobile, both of which have successfully created innovative services. In particular, I examine how these two companies used different methods to take advantage of a Web service provider approach in different ways.
6.2 Sources of Innovation

Some innovations are attributed to a single innovative provider or user\(^1\) who first developed an innovation that is later commercialized (von Hippel, 1988). This is also true of innovations developed by Web services. Web services allow both users and providers in the mobile Internet industry to become innovators. This is because the emerging technology of Web services, in conjunction with global standards, makes it possible to collaborate with complementors and to aggregate a variety of content into one creative and customized service that meets a specific need. In other words, providers hope to provide solutions they have designed and offer them via Web services interfaces to their complementors, who in turn are seeking innovations. Equally important, providers may offer Web services to users as complementary assets, and they expect users to take on a user-based design. Under these conditions, innovations could be categorized into two types as follows.

6.2.1 User Innovation

An innovation is defined as a “User Innovation” when the developer expects to benefit by using it (von Hippel, 1988). Users who can be considered innovators in the mobile Internet arena include mobile phone users and content providers. Web services enable content providers to offer Web services to mobile phone users as complementary assets. This means that content providers, if they take a Web service provider approach, can expect customers to act as Web service requesters who seek to develop a customized service by consolidating Web services into their favorite software environments. Similarly, content providers can provide their services to other content providers via Web services interfaces (see Figure 6-1). In short,

\(^1\) In discussing Web services, I use the word “provider” instead of manufacturer, which I intend to mean Web services provider. In the same way, I define “user” to be a Web services requester.
content providers can expect user innovations by providing Web services. On the other hand, users will aggregate Web service providers’ offerings into one personalized service that meets their individual needs, which will be an innovation. This enables content providers to establish a Total Custom Solution positioning by developing innovations in collaboration with users.

![Diagram of mobile phones, content providers, and user innovations.]

Source: Author, 2004

**Figure 6-1. User Innovation**

### 6.2.2 Provider Innovation

von Hippel (1988) describes what he calls a “Manufacturer Innovation” when the developer expects to benefit by selling it. Tailoring this concept to Web services in the mobile Internet industry, I redefined Manufacturer Innovation to mean “Provider Innovation”—i.e., an
innovation is a Provider Innovation when the developer expects to benefit by providing the innovation. In the mobile Internet domain, Web service providers include content providers, mobile portal providers, and mobile operators, all of which may seek to offer their innovations to customers. In most cases, providers have solution information and incorporate their observations of customers’ behaviors and tastes into their services (Figure 6-2).

![Diagram of Provider Innovation](image)

Source: Author, 2004

**Figure 6-2. Provider Innovation**
6.3  Case Study: Google

6.3.1  Promoting User Innovation

Google, the world’s leading Web search company, has enabled user-based innovations. In April 2002, Google released a Web service by opening its search engine technology, called Google Web APIs (Google website, 2004). This service allows PC users to query the Google search engine (which accesses more than three billion documents on the Web) from an application rather than from a browser. The results of the search are returned as structured data so that the requesting application can process the information (Manes, 2003). Users can take advantage of this Web service free of charge once they have created Google accounts and obtained license keys.

Although the Google Web APIs is designed for PC users, not mobile phone users, it suggests a possibility for the content business in the mobile Internet industry—how to shift the locus of innovation to users. While providers usually have solution information, in most cases users need information. Although innovators require information regarding both need and solution information, it requires huge expense to transfer both to another site due to the nature of sticky information (von Hippel, 1994). Thus, it is important to consider how to carry out product or service design at the sticky information site—in this case study, the users’ side.

6.3.2  Toolkits

Toolkits are effective for shifting innovators to become users (Thomke and von Hippel, 2002). To promote user innovations, Google offered a developer’s kit that users can use to carry out the need-intensive tasks assigned to them. The kit includes documentation and example codes for using the Google Web APIs service, such as Java and .NET programming
codes, so that users can focus on designing novel features in their designs. Under these conditions, users can easily do trials and errors to deal with problems in design (see Figure 6-3).

![Diagram](image)

- Design a custom search engine
- Develop functioning prototype by using toolkits
- Check if the prototype meet the specific need in real use environment
- Compare expected and actual results. If necessary, do trial-and error cycle again.

Source: Thomke and von Hippel, 2001, adapted by author, 2004

**Figure 6-3. Four Steps in the Trial-and-Error Process**

After users are given sufficient opportunity to make creative applications through trial and error, Google expects to develop a potentially new revenue source (in addition to advertising) by charging for the Web service. Although the Google Web APIs is currently designed for PC users, this case implies that offering toolkits for mobile phone users would promote user-design in a similar way.
6.3.3 User Innovation Communities

Google offers users access to a platform for innovation, that is, Google shifted the locus of problem-solving to users, and it is expecting user innovation communities to produce further business opportunities (von Hippel, 2001). Thus, users can consider how to incorporate the Google search engine into their favorite software environment and try it without taking on any risk. Such learning-by-doing can be carried out within the users’ own narrow niche at a significantly lower cost.

Furthermore, Google’s Web APIs service has great potential for providing enhanced B2B solutions. For instance, Website operating companies, such as CNN, might wish to notify Google of updated information by using its Web service every time they update information, and the Google search engine can then make an index of the information automatically.

6.3.4 Lead Users

Google has given rise to a great number of lead users who expect to obtain great benefits from solutions to their needs. Such users are more likely to innovate (von Hippel, 1999). One example of a lead user’s innovation is Google Mindshare.

