The Mobile Internet and Technology Innovation

Lessons from Japan

Wharton - Ford Motor Company MBA Fellowship Research Project

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Abstract

This paper analyzes how the most successful mobile Internet companies choose which technologies and business models to adopt. It uses concepts such as network effects, reach and richness, disruptive technologies, complex systems theory, self organizing systems and a unique theory of knowledge creation to help explain why the mobile Internet has evolved so much more quickly in Japan than in the United States. It draws upon research and presentations by and discussions with academics and practitioners from Japan. Some materials used have not been available in English until now while others have not been widely available in the United States. The analysis reveals that success depends less on using the latest technologies than on the unique way in which technologies have been combined with the other elements of the business model. The analysis also suggests various actions which US mobile Internet companies can take in order to maximize their chances for success while implementing the mobile Internet. For the purposes of this paper I made a distinction between the mobile Internet and the wireless Internet which includes fixed wireless access networks such as Wi-Fi or 802.11a/b, choosing to focus on only the mobile Internet. Foreign exchange figures have been converted to US dollars using 1 USD = 122 Yen.

Section 1 - Introduction

"Take it from the thousands who have tried the wireless Web and hate it: Today's mobile phones were not designed for anything other than phone calls. These users say that the phones' display screens and keypads make reading and browsing a wretched experience."[1] "When you take away the user's 104-key keyboard, big mousing surface and 17 inch display, the Web becomes a painful place."[2] As of mid 2002 there were only 10 million mobile Internet users in the United States[3] while there were more than 50 million mobile Internet users in Japan and they were spending on the average of $15 USD a month on packet, content and other charges.[4] Together, Japan's three mobile carriers made $9.9 billion USD from data traffic in 2002, up 62% from 2001.[5] Since its launch in February 1999 through to March 2003, I-mode, the mobile Internet service of Japan's NTT DoCoMo (DoCoMo) has grown to more than 37 million users and is adding 10,000 to 12,000 new customers per day.[6] Somewhere between these two extremes lies the future of the mobile Internet in North America.

Bringing together the two fastest growing technological phenomena of the past decade, wireless communications and the Internet promises to dramatically reshape the way we live and the way that we conduct business. It will liberate customers from cumbersome equipment and immovable points of access. According to Instat/MDR, it will ignite a huge demand for mobile Internet phones and services, quadrupling the number of customers to 320 million by 2006.[7] Meanwhile research firm Ovum is predicting that mobile Internet users will multiply from only six million people in January 2000 to more than 484 million by 2005 and revenues for wireless e-commerce services are anticipated to reach $80 billion USD by 2003, an increase of 222 percent.[8] The mobile Internet will dramatically change the business logic underpinning mobile communication, a logic that has been built for traditional voice-only services. The shift from circuit switched to IP (Internet protocol) or packet data based networks, together with technological evolution on the radio and terminal side, will shift control of value propositions from the core networks towards content and applications. This will create new players who will be looking to take their share of the emerging business opportunities.[9]

Even though the mobile Internet is a mere infant with most applications less than four years old it covers a wide range of topics including the creation and management of content, provision of the wireless network infrastructure, billing and pricing applications, terminal technology and much more. It is not possible to provide comprehensive coverage to all aspects of the mobile Internet industry in a paper of

this scope. However, a basic understanding of the relationships between the various elements of the mobile Internet value chain will provide a foundation for a more in depth discussion of specific elements.

1.1 The Mobile Internet Value Chain

It is important to note that while the mobile Internet value chain model provides a snapshot of the relationships between the various elements it is by necessity a very simplified rendering (see figure 1.1). In fact, in some regions some participants play multiple roles. For example, Verizon Wireless is not only a mobile Internet service provider (MISP) but also a portal provider, creates some of its own content and retails mobile Internet terminals.

