Exploring Innovation in Mobile Technology: A Comparison Between U.S. and Japan

Abstract
This study looks at the differences in technology between Japanese and United States mobile phone technologies. While advancements in micro-processing, network speeds and memory capacity have played a crucial role in the development and evolution of phones in both the United States and Japan today, our study has found that the applications embedded in Japanese cell phone technology and the infrastructure to support those applications is significantly more advanced than the United States. The contribution of this paper lies in the aspect of examining innovations in mobile technology in both the Japanese and United States culture in order to evaluate the implications on both society and business.

1. Introduction
The development of cell phone technology has greatly benefited the way in which people interact with each other and how they live their daily lives. Today, the majority of mobile phones function as portable computers, coming equipped with features such as voice mail, calls waiting, mobile Internet, picture and video cameras, SMS, games, calculators, and organizers. In this research, we examine the differences in the mobile devices between Japan and the United States, with a focus on mobile applications and their utilization in each respective society. We propose a research model that examines the valued characteristics of mobile devices, and how they influence use in both cultures. We generated a set of hypotheses for testing and analysis and conducted a survey of 286 respondents. The findings showed that cultural expectations and application quality play a key role in cell phone use.

2. Literature Review
Mobile devices are heavily used in both Japan and the U.S.A; but variations in application availability and infrastructure have shaped the use of mobile devices. The United States’ network structure is comprised of a mixture of GSM and CDMA, Code Division Multiple Access. Similarly, Japan is one of the few Asian countries that operate under W-CDMA, Wide-Code Division Multiple Access (“Japan Cellular Phones FAQ”); the difference between W-CDMA and CDMA being that W-CDMA operates on a 5MHz transmission channel, compared to CDMA’s 1.25MHz (“W-CDMA (UMTS)”). NTT DoCoMo is now releasing a 4G network with bandwidth rates of 100MB, while the United States is currently planning to operate on a 10MB download speed (Docomo, 2010). On the American side, Verizon operates on CDMA2000, a 3G equivalent to CDMA, which is only a 2G technology. AT&T, however, operates on a 3G version of GSM, UMTS, resulting in less service around the country (“Report: Apple to launch”). W-CDMA is also part of the 3G standard, and while uniform across the major carriers in Japan, mobile users are afforded more consistent, reliable, and faster service.

The Internet has played a crucial role in the development and use of both Japanese and American mobile phones. Initially released in 1999, DoCoMo’s i-mode allowed Japanese handset devices to surf the Internet to a limited extent. The initial web sites formatted for i-mode were carefully chosen by DoCoMo to lead Japanese customers towards specific companies and products. Additionally, i-mode was developed in such a way that experience with technology, the Internet, or mobile devices was not necessary. (Akiyoshi 2008). The significance of this strategy was twofold. First, the potential user base was greatly expanded by eliminating any form of technical jargon that would limit the i-mode’s popularity to technology-adept customers. Secondly, by providing an avenue for specific companies (retailers, banks, etc.) with exclusive contracts for displaying content on the i-mode, and by promoting the ease to which these services could be used, DoCoMo created an entire new genre of mobile business and marketing. No such developmental structure has been created in the United States.

Japan is one of the leading countries in terms of mobile phone Internet utilization. With a rate of 94.1%, forty seven out of fifty people fully utilize the Internet and associated features enabled in Japanese mobile devices. In comparison, the utilization rate for the United States hover around 33.5% (Chaojing 2007). With more of the population dependant on mobile device applications and Internet usage, the market in Japan for such products continues to grow and to provide new uses to customers, furthering the dependency on the products. The way in which DoCoMo’s i-mode was developed has played a key role in shaping the future relationship between Japanese society and cell phone use. Even today, Japanese mobile phone users follow the same patterns that they were confined to with the advent of i-mode (Suri 2008).
The method in which users accept new applications also differs between these two countries, see Table 1. As mobile phones were becoming cheap, popular, and abundant to every member of society, advertisers began to have increased interest in using mobile devices as marketing tools (Bauer 2005). However, the way in which new products and promotions were presented to perspective users in Japan and the U.S. have varied considerably. The “Message F (free)” feature included in DoCoMo’s i-mode is a unique push-type advertising service that allows Japanese opting-in users to receive free messages and promotions (including images up to 8kb) from advertisers; the fees associated with data transmissions do not apply for these messages. Further market segmentation allows these messages to be pushed specifically to different gender, age, or regional groups (Okazuki 2007). Other considerations for how mobile business differ in Japan lies in the more advanced hardware and software applications. One such example of this is the system of complex barcode readers implemented into Japanese camera phones that allow consumers to purchase products solely with the mobile device. Customers using the e-mode feature on their devices can easily purchase products from vending machines using a cashless, prepaid fund system. Quick Response (QR) codes, used in Japan since 1994, record data both vertically and horizontally. The result is a condensing of data that allows the QR codes to be placed unobtrusively on a variety of products (Mendell 2009). Built-in cameras on phones quickly decode and act on the stored information. Encoded information can range from simple text to pictures, advertisements, or compressed URLs that navigate users directly to specialized web sites. Food tracking is an evolving use of QR code tracking that utilizes the web site redirection functionality in Japan. QR labels placed on fruits, vegetables, and meat in the market allow users to take a picture of the code with their mobile device to be instantly redirected to a web site displaying everything about the food product, including where and how it was grown (Mendell 2009).