Steven Johnson, a writer, successfully used the Google Web APIs to calculate the share of a keyword or phrase relative to another word—what he calls Google mindshare—by issuing two queries from a user-friendly browser to Google (stevenberlinjohnson.com website, 2004). For example, Red Hat’s Google mindshare of Linux is determined as 3.63% by dividing the result of a query, “Red Hat” by the result from the query “Linux” as shown in Figure 6-4 (Calishain and Dornfest, 2003).
Many other examples of lead users exist in the Internet domain. Thus, Google, a Web service provider, has successfully created an environment where users can benefit from Web services by taking user-based designs and customizing them. This implies that Web service providers can collaborate with users to develop innovations.

6.4 Case Study: T-Mobile

6.4.1 Promoting Provider Innovation

T-Mobile International, a subsidiary of Deutsche Telekom, is one of the world's leading mobile operators, providing a mobile portal for more than three million T-mobile customers in Austria, the Czech Republic, Germany, and the United Kingdom (T-Mobile International website, 2004). To build significant competitive advantage, T-Mobile has tried to
make it easy for content providers to offer services over its mobile network, and to charge for their content in situations where the providers have difficulty building a reliable mechanism to charge access fees.

This effort proved to be successful as a result of an innovative Web services solution based on the observation of users (i.e., content providers). It means that T-Mobile has made information about individual consumers available via Web services interfaces to content providers who can take advantage of mobile assets to easily create customized, location-based services (Manes, 2003). When a user launches a mobile application, the content provider uses a Web service to obtain the customer’s profile from T-Mobile so it can authenticate the user and activate T-Mobile’s Web billing service (Moiin, 2004). At the end of the session, the transaction information is returned to T-Mobile, which then bills the mobile phone user on behalf of the content provider (see Figure 6-5).

![Diagram of T-Mobile Web Services](source: Manes, 2003)

**Figure 6-5. T-Mobile Web Services**
Thanks to this innovation, T-Mobile Online has attracted more than 200 content providers that offer a wealth of content to mobile phone users, including news, databases, restaurant recommendations, stock trading, and banking. Without charging either mobile phone users or the content providers for these Web services, T-Mobile has increased its revenues because of the increased traffic the mobile phone users bring to access the various kinds of content.

6.4.2 Collaboration

The T-mobile case indicates that Web services may also offer great opportunities for innovations by providers in the mobile Internet industry. In particular, it suggests that mobile operators can benefit from new businesses opportunities by communicating with their business partners (i.e., content providers) through application-to-application interfaces. Such collaboration is essential, for the following reasons.

Although more and more users enjoy surfing the Internet via mobile phones, and benefiting from a wide range of content such as news and games, there are limits to the type of Internet content that users can obtain via mobile phone. This is due mainly to the lack of consideration given to the capabilities of mobile networks. For example, only a small number of content providers take into consideration the location of the mobile phones to which they offer content, although mobile operators attempt to find and maintain that kind of information all the time. However, the success of the mobile Internet depends not only on mobile operators but also on content providers that provide complementary assets over the mobile networks.

Thus, for further development of the mobile Internet, there needs to be collaboration between mobile operators and content providers. In this regard, Web services provide an
innovative way for mobile operators to offer their unique mobile assets, such as location or presence information, to content providers that wish to make use of these assets to create new content. Such collaboration would lead to robust competitive advantages for both players against their respective (and mutual) competitors and increase their revenues. At the same time, mobile phone users will also benefit from such innovative mobile services.

6.4.3 **Flexible Business Models**

Web services have great potential for enabling flexible business models. As the T-Mobile case study indicates, Web services play a critical role in maintaining and enhancing the positioning of a mobile operator as well as offering new, compelling services and content to mobile phone users. Mobile operators could also increase their revenues by charging for user information, such as presence or location data.

Web services also enable content providers to enhance their services by incorporating operators’ mobile assets, such as location or presence data, into their content. Although mobile operators currently have not entered the content market, Web services might encourage mobile operators to provide their mobile assets directly to mobile phone users by, for example, serving as service integrators and building mobile portals that consolidate content. These business models are expected to encourage mobile phone users to take advantage of location, presence, or a mobile terminal profile. Furthermore, such mobile phone users’ efforts can be complemented by additional information obtained from content providers. Thus, Web services technology will create new sources of revenue generation.

In essence, Web services enable flexible business models, as indicated below, and shown in Figure 6-6 (Nokia, 2002):
1. Mobile phone users can purchase mobile assets, such as other people’s presence information, from mobile operators via the mobile portals.

2. Content providers can purchase mobile assets, such as location information, from mobile operators.

3. Mobile operators can purchase information or services from content providers and consolidate that information into their own mobile portals.

4. Mobile phone users can purchase content from content providers to be incorporated with mobile assets that they can obtain from mobile operators.

Source: Author, 2004

Figure 6-6. Flexible Business Models for Mobile Operators
6.4.4 Mobile Assets

The T-mobile case suggests that mobile assets could be a great resource for content providers and mobile operators seeking to create attractive content that can be made available to mobile phone users. These mobile assets, shown in Table 6-1, which are made available to content providers, will encourage them to enter the mobile Internet market while also increasing the value of mobile operators. Mobile operators will be asked to decide on the availability of mobile assets based on user agreements.