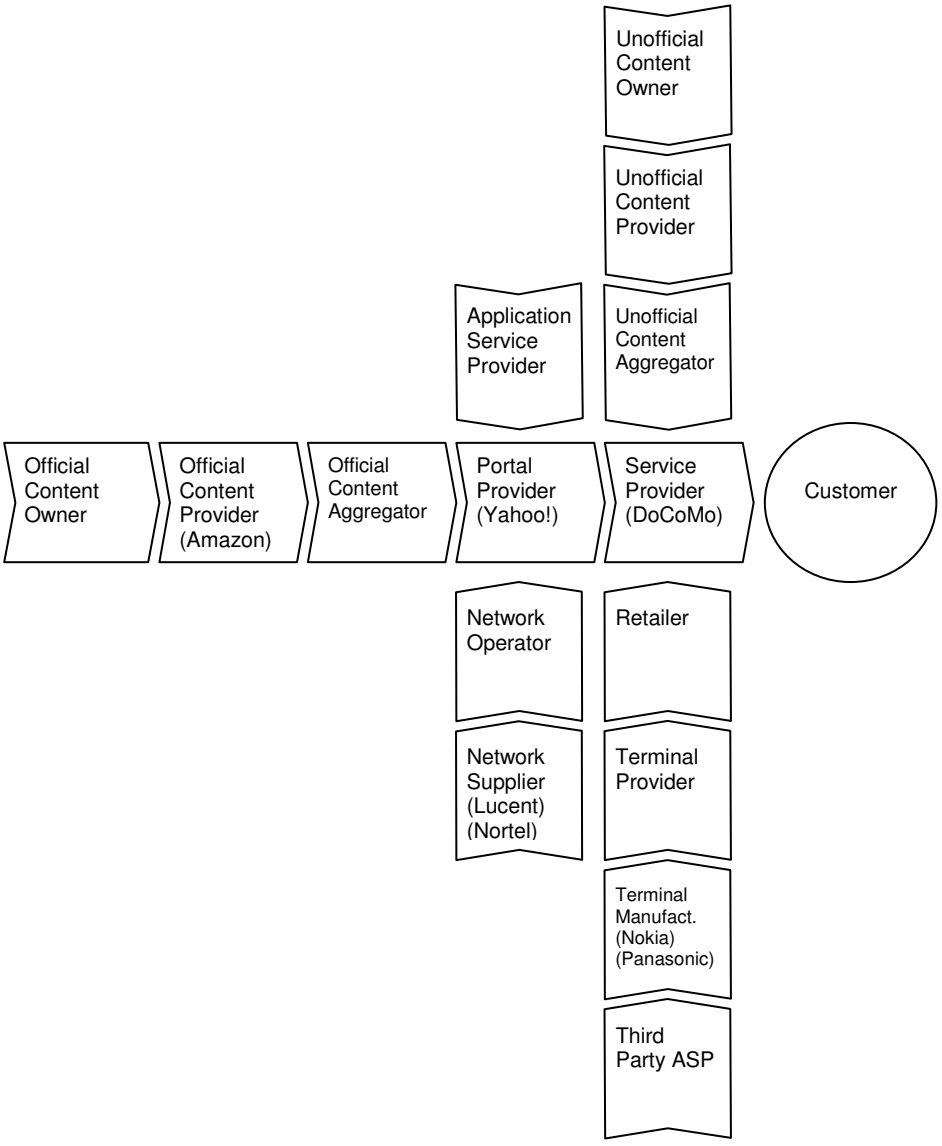

Figure 1.1 The mobile Internet value chain

The roles played by service providers will vary from country to country. For example, in Japan the MISP hosts the content but typically leaves its creation and ownership to third parties while in the United States MISPs are more apt to purchase the content or create it themselves.

Technology plays a very significant role in determining what issues that companies must address as they implement the mobile Internet. This research paper is not meant to be exclusively about technology but a brief discussion of the topic will provide a context for more meaningful understanding of the business challenges and opportunities.

1.2 An Overview of Mobile Internet Technology

Mobile telephony standards have been grouped into generations. Each generation is associated both with a range of data transmission speed capability and also with differing and incompatible methods for maximizing the volume of data that can be transmitted. For example, 2G methods for increasing the amount of data that can be transmitted include TDMA, CDMA and GSM. First generation or 1G analog applications began in the 70s and were still common in the 80's. Second generation or 2G phones employing digital voice encoding appeared in the 1990s and are still widely used. 2G technology has steadily improved, with increased bandwidth and the introduction of multimedia. 2G phones require the user to establish a connection to the network by dialing in. Thus 2G users are charged an access fee based upon the time that they are connected to the network. The present state of mobile communications for US mobile phone companies is often referred to as 2.5G. Instead of circuit switched technology it uses packet switching. This means that the user is always connected to the network but only gets charged for the volume of data packets that get transmitted. As a result, users of 2.5G and succeeding generations do not have to worry about whether they can achieve a dial up connection but merely the volume of data that they access. This has profound implications for operators that have invested in billing systems that are based upon time and now must develop systems that bill based upon the volume of packets. A few companies such as NTT DoCoMo and Korea Telecom have implemented 3G phones networks which permit transmission of data at higher rates, up to 384 Kbps. This is particularly useful for multimedia content such as live streaming video and other data intensive applications (see figure 1.2).

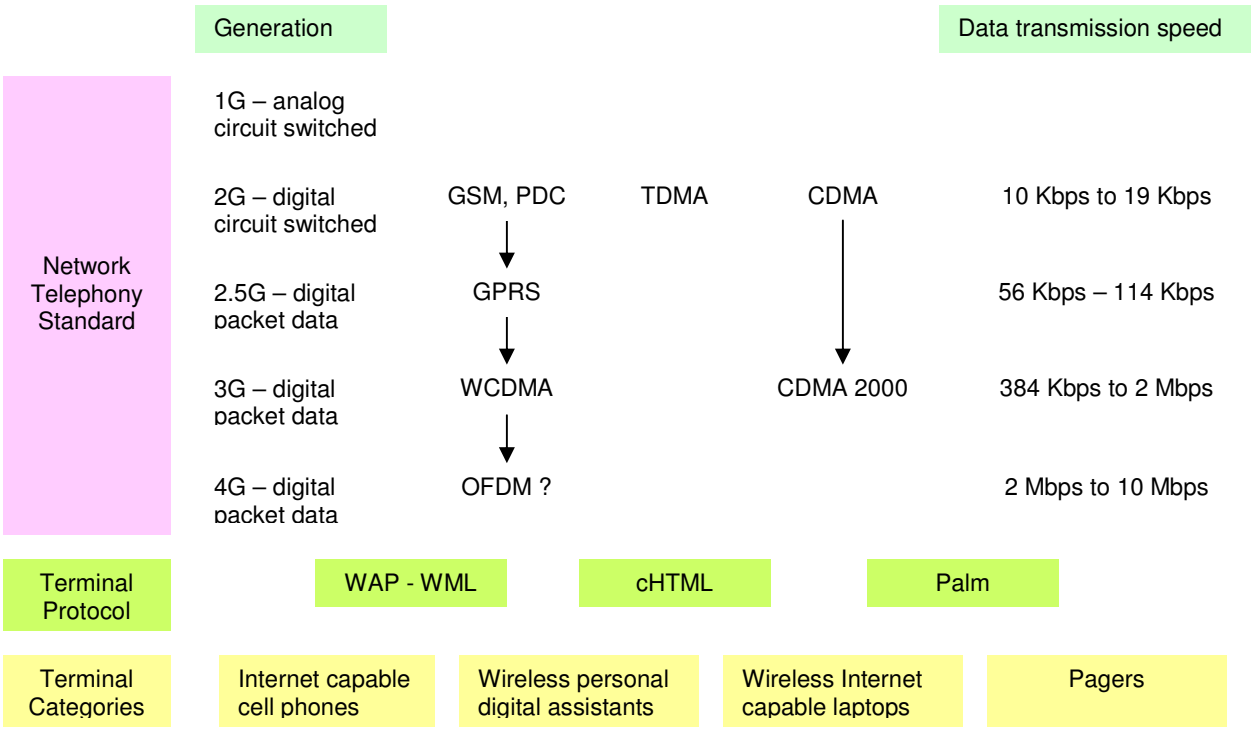

Figure 1.2 An overview of mobile Internet technology

1.3 Mobile Internet Market Trends

The media is awash with stories that characterize the mobile Internet as the next high tech hot topic. A few of the more significant mobile market Internet trends are as follows:

