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Mobile technologies have grown tremendously in the past ten years. In the United States in 1999 there were 36.7 users per 100 people (Akiyoshi & Ono, 2008). In 2005, there were 94,745,000 mobile phone subscribers in Japan and 201,650,000 mobile phone subscribers in the United States, while in 2009 Japan's mobile phone subscribers grew to 107,490,000 subscribers and the United States grew to 285,610,580 million subscribers, a growth rate of 13.5% in Japan and 41.8% in the United States. Interesting enough, most cell phone subscribers are more likely to have a higher education, a higher income, have a full time job, and are usually married with children (Akiyoshi & Ono, 2008). In Japan in 1999 there were 21.4 users per 100 people, where in 2005 there were 62.1 users per 100 people, a growth rate of 190% over five years. In 2009, the



diffusion rate of mobile phone among people in individual base was 78.4% in Japan (Ministry of Internal Affairs and Communication, 2010).

In Japan, mobile phone use has grown from 1995 to 2000, skyrocketing from around 5% to 90% of the population, and this can be attributed to the introduction of “i-mode” by Japan’s largest mobile service provider NTT DoCoMo, which allows mobile devices to access the Internet (Akiyoshi & Ono, 2008). Early adopters of the Internet tended “to be predominantly male, young, affluent, and well-educated,” but the introduction of DoCoMo’s “i-mode” brought Internet technologies to the “so-called marginalized groups consisting of women, the elderly, the less educated, and the poor” (Akiyoshi & Ono, 2008). Mobile technology use differs greatly between the United States and Japan, but the drivers behind the phenomenal growth of mobile technologies, and specifically mobile phones, can be attributed to common themes. Those themes are affordability, accessibility, compatibility, effort or ease of use, experience, perceived playfulness, perceived usefulness, service quality, safety concerns, social influences, and technical support. While each of these categories offer different motivations, they seem to show up in multiple studies examining the Internet and mobile technology research. What is interesting is that mobile Internet in the United States has followed Japan at a considerable distance.

In addition to the common drivers of PC and mobile applications, there are several applications that specifically drive the success of mobile applications including, among other items, mobile web surfing, mobile learning, gaming and entertainment, mobile banking or mobile reservations, not to mention making a phone call or texting. Mobile phones face several challenges when placed next to their full service personal computer counterparts. These challenges are smaller screen sizes with lower graphics resolutions, graphical limitations and unfriendly user interfaces, small keypads, limited input capabilities with complicated input mechanisms, limited processing power, limited memory, limited disk storage capacity, less ability to surf the web and an elevated risk of data storage and transaction errors, not to mention battery life (Y. S. Wang, Wu, & Wang, 2009)

Internet use in Japan has had a much more varied history than in most western nations. Many of the basic assumptions in early computers and Internet designs that made them so accessible in places like America actually inhibited adoption in the Asian markets. The QWERTY keyboard especially was an easy transition for Americans as it leveraged on their experience with the typewriters that were common throughout the country. Asian countries, including Japan, lacked this background though since no suitable typewriter analog was ever adopted for the complex written languages of the region (Akiyoshi & Ono, 2008). This meant that the keyboard interface, while it was modified to accept the Japanese language, was not an intuitive interface.

The dominant language of the Internet was English at the time of initial creation, although it has incorporated most all language alphabets at this point. These factors combined to cause the penetration of Internet use in Japan to be extremely low when compared to other

modern nations at the time. At the time of the introduction of mobile devices Japanese Internet users were only 219 per 1000, with America having 367 per 1000 at the same point in time (Akiyoshi & Ono, 2008). Mobile technology met a much different reception when introduced in Japan. Where the QWERTY keyboard was foreign and unintuitive, mobile devices had systems designed to work with the Japanese language (Lindmark, Bohlin, & Andersson, 2004). The new mobile interfaces were not necessarily easier to use, but it was not harder to use either for users that had not yet become comfortable with the keyboard interface (Akiyoshi & Ono, 2008). The websites themselves were also designed specifically for the new medium and target demographic. This meant that unlike most sites at the time the users were being directed specifically to Japanese websites formatted for ease of use and view-ability on the smaller mobile devices (Lindmark, et al., 2004). Ad campaigns in Japan also focused on the ease of use and features while not mentioning any recognizable terms like Internet or connection speeds. The goal was to present the Internet to consumers from a mobile package that bypassed many of the stumbling points that plagued traditional PC access among Japanese consumers (Akiyoshi & Ono, 2008).