<table>
<thead>
<tr>
<th></th>
<th>Candidate Information / Services</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Coordinate System (e.g. latitude and longitude), Geographical Location (e.g. city, state, postal code)</td>
<td>Cost savings due to non-implementation of proprietary location technology</td>
</tr>
<tr>
<td><strong>Presence</strong></td>
<td>User’s availability, mood, intentions, contact preferences</td>
<td>Possible solutions for more personalized and dynamic services</td>
</tr>
<tr>
<td><strong>User Profile</strong></td>
<td>Nickname, occupation, gender, language preference</td>
<td>Possible solutions for more personalized services</td>
</tr>
<tr>
<td><strong>Device Profile</strong></td>
<td>Display specification, keypad capabilities</td>
<td>Pre-adaptation of content to the mobile phone</td>
</tr>
<tr>
<td><strong>Device Management</strong></td>
<td>Tools to configure and update mobile phones</td>
<td>Possible solutions for simplified operation of mobile phones</td>
</tr>
<tr>
<td><strong>Payment</strong></td>
<td>Billing capability of the mobile operator on behalf of the content provider</td>
<td>Cost savings due to the utilization of mobile operator’s infrastructure Simple and secure micropayments</td>
</tr>
</tbody>
</table>

Source: Nokia, 2002

121
6.5 Summary

This chapter discussed the benefits that can be derived from Web services through a Web service provider approach. It identified two types of innovation: User Innovation and Provider Innovation.

In the chapter, I discussed two case studies that illustrate the User and Provider innovation concepts.

- A Web service provider approach requires innovations that should be made available to Web service requesters. However, such innovations can be developed in collaboration with Web service requesters or complementors by carrying out content design at the site of sticky information.

- User Innovation is one way of enabling a Web service provider approach by shifting the locus of innovation to users. Web services enable content providers to offer complementary assets to mobile phone users. In promoting user innovation, toolkits are very effective since users will be able to focus on the need-intensive tasks assigned to them.

- Provider Innovation is another approach that offers solutions at the provider’s site. Web services provide an innovative way for mobile operators to offer their unique mobile assets, such as location or presence information, to content providers that wish to make use of these assets to create robust content.
CHAPTER 7

Evolution in the Mobile Internet Industry,
with Policy Recommendations

7.1 Overview

This chapter discusses how Web services will benefit the mobile industry value chain, that is, how the mobile Internet industry can evolve further through the implementation of Web services. It is expected that Web services will enable close collaboration between stakeholders in the mobile Internet industry, including mobile operators, content providers, and mobile phone users. Finally, policy recommendations for these key players in the industry are proposed.

7.2 Web Services Value Chain

Web services will encourage further development in the content business, as discussed earlier, and thereby shape the changes in the business landscape for most stakeholders in the mobile Internet industry, including mobile operators, content providers, and mobile phone users. The emerging technology of Web services will make it even easier for stakeholders to collaborate with other players using open standards to create attractive content for mobile Internet users. Figure 7-1 shows the likely positions that each stakeholder in the mobile Internet industry will occupy as they implement Web services.
Web services will allow content providers and mobile operators to serve as Web service providers and publish their innovations. Simultaneously, Web services will enable content providers, mobile operators, or even mobile phone users to serve as Web service requesters and to integrate available Web services into their favorite software environments. In addition, Web services increase the value of infrastructure and terminal vendors that have built toolkits for application development and provide support for Web services implementation. Meanwhile, mobile operators might allow mobile phone users to develop their own toolkits in the near future. These moves will accelerate because Web services interfaces are independent of any underlying software platform, thus allowing different platforms to communicate effortlessly with each other. Such collaboration will build robust competitive advantages against competitors. Thus, Web services will likely stimulate stakeholders to seek innovations, which will lead to further evolution of the mobile Internet industry.
7.3 Policy Recommendations

7.3.1 Content Providers/Mobile Portal Providers

Content providers and mobile portal providers should make an effort to enrich their services in collaboration with Web service providers as well as toolkit developers, both of which could be crucial complementors in developing competitive advantages against competitors (see Figure 7-2). Web services make it even easier for content providers and mobile portal providers to work together with mobile operators and other content providers to develop attractive content that is available to many more users through horizontal and vertical integration. Content providers and mobile portal providers as service integrators can also create personalized content by consolidating the assets of mobile operators, such as location and presence information, which should be made available to Web service requesters. Hence, as service integrators they can pursue both service differentiation and cost reduction through these innovations, which should be a strong driver of service differentiation.

Source: Brandenburger and Nalebuff, 1996, adapted by author, 2004

Figure 7-2. Complementors via Web Services Interfaces
However, collaboration with third parties in the form of outsourcing might undermine the profitability of content business, depending on Web services diffusion as discussed in Chapter 5. Thus, it is critical to decide on how much to rely on Web service providers’ innovations, or outsourcing volume, based on a future scenario of Web services expansion.

Content providers and mobile portal providers should also enhance their value positions in partnership with vendors that provide toolkits for Web services implementation since toolkits help users to make user-based design.

From a different perspective, it is important to notice that content providers and mobile portal providers can adopt multiple strategies in the Web services arena. One strategy would be to differentiate their content services by becoming service integrators, consolidating Web services that are available over the Internet for service differentiation while reducing costs for developing services due to the nature of open standards.

Another strategy is to promote user innovation, and make toolkits available to users. This strategy enables content providers in particular to make strong relationships with customers. More importantly, content providers and mobile operators can build competitive advantages by locking in complementors, such as Web service providers and toolkit developers.