- On March 6, 2001 Business 2.0 reported that a recent survey found that 40 percent of the Fortune 2,500 businesses in the United States have equipped or are equipping their workforces with wireless tools. Another 30 percent “are considering” rolling out wireless systems.[10]
- Frost and Sullivan predicted that revenues from the North American mobile Internet market will soar to $24.6 billion USD by 2008.[11]
- In Europe and Japan the development of M-commerce is being driven by the telecommunication companies. For example, in 2001 in Finland, wireless carrier Sonera launched a service where customers can use their mobile phones to pay for parking, buy drinks from vending machines and pizzas from Pizza Hut. Meanwhile in the United States the major carriers have yet to evolve their offerings to the level where goods and services can be bought through and billed to a customer’s phone bill.[12]

- Mobile Internet operators are establishing global alliances that will enable them to provide global coverage and lever technical competencies. In 2000, Japan's NTT DoCoMo created alliances with a number of operators by paying approximately $15 billion USD for a minority stake in a number of international partners such as AT&T, KPN Mobile, Hutchison Whampoa and others.
- Mobility is no longer a luxury – it's a necessity. Users today depend upon mobile communications everyday to work effectively. Technologies such as IP (Internet protocol) and data packet switching are changing the way networks and bandwidths are planned, used and billed. The mobile communications model will not only revolve around voice, but also around m-commerce, entertainment, information and communications. Lucent forecasts that the number of mobile phone subscribers will grow to more than a billion by 2003.[13]
- The transition from 2G (second generation, circuit-based, pay per minute) systems to 3G (third generation, high speed packet based, pay per kilobit) systems will depend on individual market pressures. In Europe adoption will be swift, driven by lack of current capacity, the need to differentiate and the need to replace depreciated GSM networks. In other countries (such as India and China), migration will be slower.[14]
- The transition from circuit switched to packet switched networks will offer the opportunity for operators to combat the relentless pressure on airtime margins by adding value and revenue through the launch of new services. The provision of communications, information, entertainment and commerce is already converging. By 2005 over 1 billion people will be online to the Internet using PCs.[15] The very applications that are driving this growth – email, chat rooms, information and e-commerce become even more compelling when accessed from a mobile terminal device. Consultant Booz, Allen & Hamilton and other industry analysts believe that by 2004 the number of users accessing the Internet via wireless devices will exceed the number accessing the Internet by PC.[16]
- One of the applications that has shown early promise through its widespread adoption is text messaging whether through Short Messaging Service (SMS) or email. SMS is now a major revenue generator as its popularity rises – particularly among teenagers. In Finland, for example, teenagers send an average of 100 SMS messages per month – comprising 50% of the mobile bill. In Europe the number of messages sent now exceeds 1 billion per month. Meanwhile, in

Japan, DoCoMo's 37 million I-mode users spend an average of 42% of their time using the mobile Internet for sending and receiving email.[17] More than 70 percent of all I-mode users said that the number one reason that they bought their I-mode phone was for the email capability.[18]

- Consumers are expected to opt for simplicity by replacing the redundant purchases, services and costs from having both fixed and wireless communications links by choosing to move everything to wireless. Ultimately, the user wants simplicity and cost savings: a multifunctional multimedia device, one number, one personalized service, one supplier and one bill.[19]

Up to this point, marketers have tried to sell consumers on the notion that mobile commerce means using your phone to buy a can of Coke from a vending machine or to bark real-time stock orders into a wireless visor. The hype has led to spectacular disappointment for consumers who were promised the wireless Web. For those consumers in the United States and much of Europe what they received instead was ponderous text on four-line, black and white screens or shopping menus that required extraordinary patience.[20]

Nonetheless, while many consumers are unable to articulate an interest in the mobile Internet, there is strong evidence of "latent demand" according to Forrester Research. The mobile Internet is viewed as the next logical step in what Forrester Research describes as America's Internet lifestyle. The mad adoption of wireless technology in Japan and Europe provides US developers with the confidence that their turn is still to come.[21]

A collection of slow, competing wireless network standards and a devotion to desktop Internet access has hampered U.S. adoption of the mobile Internet. Prevailing wisdom holds that development of wireless networks and mobile commerce in the United States lags behind development in Europe and Japan by at least two years. As a result, the United States finds itself in the rather unusual situation one might describe as last-mover-advantage, being able to benefit from the lessons learned as other countries have implemented the mobile Internet. That being the case, which countries appear to offer the best examples of successful mobile Internet applications?

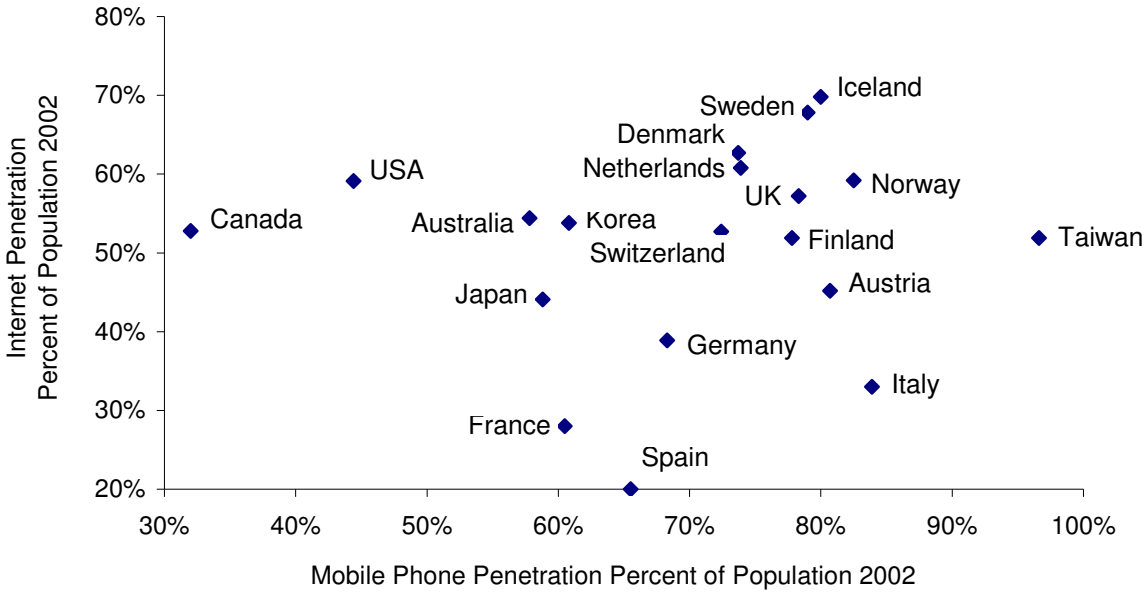

Figure 1.3 Internet penetration and mobile phone penetration [CyberAtlas, ITU] [22], [23]