Japanese consumers quickly embraced the new mobile technology, with mobile devices quickly outnumbering PCs. This changed the culture to the point that new users began to use mobile devices regardless of the technological pros and cons, and based more on external social pressures (Akiyoshi & Ono, 2008). This need to create a new structure to overcome the language and platform limitations of early Internet use for mobile devices led to an early start on the infrastructure that has seen the entire country through a massive push for cutting edge mobile technology, which has surpassed almost all other modern nations (Lindmark, et al., 2004).

The purpose of this study is three-fold: (1) to propose a model of research based upon the mobile ecosystem model, (2) to understand the role of NTT DoCoMo in the ecosystem growth, and (3) to develop an understanding of the investment model differences between Japanese and United States markets. The value of this research is that it provides a first step in understanding the adoption and utilization of mobile technologies within an ecosystem in a country that has certain cultural aspects. This research is highlighted with interview excerpts from Takeshi Natsuno, one of the visionaries in the development of the i-Mode mobile Internet breakthrough.

Literature Review

In this section, we propose to review the research that is relevant to the Japanese mobile ecosystem research model, identifying factors in the adoption of mobile applications and the growth of mobile computing in Japan. While there may be overlap of certain research areas, we have divided the research reviewed into two areas: (1) research on mobile adoption, and (2) research on mobile e-payments.

Research on Mobile Adoption

The research on mobile adoption is based upon the previous work of Amoroso and Hunsinger (D.L Amoroso & D.S. Hunsinger, (2009)a; (2009)b; (2009)c) where research models were developed and analyzed using online shopping to understand Internet adoption patterns and factors of success in the development and deployment of Internet applications. The subsequent research by Amoroso and Ogawa (2010 and 2011), the model shown in Figure 1, was proven to be reasonable in understanding the adoption of mobile technologies in both Japan and the United states. The model was proposed in 2010 and tested in 2010. Figure 1 shows the resultant model of mobile and Internet technology adoption using the online shopping application.

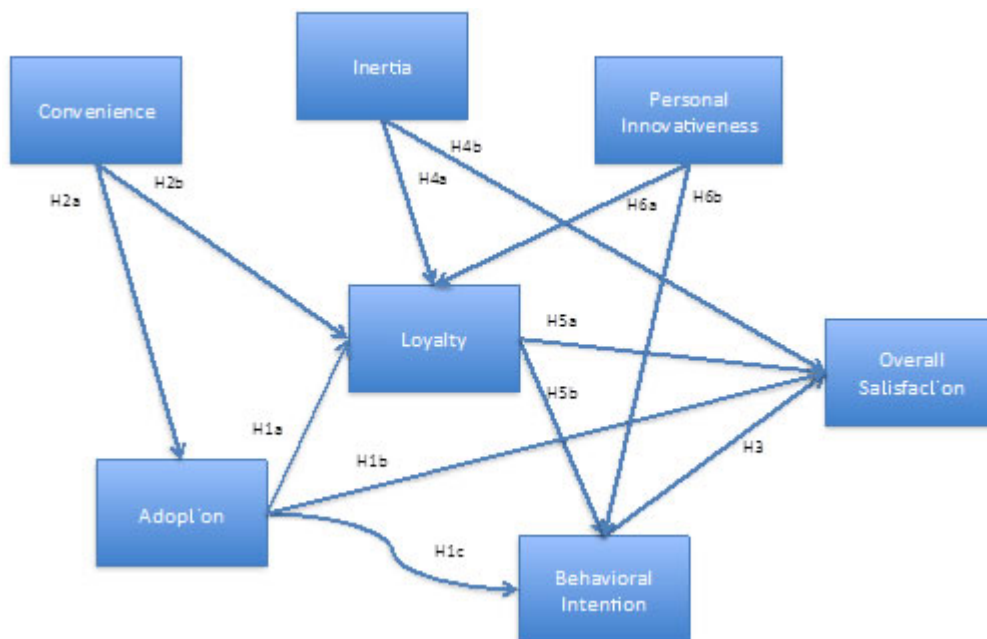


Figure 1. Amoroso and Ogawa (2011) Mobile Adoption Model

This research by Amoroso and Ogawa (2011) looked at the adoption of Internet and mobile applications in the United States and Japan. The intent of this exploratory study was to examine factors of adoption that are common in both Japan and the United States. A research model was tested with data collected from 437 students in both Japan and the United States. Online shopping was used as the common application between PC and mobile technologies. This study provided managers with a framework for understanding mobile applications for online shopping and more importantly, for academics to understand the impact of certain factors influencing adoption of mobile technologies.