By the year 2001, only two years after its public release, Internet capable mobile devices in Japan became more abundant than those lacking this feature (Chaojung 2007). As a result, handheld devices were effectively transformed away from simplistic voice-only communicators to mobile computers. The effects on society and the Japanese culture were unavoidable. Due to the unique culture of Japan, research and records show that shortly after the release of i-mode on phones, the average users began using their devices less for verbal communication, and more for Internet-ready computers. This was primarily due to the perceived differences of communicating via SMS or e-mail versus vocal communication in public places. “The well-developed and frequently-used public transportation system in Japan has become the major transportation means for most commuters/students, but the rules do not allow passengers to talk on mobile phone. This leads to the situation that most passengers contact their friends/families through mobile e-mails “silently” or play online games (Java-applications) to kill the time” (Chaojung 2007). Additionally, these forms of silent communication do not require the other party to be available at the onset of the conversation. That is, users were able to send messages to friends and colleagues that could be received and responded to at a later time.

Table 1. Comparison of Mobile Functionality

<table>
<thead>
<tr>
<th>Japan</th>
<th>United States</th>
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<tr>
<td>Phone</td>
<td>Standard Phones</td>
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<tr>
<td>i-mode</td>
<td>Phone</td>
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<tr>
<td>Internet (High End)</td>
<td>Games (Low End)</td>
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<tr>
<td>Public Transportation Schedules etc.</td>
<td>Camera (Low End)</td>
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<tr>
<td>Camera (High End)</td>
<td>Text Messages</td>
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<tr>
<td>QR Codes</td>
<td>Music</td>
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<tr>
<td>TV (Video)</td>
<td>Internet (Low End)</td>
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<tr>
<td>Games (high End)</td>
<td>e-mail</td>
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<td>e-payment</td>
<td>downloadable Applications</td>
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<td>e-mail</td>
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<td>Music</td>
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Figure 1. Diffusion Model (Chaojung 2007)

The proliferation and advancement of mobile devices and associated applications have both shaped and been shaped by the consumers. Initially, mobile devices were developed to fit the needs and wants of users; the popularity of the SMS message is one such example. Providing a silent, quick, and personal means of communication, text and e-mail messages became popular with younger users. Due to this popularity, average prices and costs associated with these services have decreased (Ito 2009). Additionally, popularity from new applications and uses of mobile devices has created a self-propagated spiral of production, see Figure 1. New, popular features in phones increase the rate in which manufacturers include the given features, thereby further increasing the popularity.

On the other hand, developments pushed out by mobile phone manufacturers have also played a role in shaping how users accept and use their phones. The lifestyles of the subscribers have gradually changed to correspond to new features implemented in new handset models. One such example of this changed behavior lies in how family members communicate with each other, with the move being from traditional face-to-face conversation to text messages and phone calls (Chaojung 2007). These cultural factors driving the cell phone culture were discovered again in separate research by Hans H. Bauer, et. al, (2005). Research conducted by Ito (2009) also uncovered various social relationships and expectations that have directed cell phone use in younger generations.
3. 研究モデル Research Model

Based on this accumulated and analyzed research, we propose a research model for investigating the cultural and functional differences in mobile phone usage between Japan and the United States. Figure 2 illustrates the research model that was used in this study, followed by specific hypotheses that will be used to test the model relationships.

**Figure 2 – Research Model**

![Research Model Diagram]

**Hypotheses**

**H1: The mobile users’ perceived ease of use is positively associated with perceived usefulness.**

Van der Heijden et al. (2003) found the effects of perceived usefulness compared to a consumer's attitude. They hypothesized that perceived usefulness directly affects a consumer’s attitude towards mobile applications. Chen, et al. (2002) hypothesized that a consumer’s perceived ease of use of a virtual store positively affects his or her attitude towards using the virtual store. They found that higher perceived usefulness does not lead to higher consumer behavioral intent, however, even though other previous studies provided different findings.

**H2: The mobile users’ attitude toward using mobile technology is positively associated with their perceived ease of use.**

Chen, et al. (2002) suggested that a consumer’s perceived ease of use of a virtual store positively affects his or her attitude toward using it (Amoroso 2009). Research by DoCoMo found non-technical marketing to extend the mobile technology use to all demographics (Akiyoshi 2008).