1.4 Which Mobile Internet Market Offers the Best Role Model for the United States?

Telecom companies in Europe are in the process of making what may prove to be the biggest gamble in business history. Between 2001 and 2004, they will invest more than $300 billion USD bringing together the mobile phone and the Internet. The amount will be split between paying for licenses to use the necessary broadcast spectrum and for the cost of building the new broadband networks to transport data at high speed.[24]

Although Europe has the highest wireless-device penetration, it doesn't lead the world in mobile Internet access. Of the 162 million mobile phone subscribers in Europe, only about 75,000 or less than one percent of them use their mobile phones to browse the Internet. That's because most Europeans make e-purchases and check e-mail via a wireless service not connected over the Internet. Currently, each month over 2 billion messages in Europe are exchanged on wireless devices through non-Internet based Short Message Services. At the same time, analysts estimate that the Asia Pacific region accounts for between 94 and 98 percent of total worldwide mobile Internet use[25] (see figures 1.4 and 1.5).

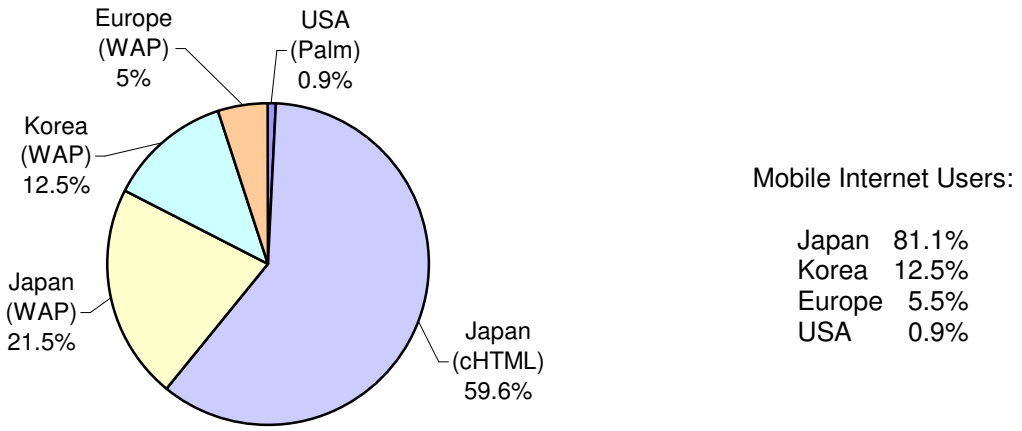

Figure 1.4 Geographic distribution of mobile Internet users and platforms [26]

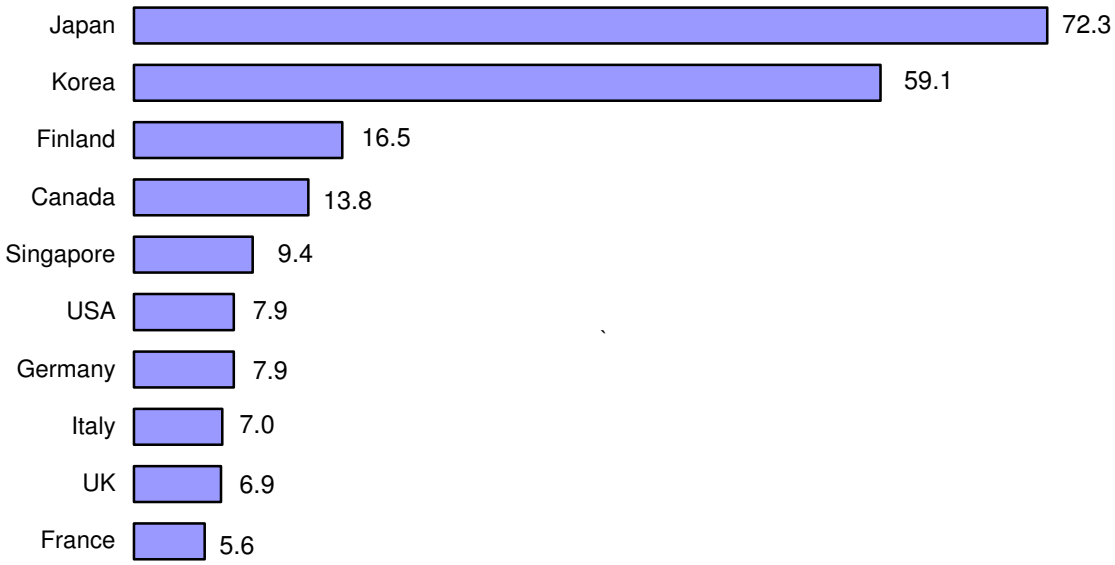

Figure 1.5 Mobile Internet users as a percentage of total mobile phone users 2001 [27]

1.4.1 Why Study Japan's Mobile Internet Industry?

- The United States and Japan are widely acknowledged as having the largest Internet populations in the world. The number of mobile phone users in the United States reached 115 million while Japan had about 74 million as of January 2003. This gives Japan a wireless penetration rate of about 58 percent.[28] An estimated 60 million people had access to the Internet via their mobile

phone, a penetration rate of 47% for the population of 127 million.[29] Given that Japan has one of the largest mobile communications populations, largest Internet populations and largest mobile Internet populations in the world they have had more opportunity to experiment with mobile Internet concepts than most of the rest of the world.