This model and results can help practitioners better understand how to meet the desires of their online customers. This study provides managers with a framework for which areas they need to focus upon when launching new online products, such as shaping and/or changing their consumers' attitude toward using the Internet, making their Website easier to use, and enhancing the perceived usefulness of the technologies that allow consumers to access their products online. The model of mobile adoption also serves as an important first step toward subsequent predictive modeling with critical marketing variables.

The value of the mobile adoption model to researchers would be that a clarification to limitation of technology acceptance model and show the possibility the difference between PC and mobile. We found that mobile technology is more influenced by personal innovativeness, inertia than that of PC technologies. The influence of the convenience directly to overall satisfaction is not proven in previous research. High convenience, when ease of use is low, was not intuitive; however, our analysis found that "perceived" convenience may offset the difficulties in the ease of use. Trust was found to be a key variable in the research by Amoroso and Mukahi (2010) in the buildup of inertia for increase in the adoption of technologies.

Research on Mobile Payments

Although the literature abounds with various models exploring the determining factors of mobile payment system adoption, no single framework had yet emerged prior to 2010 on those critical constructs from the consumer's perspective. Research by Amoroso and Magnier-Watanabe (2010, 2012) summarized the findings of 24 empirical papers on mobile payments, where eleven constructs were found to be important predictors of actual usage (see Figure 2). An integrated framework was proposed and a set of general hypotheses were found to be supported both by prior research and would later be tested. A synopsis of the literature and findings is presented below.