Thus, Web services allow content providers and mobile portal providers, both of which provide content services to mobile phone users, to develop their strategic positioning from Best Product to Total Custom Solutions to System Lock-In position—the most robust strategy (Figure 7-3).
7.3.2 Mobile Operators

To differentiate their services from other competitors, mobile operators should collaborate with content providers and infrastructure vendors. Web services allow mobile operators to increase their value positions by providing information about their users, such as presence information, location, and device profiles, to content providers or mobile phone users, acting under the mobile phone user agreement. This business model should result in building a wealth of new content that can be made available to users, thus acquiring more traffic for the mobile operator while establishing new sources of revenue from content providers.

To achieve this goal, it is recommended that mobile operators take the initiative to develop new services via Web services interfaces, which make it possible to collaborate with
content providers by making mobile assets available to them. As a consequence, mobile networks will always be able to provide sufficient service quality along with attractive content.

Similarly, mobile operators should ask content providers to cooperate in making attractive mobile portal sites based on their own analyses of market research and content design, so that mobile phone users can benefit from the combination of the network infrastructure and the content offered over it. Thus, mobile operators can collaborate with content providers to attract more mobile phone users via Web services interfaces so that both players will benefit from the mutual innovations (Figure 7-4).

![Diagram](image)

Source: Author, 2004

**Figure 7-4. Collaboration through Web Services**

7.3.3 **Infrastructure and Terminal Vendors**

Infrastructure and terminal vendors should support the effort of mobile operators and content providers, which seek to provide Web services. In particular, they will be able to complement such Web service providers’ businesses by developing toolkits, which are
essential for Web services users in promoting customization, such as content providers or mobile phone users. This strategy enables infrastructure and terminal vendors to differentiate themselves from competitors, since they have detailed knowledge of the specifications of infrastructure and terminals for mobile Internet services. It is expected that infrastructure and terminal vendors can make toolkits for Web services even more adaptable to the mobile Internet environments. This policy recommendation offers a great way to build high entry barriers into the toolkit market for other IT vendors that are not players in the mobile industry.

7.3.4 Mobile Phone Users

Mobile phone users would benefit from Web services that are supported by content providers and mobile operators, who would expect customers to take on user-based design by adopting a Web service provider approach. Under such a market situation, mobile phone users would integrate Web service providers’ offerings by serving as Web service requesters for a personalized service that meets a specific need. In particular, there is an expectation that mobile phone users will be able to make use of mobile assets, such as location, presence, or mobile terminal profile, offered by mobile operators. Furthermore, mobile phone users’ efforts to develop user innovation could be achieved by Web services obtained from content providers.

Another advantage of serving as a Web service requester is a reduction of transaction costs which, in most cases, are required to bring together need and solution information at one location. With Web services, mobile phone users can concentrate on their task of designing novel features without seeking solutions and transferring them to their sites. For these reasons, it is recommended that mobile phone users should take advantage of Web services in promoting innovations that are beneficial to themselves.
As described earlier, although there are not currently any mobile phones with the functions of Web service requesters available to mobile phone users, which enable gathering and customizing Web services, it is likely that mobile operators as well as content providers, with the support of toolkits developers, will be attracted by such flexible business models.

7.4 Summary

This chapter suggested how the mobile Internet industry can evolve through Web services implementations. It also offered several policy recommendations for major stakeholders in the industry. The following issues were discussed:

- Web services make collaboration easier for players in the mobile Internet industry, including mobile operators, content providers, and mobile phone users, all of which are seeking to develop innovations. Moreover, Web services increase the value of infrastructure and terminal vendors, which build up toolkits for application development. These moves will lead to further evolution in the mobile Internet industry.

- It is crucial for stakeholders in the mobile industry to take into consideration which player can be a complementor. Collaboration with complementors via Web services interfaces will lead to building competitive advantages against competitors.

- Content providers and mobile portal providers should enrich their content services through Web services implementation with the strong support of mobile operators as well as toolkit developers. This policy allows them to seek service differentiation and cost reduction through innovations, which leads to building stronger service differentiation.

- At the same time, content providers and mobile portal providers as service integrators should take into consideration their dependence on Web service providers’ innovations, or
outsourcing. By adopting this policy, they will be able to capture the maximum value offered by Web services.

- Mobile operators will be able to increase their value position by providing their mobile assets as Web services, including presence information and location, for content providers or mobile phone users. Simultaneously, they should make their mobile portals more attractive in collaboration with content providers in order to develop better combination of infrastructure and content.

- Infrastructure and terminal vendors can become strong complementors by developing toolkits for Web service users. They should make the toolkits even more adaptable to the mobile Internet environments in pursuit of differentiation from competitors.

- Mobile phone users could benefit from integrating Web services into their personalized environments. Furthermore, they can reduce the transaction costs required to put together need and solution information for promoting innovation
This thesis suggests that an emerging technology, Web services, is a solution to overcoming the problem of the encroaching commoditization of the content business. This suggestion can be made because this emerging technology allows users to develop a combination of Web resources that lead to innovation. With Web services implementations, it is expected that content providers and mobile portal providers—key players in the content business market—will be able to differentiate their services from competitors and thus build a robust strategic position by promoting innovations.

For both parties, there are two approaches to implementing Web services: the Web service requester approach, and the Web service provider approach. The first approach means serving as a Web service requester, which tries to take advantage of innovations made available by other players, namely, Web service providers. The other approach is to serve as a Web service provider, which explores additional distribution channels for its services.