- Third generation phones capable of handling data streams of up to 384 Kbps were introduced in Japan in mid 2001, at least 18 months ahead of the rest of the world.[30]
- Gerald R. Faulhaber, (Wharton professor and former chief economist of the Federal Communications Commission in the United States) acknowledged that Japan is leading the United States when it comes to deploying wireless services.[31]

	Japan	**USA**
Population[32]	127 million	288 million
Population density[33]	880 / sq. mile	81 / sq. mile
% living in an urban area[34]	78%	41%
Avg. per capita income[35]	$21,972 USD	$31,880 USD
Number of Internet users as of Apr. '02[36]	56 million - 44 %	165 million - 59%
Cell phone subscribers[37]	74 million - 58%	115 million - 41%
Mobile Internet users as of Feb. '03[38] [39]	60 million – 47%	10 million – 3%
Key wireless platforms[40]	I-mode, WAP, PHS, PDC	TDMA, CDMA, GSM, WAP, Palm
Total Internet penetration as of '02[41]	44%	60%
Wireless penetration[42]	58%	30%
Cell site density per 100 sq. miles[43]	9.4	2.3
Miles traveled by car / yr[44]	2,800	14,000
Average coverage req'd.[45]	95 sq. miles	1,330 sq. miles
Land line penetration[46]	62 million - 49%	186 million - 66%
Est. M-commerce users[47]	7 million 5.6%	4.7 million 1.7%
Est. M-commerce revenue[48]	$1.2 billion USD	$728 million USD
Leading mobile services[49]	Email, ringing tones, cartoon characters, messaging, banking, stock trading, news.	Email, product tracking, enterprise apps, news, stock trading.
Outlook[50]	Low wire line Internet penetration means mobile devices provide the only Internet access many people have. Always on I-mode packet network means no per-minute charges. Fees added to phone bills simplify service charges.	Web clipping services and small screens aren't igniting consumer passion. The highest cellular penetration is among business users and smarter carriers and applications vendors are aiming for enterprise m-commerce tools.
Key players[51]	NTT Docomo, KDDI, J-Phone, banks, securities firms, airlines, numerous content providers.	Sprint PCS, Verizon, AT&T, Nextel control large digital networks. Yahoo! and Microsoft control applications, content and subscribers.

Table 1.1 Mobile Internet market comparison

Section 2 - Network Effects, Reach & Richness, Disruptive Technologies

This section focuses on the role that network effects, reach and richness, and disruptive technologies have played in accelerating the evolution of the mobile Internet in Japan. When the value of a product to one user depends on how many other users there are, the product is said to exhibit network effects or network externalities.[52] Professor Jeffrey Funk of Kobe University contends that the mobile Internet has grown much more quickly in Japan than in the West because Japanese MISPs recognized the unique characteristics of the mobile Internet and exploited network effects by creating stronger positive feedback between the users, content, business models, phones, and services. The Japanese did this by initially focusing on young users, simple entertainment content, subsidized Internet capable phones with large screens, packet based micro-payment services and simple portals to organize the information.[53]

By contrast, the West initially focused on those users, which have traditionally yielded the highest revenues for use of mobile phones. In other words the West concentrated on business users and more complex content.[54] In effect the West focused on incumbent markets even though the mobile Internet represents a disruptive technology, which needs to be nurtured and its capabilities grown until it meets the needs of the incumbent market. Approaching the existing business users with an immature technology as the West did, resulted in disinterest and a lack of the positive feedback necessary for the technology to be embraced as enthusiastically as it has been in Japan. Meanwhile, the Japanese focused on new markets such as young people who were more apt to embrace the new, immature technology. As the mobile Internet matures its capabilities are converging with the needs of a more diverse set of users including the business market. The following discussion will illustrate how Japan approached the main elements of the mobile Internet in order to create positive feedback. This will be followed by a more in depth discussion about how the mobile Internet is a disruptive technology.

	Content	Users	Content provider business models	Portals / search engines	Phones
Initially	Simple entertainment and mail	Young	Simple monthly charges	Simple	Large screens but simple
Current	Entertainment, mail, news, navigation information, remote mail, online stock trading	Diverse	Simple monthly charges, advertising, discount coupons, dynamic pricing, multi-channel convergence.	Complex and varied	Large screens and multifunctional

Table 2.1 Mobile Internet evolution in Japan [55]

2.1 Content

Some people claim that the success of the mobile Internet in Japan is an anomaly due primarily to the high cost of PC Internet access. It is true that in Japan the combined ISP and per minute phone charges required to access the Internet from a PC are among the highest in the world with most Japanese spending between $49 - $98 USD per month in order to access the Internet from their PC.[56] However, PC Internet usage is higher in Japan than many European countries. Furthermore, there are more joint users of mobile and PC Internet services than pure mobile Internet users in Japan.[57] It is because the PC Internet and the mobile Internet are very different that the two are not simple substitutes for each other. This difference is slowly eroding as the capability of handsets converges with what users expect from PC Internet devices. Handsets' ability to handle rich content is improving as manufacturers increase display size and quality, increase memory and processing power and improve input methods through new technologies such as voice recognition.

The number of subscribers for NTT DoCoMo's I-mode mobile Internet service has grown to 37 million in only four years and they have access to more than 3,000 official content sites and more than 54,000 unofficial content sites.[58] The concepts of reach and richness are useful for explaining which elements have been critical to creating the positive feedback, which has helped the Japanese mobile Internet grow so quickly. "Reach" refers to the number of people who participate in the sharing of information. "Richness" refers to the quality and quantity of information as defined by the user. Richness can be defined in terms of relevance, security, interactivity, customization, timing, accuracy and bandwidth required for transmission. Traditional media have typically required that users choose between reach and richness. As an example, general purpose newspapers offer broad reach but limited richness.

In contrast, specialized magazines usually offer much greater richness of content but have a more restricted reach because their appeal is more limited.

Broadband technology and the larger screen typical of the PC Internet have the potential of supporting richness and to some extent reach, both at the same time. However, in Japan, where most users access the Internet using the 2 square inch screen of their mobile phone, competition between mobile Internet content providers focuses on reach more so than richness. Reach and richness explain why simple entertainment content and young users have been so important to the growth of the mobile Internet in Japan. Simple entertainment initially drove traffic in the Japanese mobile Internet because it matched the high reach and low richness of the mobile phone and the type of people (ie, mostly young people) who emphasize reach over richness. Content such as screen savers, ring tones, games, dating services and horoscopes are simple applications that require only low levels of bandwidth characteristic of the earliest mobile Internet handsets and accounted for 23% of how people in Japan use their mobile phones (see figure 2.1)[59]. Such applications are especially appealing to young people. As an example, Japanese content provider Xing sold $100 million USD worth of ring tones in 2002.[60] Downloading of ring tones is also one of the most popular short messaging services in Europe. In January 2003, Cees van den Heijkant, CEO of KPN Mobile, which launched a mobile Internet service similar to I-mode in 2002, noted that ring tones were the most popular content for KPN's mobile Internet service in Holland and Germany. He further stated that he saw no significant differences between Japan and Western Europe regarding mobile data services. Informa Media Group Senior Analyst Simon Dyson estimated that the worldwide sales of mobile phone ring tones in 2002 was between $700 million and $1 billion USD.[61]