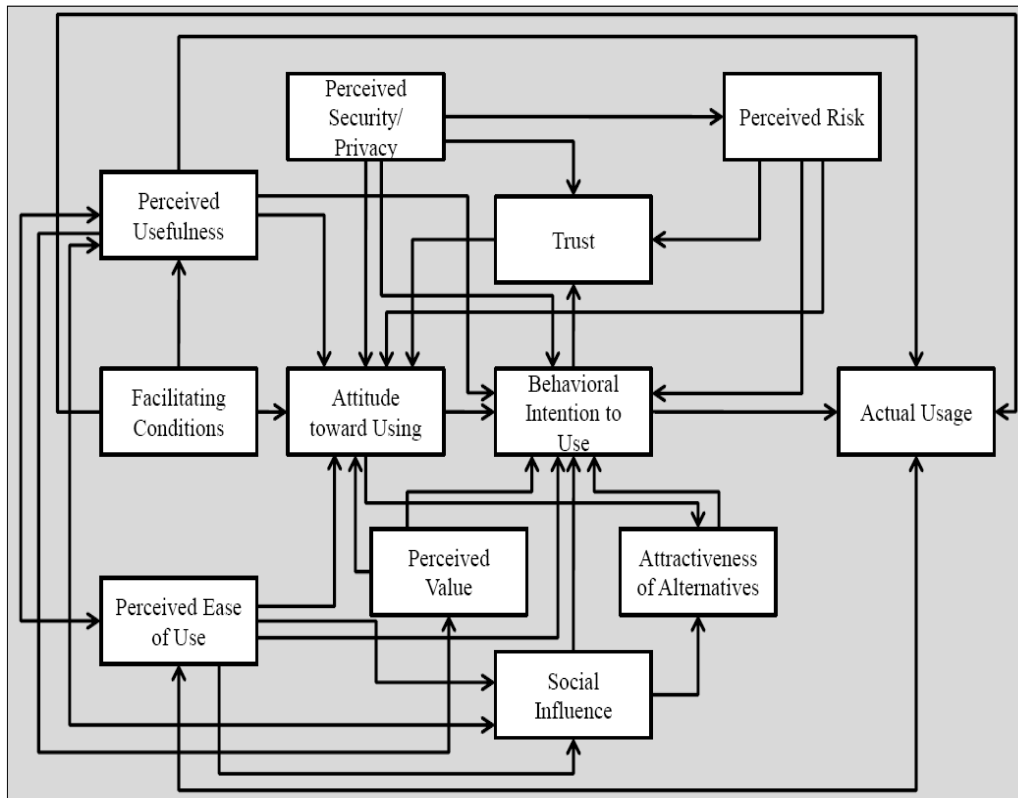


Figure 2. Amoroso and Magnier-Watanabe (2010) Payment Adoption Model

Japan has some of the most advanced and diverse mobile applications in the world (Ezell, 2009). When asked about the meaning of electronic payments, more people in Japan think of payment systems using value-stored IC cards or mobile phones that they wave in front of dedicated card readers (BOJ, 2009). A recent report by the Japanese Ministry of Internal Affairs and Communications (MIC, 2009) shows that 29.6% of 12,805 respondents possess a contactless electronic money instrument, and among those respondents, 24.2% use a contactless integrated circuit (IC) card and 9.4% use a mobile-phone-based contactless IC card. In addition to a high penetration rate of mobile phones (87%), there are currently 78 million mobile phone subscribers owning a mobile phone equipped with an integrated contactless IC chip (Ezell, 2009) and almost 11 million active users of mobile phone-based mobile payment systems (data compiled from: JR East, 2009a; JR East, 2009b; JR East, 2009c; Suica, 2009a; Suica, 2009b; Suica, 2010a; Suica, 2010b; EDY, 2009; EDY, 2010). According to japan.internet.com (2010), 92.9% of 900 respondents were aware of their mobile phone's capability to make electronic payments, and 23% said they actually used their mobile phone as electronic wallet, also known as Osaifu-Keitai.

A range of new services leveraging mobile networks is spreading rapidly in Japan. In 2009, NTT DoCoMo and Seven-Eleven Japan started “Kazasu Seikyusyo” (holding your bill in the air), a service allowing people to receive billing statements to their mobile phone mobile wallet application, and then pay their bills at any Seven Eleven convenience store in Japan by holding their mobile phone over the card readers set up at the counter. Some public transportation operators in the Tokyo area offer parents a service to monitor their children’s movements on the transportation network, based on their use of their IC-based transportation pass. Indeed, Japanese children usually start going to school on their own from the age of six, and a service such as Tokyu’s Kids Security Service, enables parents to receive email notifications to their mobile phone every time their children go through a ticket gate and use their IC pass (Tokyu Security, 2010). Odakyu Railways offers a similar service that caters to the children that use Odakyu Lines with their IC pass (Odakyu, 2007).

Yasuoka (2009) reports that the decrease by 0.04% in the circulation of money announced by the Bank of Japan in 2006, the first time since 1971, can be attributed in part to the increase usage of electronic money. However, the high penetration rate of mobile phones and the existence of a majority of mobile phones capable of making mobile payments (Ezell, 2009) cannot alone explain the success of mobile payments. The United States enjoys a similar penetration rate of mobile phones, but that country offers mobile payment systems on a trial basis only, whereas Japan boasts more than 90 million active IC cards or mobile phones engaging in mobile payments for Suica/Pasmo and EDY, Japan’s two main electronic payment systems.

Research Model

While there is a distinct difference between mobile phone use by users in the United States and those in Japan, the reasons for that use seems to be multi-layered (Amoroso and Ogawa, 2010). There are many drivers that motivate people to purchase mobile technologies and, although for a myriad of different reasons, those drivers seem to cross borders. We noticed that there are applications that are developed for adoption and for use in the mobile environment. We believe that there may be cultural differences or infrastructure differences in each country and patterns of adoption and use of mobile technologies that might also be different. For example, the train infrastructure in Japan is significantly more embedded in the culture, and therefore, mobile applications involving contactless payment systems are more evolved in Japan than in the United States. Figure 3 illustrates the high-level mobile infrastructure research model and the comparative areas of analysis. Bill Moyers from PBS defines ecosystems as “communities of interacting organisms and the physical environment in which they live” in his 2000-2001 special reports titled “Earth on the Edge.” The actions of each member of the ecosystem affect another area in that ecosystem. Everything must balance out, or the ecosystem could fail. The ultimate goal of all the members is to protect and maintain the wellbeing of the ecosystem as a whole (Sugai, Koeder, & Ciferri, 2010).