The first approach is invaluable because most content providers and mobile portal providers can expect to benefit from Web services implementation. The Web service requester approach allows service integrators to pursue horizontal integration, which would be a source for service differentiation, or vertical integration, which leads to efficient process management. These types of integration lead to development of new functions that can be made available to users and to lower production costs. As a consequence, service integrators can build a robust strategic positioning, such as Best Product, Total Customer Solutions, or System Lock-In.
Another major focus of this thesis was to analyze the benefits of a Web service requester approach to the content business, by doing qualitative and quantitative analyses using the System Dynamics methodology to develop simulation models. Qualitative analysis clarified key dynamics in the content business. The first is product innovation, which enhances service differentiation and increases the attractiveness of the content service. Another is process innovation, which increases productivity and leads to lower production costs; a higher content update rate; and diversity of content, which accelerates service differentiation. These two dynamics are triggered by investment in R&D.

With Web services implementation, service integrators can expect to achieve service differentiation as well as cost reductions through product and process innovation. However, Web services may require collaboration with third parties in the form of outsourcing, which has the potential to undermine the profitability of the content business even while driving significant cost reductions. This is due largely to loss of control over programs developed by Web service providers, making it difficult to differentiate their content services, which incorporate such programs, from competitors.

Thus, it is critical for service integrators to evaluate what dynamics are dominant by implementing Web services. Quantitative analysis addresses this issue using different scenarios of Web services diffusion. Simulation results indicate that Web services diffusion will enable service integrators to pursue service differentiation though product and process innovation under a high growth scenario so that it becomes a key determinant of profitability in the content business. In this case, the service integrators should commit to building its own strong core business using limited workforces with process innovation and a modest amount of outsourcing, rather than be dependent on heavy outsourcing which makes it difficult to pursue
service differentiation.

Under a gradual-growth scenario, service integrators should work to lower costs through use of Web services as well as outsourcing, which can have a strong effect on the profitability of the content business.

From a different point of view, regardless of scenarios, outsourcing to Web service providers would be a major factor contributing to higher profits in the early stages of the Web services adoption life cycle, although it will have a negative effect on service differentiation, which largely determines profitability of content business in the later stages. Thus, it is essential to adopt different strategic positions for receiving support from business partners based on the market situation as well as targeted time frame.

In particular, dynamic strategies, such as the option of waiting and the option of expanding while observing whether Web services will prevail or not, should be effective in dealing with the uncertainty in the diffusion of Web services, since both of them reduce the risk of loss of profits and allow adjust to an optimized outsourcing volume. Service integrators should establish dynamic outsourcing strategies, which capture the dynamics of the Web services adoption life cycle, to take advantage of innovations offered by Web service providers.

The second approach for implementing Web services, namely, the Web service provider approach, also offers opportunities for innovation. The thesis has proposed how to create innovations in collaboration with other players in the content market, using two case studies to support the proposal. The case study of Google suggested that user innovation can be achieved by shifting the locus of innovation to users. More specifically, content providers can offer Web services to mobile phone users as complementary assets. Toolkits are very effective
in promoting user innovation because users can concentrate their design work on the novel features of their designs.

A second case study, T-Mobile, implicated that provider innovation can be developed, even at the provider’s site, by observing users. It suggested that Web services should allow mobile operators to offer their unique mobile assets, such as location or presence information, to content providers seeking to incorporate these assets into their content.

In addition, the T-Mobile case study also indicated that flexible business models might create new revenue sources for mobile operators who could charge for user information given to content providers as well as for use of their mobile portals, thus consolidating mobile assets and some useful content made available to mobile phone users.

Taking into consideration both the Web service requester approach and the Web service provider approach, this thesis investigated how the mobile Internet industry could evolve through Web services implementation. Web services facilitate collaboration between stakeholders in the mobile Internet industry, including mobile operators, content providers, and mobile phone users. The first two players could adopt a Web service provider approach, while all of them are able to take a Web service requester approach. Web services also increase the values of infrastructure and terminal vendors, which build toolkits for application development and provide support for Web services implementation.

All the players should consider collaboration with complementors, which leads to building competitive advantages against competitors. For mobile operators, content providers are the most crucial complementors for attracting more mobile phone users via Web services interfaces so that both players can promote further innovations. For content providers, it is essential to enrich their services in collaboration with Web service providers and toolkit
developers, both of which can be powerful complementors in building robust competitive advantages against competitors.

From these points, it is clear that content providers and mobile operators as mobile portal providers can adopt multiple strategies for Web services implementation. In particular, Web services enables development of strategic positioning from Best Product, or service differentiation and cost reduction, to Total Custom Solutions, or promotion of user innovation or diversity of content, and eventually to System Lock-In position, which locks-in complementors, such as Web service providers and toolkit developers.

Thus, Web services will likely encourage stakeholders to develop innovations and build strong strategic positioning, which will lead to further evolution of the mobile Internet industry.
APPENDIX

The following equations are used in the detailed model for qualitative analysis as shown in Figure 5-9.