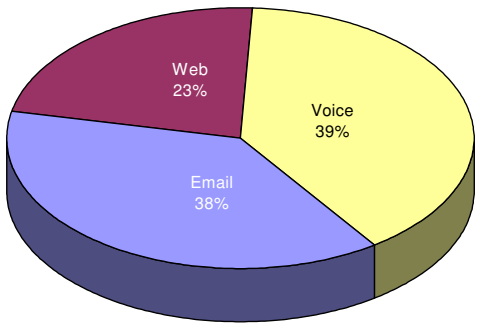

Figure 2.1 What people use their mobile phone for in Japan

In Japan, the most popular non-entertainment content also tends to emphasize simplicity. For example, weather and general news receive far more traffic than business and information technology news.[62]

Japanese young people find the greater reach of the mobile Internet appealing for three reasons. First, young people tend to be very mobile and so need a device, which suits their mobile lifestyle. Young people often have a variety of portable devices such as music players and so using a mobile device for accessing the Internet is a natural fit. Young people also tend to have less experience than older people, which causes them to have more diverse and less specialized interests than older people. Thus, content richness is often less important for young people.

The second reason that young people find the mobile Internet appealing is its usefulness in "killing time". The greater mobility of young people means they often spend time waiting for classes, trains, buses, friends etc. A mobile Internet device can offer many ways in which to fill idle time. A handset is also easier to handle on a crowded train than a newspaper or book. A survey by tech magazine Japan Inc. revealed that one of the most popular ways for young people to use mobile phones is to send and receive email (see figure 2.3).

A third reason why Japanese youths have been drawn to the mobile Internet is because it offers more opportunities for personalization than the PC Internet does. Japanese handset manufacturers have steadily improved the sound quality of phones through the addition of refinements such as polyphonic ring tones so that users can personalize their phones. Users can also customize their phones with animated characters and other pictures that are available from screen saver content providers. Beginning in 2000, Japanese users could take pictures with a simple camera that is embedded in the back of some phones and then use the picture as a screen saver. Japanese MISP J-Phone launched such a camera service in June 2001. Only 18 months later, J-Phone announced that its subscribers had purchased over 8 million camera phones, equivalent to 60% of J-Phone's total mobile subscriber base. Not surprisingly, J-Phone has the largest line up of camera phones of any carrier with 22 different models in January 2003.[63]

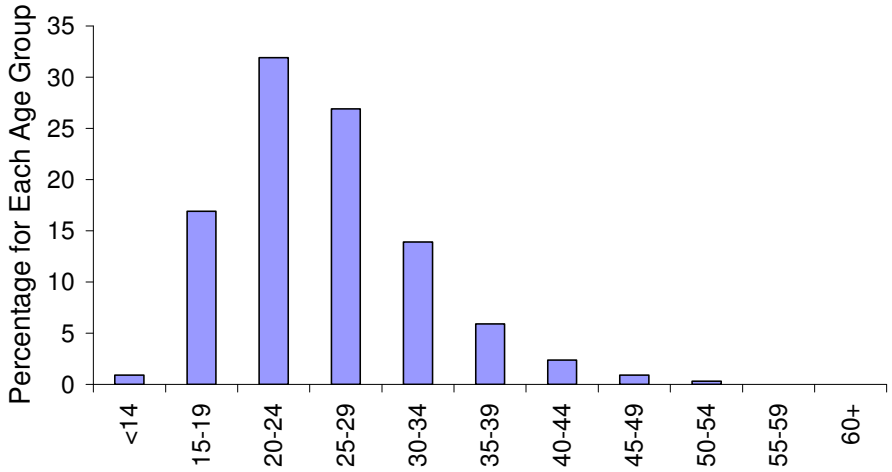

Figure 2.2 Distribution of I-mode users, mobile Internet users tend to be young [64]

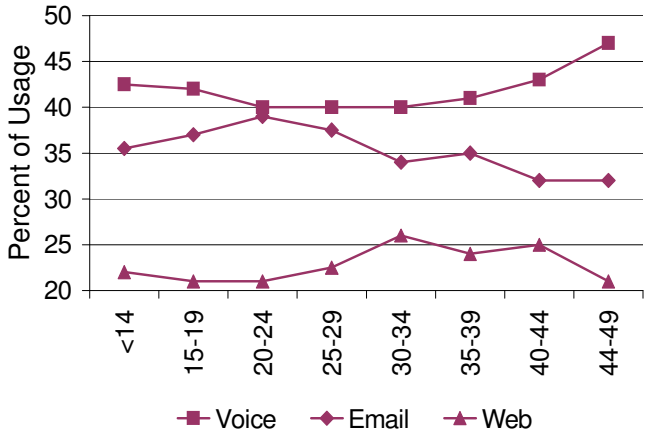

Figure 2.3 What people in Japan use their mobile phone for, by age [65]

In pursuing the youth market, successful Japanese content providers have realized the full potential of mobile phones by creating simple content for the mobile Internet. Second, they have expanded the breadth of the content and services in order to appeal to a larger number of people.[66] The breadth of the content drives the number of people who have an interest in the content while the breadth of the services determines the ease with which people can access the content. Two key services for improving user's access to content are email and site customization services. Most Japanese content providers give users the opportunity to select and receive mail about topics of their choice. Some content

providers also enable users to customize their site so that when users access the site, information about their chosen topic is displayed on their site. A variation of this service is to allow users to save recent conditions so that they don't have to constantly re-enter the desired characteristics of an item that they are searching for. Both customization and mail services make it easier for users to find specific information with a minimal use of the small keyboards and screens found on mobile phones.[67]

2.1.1 Discussion and Implications for US Mobile Internet Companies

In Japan the early success of simple entertainment content caused the number of entertainment related content providers to increase, thus creating positive feedback between content and users. The most successful content providers first focused on realizing the potential reach of phones before turning their attention to richness. Continued positive feedback between new services such as Java, phones with color displays, and a diversification of users and business models will make it even easier for these providers to add richness to their content.[68]