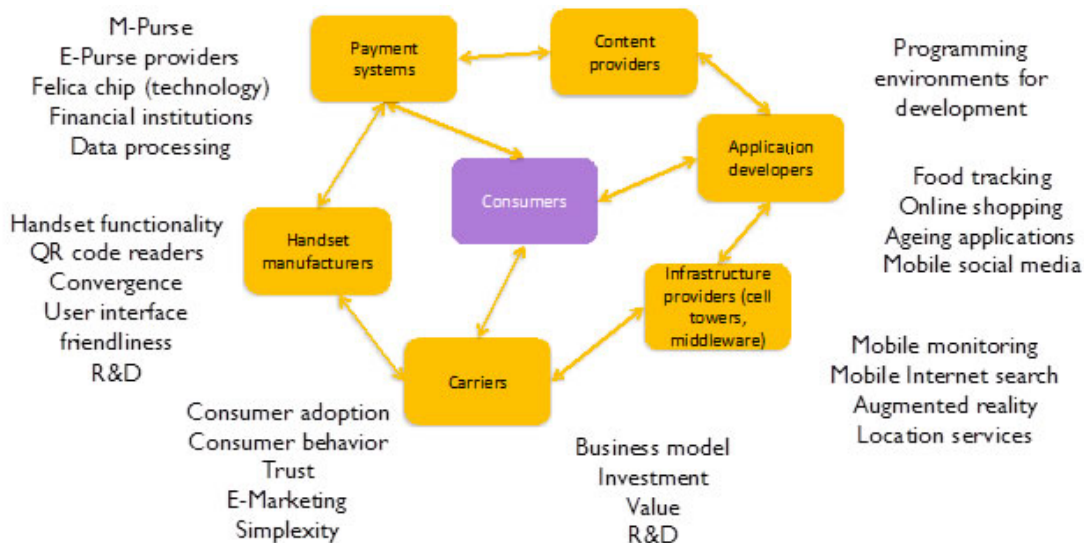


Figure 3. Mobile Ecosystem in Japan – Model for Research

An ecosystem model has certain characteristics that are important to understanding mobile adoption and widespread utilization. An ecosystem has a set of players that are vitally interconnected. All members of the ecosystem are members of the larger team, and their understanding of the overall health of the ecosystem in total is paramount. Therefore collaboration is vital to having a working ecosystem. Another related goal is the concept of Kaizen or ongoing improvement (Sugai, Koeder, & Ciferri, 2010).

The overall mobile ecosystem in Japan has six components including (1) handset manufacturers, (2) carriers, (3) infrastructure providers, (4) application developers, (5) content developers, and (6) payment systems. Certain components of the Japanese mobile ecosystem project are highlighted on Figure 3, as they include factors or characteristics for the overall ecosystem that we are investigating at ten universities in Japan. For example, to understand how carriers flourish in the mobile ecosystem, we have to study business model, investments, value, and using research and development to foster innovation. Payment systems in Japan require an understanding of mobile purse, Felica chip technologies, financial institutions, and data processing. Infrastructure providers need to incorporate mobile monitoring, mobile Internet search, augmented reality, and location services. Application and content developers are providing the richness both in terms of usability and ease of use.

Case Study NTT DoCoMo

The analysis we conducted is based upon the NTT DoCoMo organization – the largest mobile company in Japan, with a net income of ¥494 billion. NTT DoCoMo was founded in 1992 when Nippon Telegraph and Telephone Corporation decided to spin off its mobile division to target the new market. ("DoCoMo" is shorthand for "Do Communications Over the Mobile Network" as well as a play on the Japanese word "dokomo," which means "everywhere,") DoCoMo has risen to become the largest mobile carrier in Japan through a history of innovative moves and reacting to the Japanese market. With a user base of over 56 million, almost half of the total Japanese population, it is a powerful player despite losing much of its market share to rivals KDDI and SoftBank Mobile. NTT DoCoMo's launched its mobile Internet service *i-mode* in 1999, which many unexpected to fail as it was a new form of connectivity for mobile carriers. DoCoMo's *i-Mode* added Internet access, email, and other networking capabilities to cellular phones in Japan. To succeed in the changing market NTT DoCoMo must begin to look at creating new markets and revenue streams to create value going forward. Traditional strategies must be realigned to the changing realities of the market and consumer demands to facilitate horizontal or vertical growth into new markets.