(01) Actual Penetration =
    \[
    \frac{\text{Installed Base/Initial Potential Base}}{}
    \]
    Units: \text{DmnL}

(02) Adjustment to Human Resources =
    \[
    \frac{(\text{Target Production Volume - Production Volume})}{\text{Total Working Time/Productivity}}
    \]
    Units: \text{staff}

(03) Adjustment Time =
    12
    Units: \text{Month}

(04) Adoption Rate =
    \[
    \text{Desired Adoption Rate} \times \text{Attractiveness Effect} \times \text{Intensity Effect}
    \]
    Units: \text{users/Month}

(05) Attractiveness =
    \[
    0.3 \times \text{Attractiveness of Price} + 0.7 \times \text{Service Differentiation}
    \]
    Units: \text{DmnL}

(06) Attractiveness Effect =
    \[
    \text{Table for Attractiveness Effect} (\text{Attractiveness})
    \]
    Units: \text{DmnL}

(07) Attractiveness of Diversity =
    \[
    \text{IF THEN ELSE} ("\text{In-House Content} + \text{Outsourcing Content} / \text{Desired Diversity} \leq 1, \text{Table for Diversity} ("\text{In-House Content} + \text{Outsourcing Content} / \text{Desired Diversity} , 1))
    \]
    Units: \text{DmnL}

(08) Attractiveness of Price =
    \[
    \text{Table for Price (IF THEN ELSE} (\text{Price} \leq \text{Maximum Price}, \text{Price/Maximum Price}, 1))
    \]
    Units: \text{DmnL}

(09) Attractiveness of Update =
    \[
    \text{IF THEN ELSE} ("\text{In-House Update Rate} + \text{Outsourcing Update Rate} / \text{Desired Update} \leq 1, \text{Table for Update} ("\text{In-House Update Rate} + \text{Outsourcing Update Rate} / \text{Desired Update} , 1))
    \]
    Units: \text{DmnL}

(10) Base Churn Fraction =
    0.02
    Units: \text{1/Month}
(11) Base Productivity =
    10
Units: lines/(staff*hour)

(12) Change in Costs=
    TREND(Total Costs,1,0)
Units: Dmn1

(13) Churn Fraction =
    Base Churn Fraction*Table for Churn Fraction(Intensity of Competition)
Units: 1/Month

(14) Churn Rate =
    Installed Base*Churn Fraction
Units: users/Month

(15) Cost Elasticity =
    0.3
Units: Dmn1

(16) Cumulative Profits = INTEG ( Profits-*Product R&D Rate"-*Process R&D Rate", 0)
Units: dollars

(17) Desired Adoption Rate =
    20000
Units: users/Month

(18) Desired Diversity =
    1e+007
Units: lines

(19) Desired Investment =
    1e+006
Units: dollars

(20) Desired Profitability =
    1e+008
Units: dollars/Month

(21) Desired Update =
    100000
Units: lines/Month

(22) Discount Rate =
    (1+0.05)^(1/12)-1
Units: 1/Month
(23) Expenses = 
Production Costs + Human Resource Costs
Units: dollars/Month

(24) FINAL TIME = 120
Units: Month
The final time for the simulation.

(25) Fraction to Process =
Table for Fraction (Actual Penetration/Target Penetration)
Units: Dms/ml

(26) Gap Elasticity =
-0.3
Units: Dms/ml

(27) Gap of Base =
(Target Installed Base - Installed Base)/Target Installed Base
Units: Dms/ml

(28) Hiring Rate =
Adjustment to Human Resources/Adjustment Time
Units: staff/Month

(29) Hours worked for Diversity =
140
Units: hours/Month

(30) Hours worked for Update =
60
Units: hours/Month

(31) Human Resource Costs =
Human Resources * Total Working Time * Payment for Work
Units: dollars/Month

(32) Human Resources = INTG (Hiring Rate,
20)
Units: staff

(33) "In-House Content" = INTG (Production Rate,
1000)
Units: lines

(34) "In-House Update Rate" =
Productivity * Hours worked for Update * Human Resources
Units: lines/Month
"In-House Volume" = "In-House Update Rate" + Production Rate
Units: lines/Month

Initial Potential Base = INITIAL(Potential Base)
Units: users

INITIAL TIME = 0
Units: Month
The initial time for the simulation.

Innovation Elasticity = 0.8
Units: Dmnl

Installed Base = INTEG(Adoption Rate-Churn Rate, 0)
Units: users

Intensity Effect = Table for Intensity Effect(Intensity of Competition)
Units: Dmnl

Intensity of Competition = IF THEN ELSE(Cumulative Profits/Desired Profitability <= 0, 0.1,
IF THEN ELSE(Cumulative Profits/Desired Profitability <= 1,
Table for Intensity(Cumulative Profits/Desired Profitability), 1 ))
Units: Dmnl

Investment in Process = INTEG("Process R&D Rate", 0)
Units: dollars

Investment in Product = INTEG("Product R&D Rate", 0)
Units: dollars

Maximum Price = 5
Units: dollars/(Month * user)

Net Present Value 0 = NPVE(Profits, Discount Rate, 0, 1)
Units: dollars
(46) Operation Unit Costs =
    2
Units: dollars/line

(47) Outsourcing Content = INTEG (Outsourcing Rate,
    0)
Units: lines

(48) Outsourcing Effect on Differentiation =
    Table for Outsourcing (Outsourcing Volume/Production Volume)
Units: Dmnl

(49) Outsourcing Rate =
    Outsourcing Volume * Outsourcing Ratio
Units: lines/Month

(50) Outsourcing Ratio =
    0.7
Units: Dmnl

(51) Outsourcing Unit Costs =
    1.5
Units: dollars/line

(52) Outsourcing Update Rate =
    Outsourcing Volume * Outsourcing Ratio
Units: lines/Month

(53) Outsourcing Volume =
    30000
Units: lines/Month

(54) Outsourcing Volume (Dynamic Outsourcing Strategy) =
    Table for Outsourcing Volume (Time)
Units: lines/Month

(55) Payment for Work =
    25
Units: dollars/hour/staff

(56) Potential Base = INTEG (-Adoption Rate + Churn Rate,
    6e+007)
Units: users