**H3: The mobile users’ attitude toward using mobile technology is positively associated with their perceived usefulness of the technology.**

Research by Ito (2009) found that technologies that fit into the daily lives of users were adopted more than others that didn’t. Given the limitations imposed by society, the level of ease associated with the product determines its adoption rate.

**H4: The mobile users’ attitude toward using mobile technology is positively associated with their personal innovativeness.**

Chaojung, et al. (2007) studied the effects of personal innovativeness on acceptance of mobile technologies. Chaojung reported that innovative technologies are first distributed to meet the needs of consumers, but after adoption consumers begin to find new ways for using the technologies. The degree to which users can discover new uses for existing technologies will positively affect the associated attitude.

**H5: The mobile users’ attitude toward using mobile technology is positively associated with convenience.**

Chaojung, et al. (2007) and Ito (2009) both studied the effects of convenience on acceptance of mobile technologies. Studies by Chaojung found that data communication capabilities found in mobile devices added a new layer of convenience to the phones that was readily accepted by users. In opposition to voice communications, digital and text communications allow the user to communicate a message at their leisure, to be read by the recipient any time. Ito’s study examined the ways in which Japanese culture affected mobile phone development and use. Spatial boundaries set by society and families were able to be overcome through added convenience of mobile devices. Social restrictions and customs were also able to be circumvented. Technologies such as SMS and mobile e-mail affected their attitude towards mobile technologies by adding a level of convenience to the users’ lives.

**H6: The mobile users’ behavioral intention to use mobile technology is positively associated with the users’ attitude toward using mobile technologies.**

Several articles examine the relationship between experience using the Internet and the user’s behavioral intention to use the Internet (Amoroso 2009, George 2002, Shim 2001) each found strong support for the direct correlation of these two variables (Amoroso 2009). Nine articles we reviewed predicted that the variable perceived usefulness has a direct effect on behavioral intention. Of the nine, seven articles found significant support for this hypothesis. Venkatesh, et al. (2003) studied user acceptance of personal computers. They correctly predicted that computer anxiety would not have a significant effect on behavioral intention, and that computer self-efficacy would also not have a significant effect on behavioral intention (Amoroso 2009). Research by Akiyoshi (2008) found that the traditional factors that would limit one’s use of PC Internet did not have any effect on mobile Internet.

4. 分析 Analysis

Further research was conducted to test the validity of the hypothesis and model. In an online survey, respondents from both the United States and Japan were asked a set of questions on mobile application use. There were a total of 286 respondents, 178 from Japan and 108 from the United States. The complete list of demographics is displayed in Table 2. Most of the respondents were younger in age, around 18-20 years.
Accessing the applications used on mobile devices in both the United States and Japan was also studied to provide a cultural comparison, see Table 3. Online shopping was used as the application in the survey as it provided a strong sense of commonality across both the Japanese and United States cultures. We found that users in the U.S preferred checking email from the PC, rather than the mobile phone. Both groups strongly responded to using the Internet on PCs for online shopping, but over twice the number of Japanese respondents also practiced online shopping from their mobile devices. Finally, SMS (text messaging) was used by the vast majority of Japanese users, with U.S. users lagging somewhat behind. The differences in these application-use statistics show the cultural variations between these two countries. The unique cultural/social considerations, advanced infrastructure, and mobile lifestyle of Japanese citizens

Essential characteristics of mobile devices were analyzed by posing various questions. Each characteristic, or construct, in Table 4 represents the culmination of numerous questions tailored around a specific theme. The mean values of each construct are also displayed for each country. The response range was on a scale of 1-5, with higher values showing a stronger positive response. Across the board, Japanese responders rated each of these characteristics as being more important than that of the people in the U.S. For example, the Japanese survey takers rated the convenience of the mobile applications as 4 out of 5. In contrast, we can see that American users felt that their personal innovativeness with the applications was the second highest rated quality, right behind ease of use. Analysis of this information shows the higher importance of mobile phone devices in Japan, and the higher level of consideration that goes into determining important elements of the devices.

Conclusions
Developments in Japanese mobile phones have given these mobile devices a unique role, compared with the United States. Early developments in Japanese mobile devices, along with advancements in industry architecture, marketing techniques, and application functionality, are the factors that have made a difference in the mobile phone industry from the U.S. As such, these devices have taken the place of personal computers in the Japanese market. A higher level of value has been placed on Japanese mobile devices, further propagating the development of mobile phone technologies over that of PCs, which continues self-sustaining cycle of mobile device progression. Special cultural considerations also need to be considered, as various social norms, expectations, and customs have influenced the popularity, use, and development of the device applications.

This study has provided an initial investigation into the use of mobile phone technologies, with application applied cross-culturally. At the high level, we have found significant differences in the adoption of mobile technologies. We intend to examine the data more extensively in order to develop a structural model explaining the relationships among the factors of mobile technology adoption in Japan and the United States.

REFERENCES AVAILABLE UPON REQUEST