Our contact point for NTT DoCoMo was Takeshi Natsuno, Professor of Keio University, was formerly Senior Vice President of NTT DoCoMo, where he developed the business strategy of all NTT DoCoMo's multimedia-related services, including i-Mode and strategic alliances with partners, suppliers, content providers and key Internet players. Mr. Natsuno has led the development of culture-changing mobile services between 2000-2005 including e-wallet, mobile payments, mobile games, credit card settlements, and i-concierge. Mr. Natsuno is the author of *i-Mode Strategy* (Nikkei BP Planning, Inc., 2000), *a la i-Mode* (Nikkei BP Planning, Inc., 2002), and *Keitai-no-Mirai (The Future of Mobile Phones)*, Diamond, Inc., 2006). He graduated from Waseda University in 1988 and the Wharton School of the University of Pennsylvania in 1995.

We conducted an interview with Mr. Natsuno on March 14, 2011, the founder of the i-Mode and e-payment systems in Japan in 1999-2005, originating from NTT DoCoMo. We categorized the interview data by ecosystem factor as presented in Figure 1. All of the comments below are extracted from the Natsuno interview without the interviewer interjections. The interview comments were manually categorized based upon the six ecosystem factors, where in some cases certain interview data was classified into two or more factors, based upon qualitative keywords.



Analysis

The analysis is based upon the interview with Natsuno and other references regarding the fifteen-year period leading up to the present, where Japan has taken a leadership position with its mobile industry. First, we wanted to know how did it all get started in 1999 with i-Mode. Second, we asked Natsuno to comment on each of the mobile ecosystem players.

Mobile Ecosystem Players #1 and #2: Carriers and Infrastructure Providers

Natsuno commented that the main impetus for the huge success of the Japan mobile ecosystem was the risk takers. Who are the risk takers? The mobile carriers were the risk takers, specifically NTT DoCoMo. Natsuno comments, "We added new functionalities every year. In 1999, the phone had only email and an HTML browser, but the second version of the phone featured midi file download capabilities for ringtones. It began selling in December 1999. February 1999 was the black and white display of i-Mode phones, but ten months later, midi and color LCD came out. And the next one was January 2001, which had the application download capability and gaming functionality, as well as full color screen for all the handsets and other additional features." I-Mode was the Internet and email capability of the mobile phone, launched in 1999 by NTT DoCoMo after extensive research in university labs. Natsuno states, "With i-Mode, I really tried to make the browser and the application capability of the phones as close to Internet applications as possible. Almost all the technology I adopted was from the U.S. because in the U.S., the technology is Java and HTML. Everything was Internet standard." In Japan, the four major carriers were competing with each other. Japanese carriers were using different systems, for example KDDI was using CDMI, and DoCoMo moved from 2G to 3G. From the user perspective, there's no differentiation. That means theoretically, if four operators have the same service, same coverage, same network, and same system, of course the market would go into equilibrium with 25% for each carrier.

Mobile Ecosystem Player #3: Payment Systems

In 2003, NTT DoCoMo added substantial new functionality by introducing payment systems. In Japan, the carriers had to take a risk to get more return coming out. The initial risk for this application was very heavy, but they needed to do so because of the competition. In 2000, nobody was talking about payment systems. At NTT DoCoMo, payment systems required partnering with major delivery suppliers, such as JR East and convenience stores in the Kanto area. Payment systems were predominantly commission-based with a focus on volume rather than content revenue. The commission was 9% per transaction, where NTT DoCoMo's interest was in increasing the traffic rate. Natsuno comments, "I didn't care about the content revenue because the value of what the content provided, did not have as much value. I just set the commission ratio up for 9%, which is