(57) Price =
    Target Price * (1 + Cost Elasticity * Change in Costs + Gap Elasticity * Gap of Base)
    * Price War Effect
Units: dollars/Month/user
(58) **Price War Effect**
Table for Price War Effect (Intensity of Competition)
Units: Dmnl

(59) **Process Innovation**
Table for Process Innovation (IF THEN ELSE (Investment in Process <= Desired Investment, Investment in Process/Desired Investment, 1))
Units: Dmnl

(60) "**Process R&D Rate**" = "Total Investment in R&D"*Fraction to Process
Units: dollars/Month

(61) **Product Innovation**
Table for Product Innovation (IF THEN ELSE (Investment in Product <= Desired Investment, Investment in Product/Desired Investment, 1))
Units: Dmnl

(62) "**Product R&D Rate**" = "Total Investment in R&D"*(1-Fraction to Process)
Units: dollars/Month

(63) **Production Costs**
"In-House Volume"*Operation Unit Costs+Outsourcing Volume
*Outsourcing Unit Costs
Units: dollars/Month

(64) **Production Rate**
Productivity*Hours worked for Diversity*Human Resources
Units: lines/Month

(65) **Production Volume**
"In-House Volume"+Outsourcing Volume
Units: lines/Month

(66) **Productivity**
Base Productivity*(1+Process Innovation*Innovation Elasticity)
Units: lines/staff/hour

(67) **Profits**
Revenues-Total Costs
Units: dollars/Month

(68) **Revenues**
Installed Base*Price
Units: dollars/Month

(69) **SAVEPER** = TIME STEP
Units: Month [0,?]  
The frequency with which output is stored.
(70) Service Differentiation = 
\[ 0.4 \times \text{Attractiveness of Diversity} + 0.1 \times \text{Attractiveness of Update} + 0.5 \times \text{Product Innovation} \times \text{Outsourcing Effect on Differentiation} \]
Units: Dmnl

(71) Table for Attractiveness Effect:
\[ [(0, 0) - (1, 1)], (0, 0), (0.1, 0.21), (0.2, 0.39), (0.3, 0.55), (0.4, 0.68), (0.5, 0.78), (0.6, 0.86), 
(0.7, 0.92), (0.8, 0.96), (0.9, 0.98), (1, 1)] \]
Units: Dmnl

(72) Table for Churn Fraction:
\[ [(0, 0) - (1, 2.5)], (0, 0), (0.1, 0.42), (0.2, 0.85), (0.3, 1.23), (0.4, 1.6), (0.5, 1.9), (0.6, 2.1), 
(0.7, 2.25), (0.8, 2.36), (0.9, 2.45), (1, 2.5)] \]
Units: Dmnl

(73) Table for Diversity:
\[ [(0, 0) - (1, 1)], (0, 0), (0.1, 0.02), (0.2, 0.07), (0.3, 0.15), (0.4, 0.29), (0.5, 0.5), (0.6, 0.71), 
(0.7, 0.85), (0.8, 0.92), (0.9, 0.97), (1, 1)] \]
Units: Dmnl

(74) Table for Fraction(Base Investment Allocation Strategy):
\[ [(0, 0) - (2, 1)], (0, 0.05), (0.1, 0.07), (0.2, 0.12), (0.3, 0.2), (0.4, 0.32), (0.5, 0.5), (0.6, 0.62), 
(0.7, 0.7), (0.8, 0.75), (0.9, 0.78), (1, 0.8), (1.1, 0.8), (1.2, 0.8), (1.5, 0.8), (2, 0.8)] \]
Units: Dmnl

(75) Table for Fraction(Internal Focus on Process Innovation):
\[ [(0, 0) - (2, 1)], (0, 1), (0.1, 1), (0.2, 1), (0.3, 1), (0.4, 1), (0.5, 1), (0.6, 1), (0.7, 1), (0.8, 1), (0.9, 1) 
(1, 1), (1.1, 1), (1.2, 1), (1.5, 1), (2, 1)] \]
Units: Dmnl

(76) Table for Fraction(Investment Allocation Strategy 1):
\[ [(0, 0) - (2, 1)], (0, 0.05), (0.1, 0.3), (0.2, 0.48), (0.3, 0.4), (0.4, 0.68), (0.5, 0.72), (0.6, 0.75), 
(0.7, 0.77), (0.8, 0.78), (0.9, 0.793), (1, 0.8), (1.1, 0.8), (1.2, 0.8), (1.5, 0.8), (2, 0.8)] \]
Units: Dmnl

(77) Table for Fraction(Investment Allocation Strategy 2):
\[ [(0, 0) - (0.5, 1)], (0, 0.4), (0.1, 0.59), (0.2, 0.7), (0.3, 0.765), (0.4, 0.793), (0.5, 0.8), (0.6, 0.8), 
(0.7, 0.8), (0.8, 0.8), (0.9, 0.8), (1, 0.8), (1.1, 0.8), (1.2, 0.8), (1.5, 0.8), (2, 0.8)] \]
Units: Dmnl

(78) Table for Intensity:
\[ [(0, 0) - (1, 1)], (0, 0.1), (0.1, 0.12), (0.2, 0.17), (0.3, 0.25), (0.4, 0.42), (0.5, 0.64), (0.6, 0.82), 
(0.7, 0.9), (0.8, 0.95), (0.9, 0.98), (1, 1)] \]
Units: Dmnl