Western content providers and carriers have taken a different approach. In implementing the mobile Internet they have tried to add reach to the successful applications and content that exist on the PC Internet in order to leverage the success of that media. They are trying to use complex technologies to do this, because these complex technologies are driving the PC Internet. Furthermore, service providers and phone manufacturers have focused on applications and content for business users, such as banking, travel and news because they have always introduced new services and phones first to business users. An example of this approach is the emphasis on location based technologies by Western service providers, manufacturers and content providers. These location dependent services include travel reservation services, navigation services and information on local restaurants etc. Some of these services, such as reserving airline tickets, are highly developed on the PC Internet and business people are major users. Proposed location based applications include offering coupons when customers are in the vicinity of specific stores and providing directions to the nearest business a user is searching for. Some location based services such as reserving hotels and airline tickets do exist in Japan. However, many forms of location based services being proposed by the West have not yet been successful even in Japan.[69]

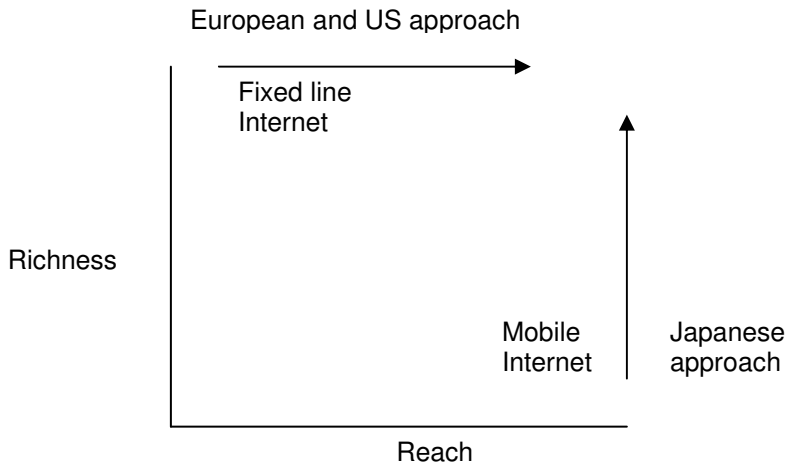

Figure 2.4 Japanese versus European / US approaches to the mobile Internet [70]

Professor Jeffrey Funk believes that Japanese content providers will eventually utilize the more sophisticated location based technologies that the West is now considering. Use of these technologies will be a result of the positive feedback that has been created between users, content, business models, phones and services. He also believes that the West's early focus on complex technologies and business users has impeded the creation of positive feedback and may result in Japan becoming the earliest user of these complex technologies. US service providers should first focus on content that matches the needs of early users. This means low-richness and high reach content designed for young people. This includes simple entertainment and news. Richness should only be added after reach has been achieved and in such a way as to not burden users with too much information. US MISPs should also provide users with the opportunity both to receive mail about specific topics and to customize sites so that when users access the site, the information they are interested in is easily accessible from the top of the page. Taking these steps will help contribute to the positive feedback that will drive the growth of the mobile Internet in the West. Once the positive feedback is created the West can place more emphasis on offering richer content.

Finally, in order to realize the maximum reach of the mobile Internet content providers should expand their content in a way that reflects the interests of the major users of the mobile Internet. In Japan this meant focusing on young people initially. However, the profile of users of the mobile Internet has evolved to include people of all ages. Thus, content strategy should be designed to reflect who it is that is

actually using the mobile Internet. As the subscriber base includes more mature customers the available contents needs to reflect their more specialized interests. To reiterate, positive feedback must be created first using simple content, only then should more sophisticated content be added.

2.2 Business Models, Pricing and Billing

According to Michael Wehrs, principal in the venture firm Ignition, there is nothing uniquely Japanese about the factors that made I-mode a success – packet switching, HTML, a billing service, a fair revenue spilt, smart marketing, careful monitoring of content providers, and the ability to make handset manufacturers toe the line. He believes that much of the success is attributable to the way that the various elements have been arranged to make up the business model.[71] This is good news for aspiring US mobile Internet companies. The comprehensive business model employed by the Japanese mobile Internet has been critical to encouraging cooperation between phone manufacturers, content providers and portals / search engines. Key aspects of this business model include subsidizing handsets, offering micro-payment services and maintaining an open policy toward portals and search engines.

2.2.1 Handset Subsidies

Heavy subsidization of handsets by service providers made it very easy for everyone, even young people with limited budgets, to acquire high quality mobile Internet compatible phones. Prices for most phones fell below $100 USD within six months of the start of I-mode services in February 1999. Subsidies have also fueled the replacement market for phones. This policy of subsidization has encouraged manufacturers to continually introduce new models with advanced technologies. Even the most popular phones have not remained on the market for more than one year. [72] Originally manufacturers competed on phone weight but now they compete on the basis of screen size, quality and other new features in addition to weight.

NTT DoCoMo and other Japanese service providers have historically believed that high activation commissions are necessary to attract new subscribers and retain existing ones, because they believe that subscribers want the latest phones. Currently DoCoMo pays retail outlets about $250 USD to obtain a new phone subscriber and about $250 USD to provide an existing subscriber (greater than one year of service) with a new phone.[73] According to Professor Jeffrey Funk other Japanese service providers pay as much as $400 USD to obtain a new subscriber and about $150 USD to provide an existing subscriber with a new phone. The former subsidies are provided to attract subscribers, while the latter are provided

to discourage subscribers from changing service providers. Both of these subsidies are implemented under the assumption that they will provide the service provider with about $80 to $100 USD a month in additional income. This figure is made up of $40 USD per month for access, $40 USD per month for voice service and about $20 USD per month in packet charges.[74] Given that the average subscriber keeps their handset for about 2.5 years DoCoMo is paying $250 USD in subsidies in order to receive a revenue stream of $3000 USD.[75] Professor Funk estimates that it takes between four and six months for the Japanese service providers to recoup their initial outlay on a new subscriber.[76] By comparison it takes about 2.5 months for a US service provider to break even on a new subscriber based on paying an average of $100 USD to acquire a subscriber and earn an average income of $40 USD per month.[77] Meanwhile, retail outlets in Japan, on average, pay about $300 USD for a mobile phone and sell them to users for an average of $50 USD. With an average subsidy from service providers of $325 USD this results in a gross profit of about $75 USD per subscriber (see figure 2.5).[78]