very, very low compared to the American carriers. I thought it was a good strategy because to make the mobile wallet, if I made it totally exclusive to DoCoMo, then it was too hard to get the partners', in this case, the content providers' or application developers' support. So I did it intentionally, and I decided the name 'Osafu-Keitai' as well." NTT DoCoMo partnered with pre-paid and post-paid e-money card companies to develop Passmo and Suica systems. The Sony Felica chip, embedded into the mobile phones, enabled consumers to utilize contactless payment technologies to conduct their transactions. This was extremely successful for JR East, a company that supplies trains and related support systems. And to do that, Sony was saying that if carriers, such as NTT DoCoMo, would just buy their technology and start to provide the form factor, then all the application partners would come in. This would then provide a first-mover disadvantage for NTT DoCoMo. Because afterwards, AU, KDDI, and Softbank would come into mobile payments and NTT DoCoMo needed to allow them to use the same technology. Otherwise, if they started to do different things, it would not be profitable. But if all the handset manufacturers followed the same strategy as Sony, the mobile ecosystem would thrive.

Mobile Ecosystem Player #4: Handset Manufacturers

It appeared that manufacturers didn't take a risk at all. Instead, certain mobile handset manufacturers really tried to slow down progress in the mobile industry, such as the integration with the Internet industry. Natsuno comments on the business model, "That's the business model I set up (at NTT DoCoMo). And by having \$17 billion to \$20 billion coming in, I could keep incentives for new handsets, and the new handset should have some new features. Every time the same user upgraded their handset from an older handset to a newer one, the (network data) output will go up. With a single handset release, we added a camera; then we added flash capability; then we added PDF viewers. When we buy phones from Nokia for example, we mandate some specifications (for Japanese carriers), and then I'm committed (at DoCoMo). For example, if I said 300,000 units, then they made them. They didn't have to take an inventory risk. They didn't have to take any risk of non-sales. Their profit is almost guaranteed. So for Japanese manufacturers, this is an easier job because they didn't have to take any risk." Looking at the industry ecosystem, the balance of power between the operators and the manufacturers appeared to be quite a bit different than the United States or Europe. The carriers tended to have most of the power in the ecosystem. This was evident where the carrier didn't even allow the manufacturer to put their name or logo on the mobile device.

Mobile Ecosystem Player #5: Content Providers

Content providers were not in the initial mix where strategy was being decided for the industry in Japan. The first wave of standardization was terrible because nobody was talking about the content providers. Initially, nobody was talking about the application



developers and the big, industry-changing applications that could result, such as payment systems. Actually, the biggest motivation for the content providers was very simple. Natsuno states, "All the risk to make services popular was taken by the mobile operators. And because of that, last year, the content charges, content amount, and content market on iPhone, as officially reported, was around \$3 billion. And DoCoMo was giving out 91% to content providers, so many content providers went public in the past ten years, which is fine because as far as I could keep \$20 billion revenue coming in from the traffic, I can forget the \$3 billion subsidy to content providers."

Mobile Ecosystem Player #6: Application Providers

In the mobile industry in Japan, almost all the customization was on the application layer. It was not the hardware layer. Just like the current Samsung phones for Android, developers are scrambling to build applications to catch up to Apple, who has the large iTunes and iStore applications. Natsuno states, "They're applications! It's a software development! Why is it so difficult? The amount of work is the same, so the cost would be the same. This is natural for everything, right? But from the Japanese manufacturers' point of view, as far as they are dealing with Japanese carriers, they needed customization to sell phones to India or China. For the content providers, if all the carriers are using a different name, it's terrible. It would be better to make everything equal. But to do so, I needed a business model for DoCoMo." NTT DoCoMo continued to develop integrated applications in each new release of their mobile phone operating system and handsets, such as screen lock when mobile phones are lost and the iConcierge service.

Conclusions

By using the ecosystem model, we were able to understand how Japan was successful in creating a mobile industry. Creating those innovative technologies in the Japanese market was more of a "push" theory, as we discovered in our research. The final question that we asked Natsuno was to describe the business model of the mobile ecosystem from the NTT DoCoMo perspective. We wanted to know whether the business model in Japan for mobile technologies was built around a "push" theory or a "pull" theory, see Figure 4. Could this business model work in the United States as well? Natsuno states, "So this is a business model. Nintendo is doing it. The Nintendo price is like \$200, right? But it's too cheap, and they're getting the profit back from the licensing fees and royalty. Same as PSP. And the same for the subsidy model, incentive model with Japanese operators. Some say this is a terrible business model and that they are taking a heavy risk. But as a result, I could get huge returns coming out pushing innovative technologies. Who took the risk? They (the carriers) took a huge risk. So, back to 1999, when everybody, all the world, everybody was talking about the Internet and everybody was dreaming about the wireless Internet; nobody could make it successful. Why? Because nobody took a risk. Manufacturers didn't take a risk at all."