(79) Table for Intensity Effect:
\[ [(0.075) - (1, 1)], (0, 1), (0.1, 0.993), (0.2, 0.985), (0.3, 0.976), (0.4, 0.963), (0.5, 0.945), 
(0.6, 0.925), (0.7, 0.9), (0.8, 0.87), (0.9, 0.834), (1, 0.79)] \]
Units: Dmnl
(80) Table for Outsourcing Effect:

- $[(0.0)-(1.1)], (0.1), (0.1, 0.993), (0.2, 0.98), (0.3, 0.95), (0.4, 0.92), (0.5, 0.87), (0.6, 0.78), (0.7, 0.66), (0.8, 0.48), (0.9, 0.26), (1.0, 0.03)]$

Units: Dmnl

(81) Table for Outsourcing Volume (Dynamic Outsourcing Strategy 1):

- $[(0.0)-(50, 100000)], (0.0), (5, 18000), (10, 31000), (15, 38000), (20, 42000), (25, 45000), (30, 47000), (35, 48000), (40, 48800), (45, 49500), (50, 50000), (60, 50000), (70, 50000), (80, 50000), (90, 50000), (100, 50000), (110, 50000), (120, 50000)]$

Units: Dmnl

(82) Table for Outsourcing Volume (Dynamic Outsourcing Strategy 2):

- $[(0.0)-(50, 100000)], (0.0), (5, 18000), (10, 31000), (15, 38000), (20, 42000), (25, 45000), (30, 47000), (35, 48000), (40, 48800), (45, 49500), (50, 50000), (60, 50000), (70, 50000), (80, 50000), (90, 50000), (100, 50000), (110, 50000), (120, 50000)]$

Units: Dmnl

(83) Table for Price:

- $[(0.0)-(1.1)], (0.1), (0.1, 0.6), (0.2, 0.36), (0.3, 0.22), (0.4, 0.14), (0.5, 0.1), (0.6, 0.06), (0.7, 0.035), (0.8, 0.02), (0.9, 0.01), (1.0, 0.08)]$

Units: Dmnl

(84) Table for Price War Effect:

- $[(0.0)-(1.1)], (0.1), (0.1, 0.993), (0.2, 0.985), (0.3, 0.976), (0.4, 0.96), (0.5, 0.94), (0.6, 0.91), (0.7, 0.86), (0.8, 0.79), (0.9, 0.7), (1.0, 0.59)]$

Units: Dmnl

(85) Table for Process Innovation in the High Diffusion scenario:

- $[(0.0)-(1.1)], (0.0), (0.1, 0.04), (0.2, 0.1), (0.3, 0.19), (0.4, 0.33), (0.5, 0.5), (0.6, 0.67), (0.7, 0.81), (0.8, 0.9), (0.9, 0.96), (1.1)]$

Units: Dmnl

(86) Table for Process Innovation in the Low Diffusion scenario:

- $[(0.0)-(1.4)], (0.0), (0.1, 0.038), (0.2, 0.096), (0.3, 0.173), (0.4, 0.24), (0.5, 0.285), (0.6, 0.305), (0.7, 0.318), (0.8, 0.325), (0.9, 0.33), (1.0, 0.33)]$

Units: Dmnl

(87) Table for Process Innovation in the Moderate Diffusion scenario:

- $[(0.0)-(1.1)], (0.0), (0.1, 0.039), (0.2, 0.098), (0.3, 0.182), (0.4, 0.285), (0.5, 0.393), (0.6, 0.488), (0.7, 0.564), (0.8, 0.613), (0.9, 0.645), (1.0, 0.666)]$

Units: Dmnl

(88) Table for Product Innovation in the High Diffusion scenario:

- $[(0.0)-(1.1)], (0.0), (0.1, 0.04), (0.2, 0.1), (0.3, 0.19), (0.4, 0.33), (0.5, 0.5), (0.6, 0.67), (0.7, 0.81), (0.8, 0.9), (0.9, 0.96), (1.1)]$

Units: Dmnl

(89) Table for Product Innovation in the Low Diffusion scenario:

- $[(0.0)-(1.04)], (0.0), (0.1, 0.038), (0.2, 0.096), (0.3, 0.173), (0.4, 0.24), (0.5, 0.285), (0.6, 0.305), (0.7, 0.318), (0.8, 0.325), (0.9, 0.33), (1.0, 0.33)]$

Units: Dmnl
(90) Table for Product Innovation in the Moderate Diffusion scenario:

\[(0.0)-(1.1), (0.0),(0.1,0.039),(0.2,0.098),(0.3,0.182),(0.4,0.285),(0.5,0.393),
(0.6,0.488),(0.7,0.564),(0.8,0.613),(0.9,0.645),(1.0,0.666)\]
Units: Dnml

(91) Table for Update:

\[(0.0)-(1.1), (0.0),(0.1,0.02),(0.2,0.07),(0.3,0.15),(0.4,0.29),(0.5,0.5),(0.6,0.71),
(0.7,0.85),(0.8,0.92),(0.9,0.97),(1.1)\]
Units: Dnml

(92) Target Installed Base= 3e+006
Units: users

(93) Target Penetration= 0.03
Units: Dnml

(94) Target Price= 3
Units: dollars/(Month*user)

(95) Target Production Volume= 100000
Units: lines/Month

(96) TIME STEP = 1
Units: Month [0,?] The time step for the simulation.

(97) Total Costs= "Total Investment in R&D"+Expenses
Units: dollars/Month

(98) "Total Investment in R&D"= 50000
Units: dollars/Month

(99) Total Working Time=
Hours worked for Update+Hours worked for Diversity
Units: hours/Month
REFERENCES