We are able to conclude from this interview and our subsequent research that the Japan business model was centered around the "push" theory (see Figure 4) with a goal to change the consumer adoption patterns of mobile technology use. The vision was to change the entire culture of Japan. Even though the first applications were launched in 1999, we found that years prior to this, NTT DoCoMo had partnered with university labs in Japan to develop innovations and prototype mobile technology applications. This enabled the organization to create the vision, develop the innovation, and invest in the application development process. By 1999, NTT DoCoMo was then able to launch commercial applications, such as i-Mode to 50% of the 120 million Japanese consumers, on a country-wide scale.

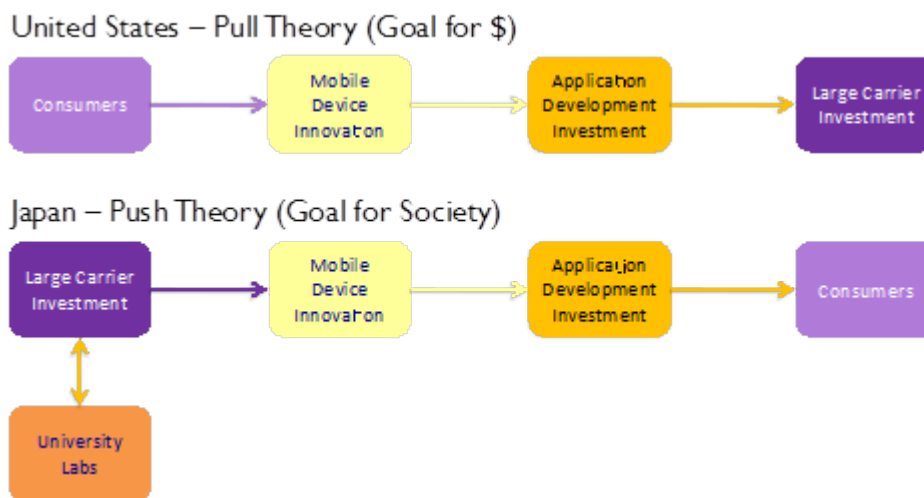


Figure 4. Investment Model Comparison for the Mobile Industry

We found that the risk-taking aspect of implementing the business model in Japan allowed them to be successful using the strategy of building the mobile ecosystem. This put NTT DoCoMo right in the middle of the ecosystem, where they could manage the entire set of players and control the business model. This differs dramatically from Apple Corporation, who developed their own ecosystem, with Apple as the sole handset manufacturer, and they became the predominant organization in the ecosystem. Can the Japanese business model work in the United States? Natsuno comments, “No, no, no. And if you don’t take a risk in the market capitalist economy, you would not get a huge return. So they (US carriers) didn’t take a risk. Nobody took a risk (at that time). But here in Japan, it’s different. So, we really concentrated on the domestic market without thinking about the outside. So the only way to differentiate is to move ahead.”

Value of this Research and Future Research



Based upon the interview research data, we suggest a model for future research. We believe that the basic fundamental theory with respect to the United States is focused toward a “pull” theory, where the United States will make the investment in mobile device application development when they can clearly ascertain that there will be demand from consumers to adopt the application product. Whereas, we have found in Japan a clear investment earlier in the process, where mobile carriers, such as NTT DoCoMo, will partner with university labs to develop the mobile application, such as i-Mode and e-payment systems, and then mobile consumers will have new applications and functionality to adopt. In our future research, we intend to examine the process steps involved in mobile application development and adoption for the ecosystem. Future researchers may want to examine the mobile ecosystem in other countries and/or look at mobile purchasing in other countries, outside of Japan. The model is very powerful and can be considered for adoption in other countries and maybe for other ecosystems, including other mobile ecosystems (such as Android) or other industries and/or countries

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