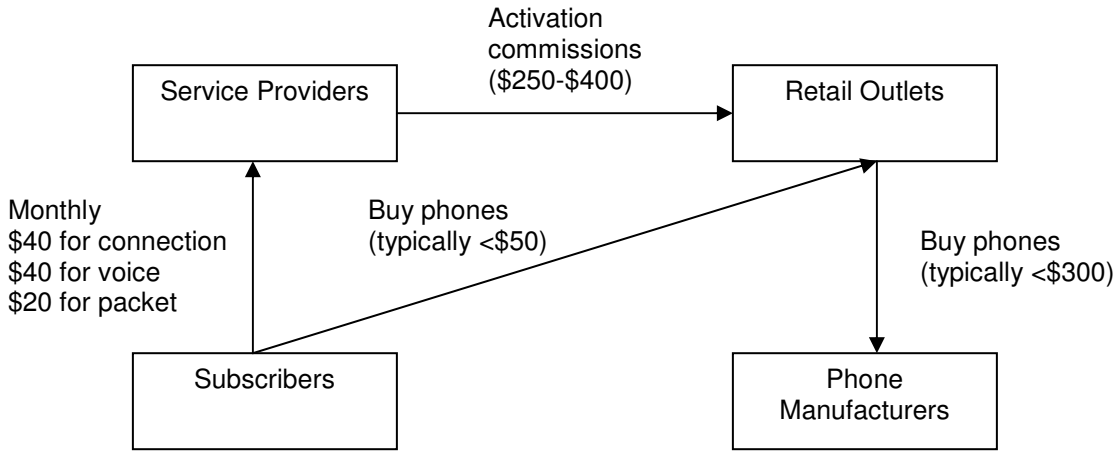

Figure 2.5 Basic business model for Japanese mobile phone market [79]

2.2.2 Pricing and Micro-payment Services

Japanese MISPs have designed their pricing and payment systems to help encourage the creation of content. Prices are capped at modest levels making them affordable for most users with the majority of the content fee being passed along to the content provider.

Official sites

The most successful business model for content providers has been monthly paid content subscriptions. In May 2001 alone, content providers made more than $100 million USD from their mobile content.[80] I-mode users are charged a flat 300 yen (about $2.46 USD) monthly fee plus a variable fee of 0.3 yen per 128 bits transmitted. As a result most services cost about $0.20 per transaction. This works out to about 10 – 15 cents to check a bank balance or transfer funds and about 20 cents to purchase tickets or other information services.[81] The average monthly usage is around 100 packets per day. DoCoMo intentionally capped subscription fees for official sites at about the average cost to buy a magazine in order to encourage the market to grow quickly. In addition to a common platform, DoCoMo offers content providers increased credibility among users through association with the trusted NTT name. Furthermore, DoCoMo provides a convenient and efficient process for monetizing the mobile Internet by collecting fees on behalf of official content providers and adding these fees to the user's phone bill. This approach is particular useful for facilitating micro-payments. After collecting the fees and taking a modest 9 percent service charge the rest is passed on to the content provider.[82]

Unofficial Sites

The number of unofficial sites is growing much faster than the number of official sites. Unofficial sites make up more than 95% of Japan's mobile Internet and typically have more than 20 times as many pages as official sites. A number of alternative payment schemes have emerged to accommodate the broader needs of unofficial sites. Each alternative has drawbacks, which have impeded the creation of positive feedback and the growth of the mobile Internet in Japan. Alternatives include bank transfers, credit cards, fixed line telephone accounts and portal sites. Bank transfers are the most common in spite of their relatively high commissions. Credit cards are widely used but have commissions that are too high for micro-payments. Pre-paid cards have lower commissions, but they are not widely used and thus are difficult to obtain. Fixed line telephone accounts are widespread but few young people have one as most young people live with their parents. Despite these obstacles the number of unofficial sites continues to grow much more rapidly than official sites because they permit content providers to charge higher monthly rates, charge by view or transaction, offer more advertising, and provide more flexibility in cross marketing and the type of content offered.

2.2.3 Discussion and Implications for US Mobile Internet Companies

According to Wharton's Professor Gerald Faulhaber, for the mobile Internet to be a success in the United States one of the biggest challenges that must be overcome is to provide an effective payment system. US mobile consumers are not use to paying on a metered (per packet) basis as most services have gone to flat rates.[83] Yet the payment system is critical to encouraging content providers to create a range of diverse, compelling content, which will capture and hold subscriber's attention, in turn creating the positive feedback which will accelerate growth of the mobile Internet.

There are at least two reasons why fixed term paid subscriptions and simple paid content are initially the most appropriate business model for the mobile Internet. First, fixed term content subscriptions are one of the more efficient ways of charging for the simple content which is best suited for the initial stages of the mobile Internet. Theoretically, content providers could charge by the transaction. But, the transmission charges for informing the user of the content transaction fees would probably equal the actual content transaction fees in many cases. Second, the small screens on mobile phones make other business models such as advertising, mobile shopping and transaction based business models difficult to operate. This means that these business models in Japan are playing a role in expanding but not in creating the initial positive feedback between mobile phone users, content, handsets, portals and business models.

Service providers can promote positive feedback between users and content providers without having to abandon the idea of an official content menu by promoting the creation of portals and alternative payment systems. Promotion of portals would be a way of outsourcing the responsibility for administering content under a broader set of criteria than might be appropriate for the service provider given its limited resources and desired brand image. Service providers could also support the creation of low commission credit cards and bank transfers, standard pre-paid cards and other schemes to help encourage growth of a content industry which is responsive to users' interests.

A comparison of Japanese and US mobile Internet pricing schemes revealed a significant difference in their approach toward pricing content. While Japanese carriers typically charge a commission of only 9 percent, research by the Yankee Group suggests that US carriers want closer to a 50 percent commission on content.[84] Such a high commission is likely to stifle the creation of content and constrain the creation of positive feedback which would help accelerate growth of the mobile Internet.

Therefore, US carriers should take a longer term view and aim to help the market grow first. As the Japanese experience has shown, service providers will ultimately earn more revenue by "taking a smaller slice of a larger pie".

According to the Director of DoCoMo's I-mode Strategy, Takeshi Natsuno, the US approach is to exploit mobile Internet content providers by demanding a share of their e-commerce revenue. But a normal fixed line operator cannot take any portion of e-commerce. DoCoMo designed its business model with this in mind. They thought that by providing a better platform, that they would benefit from the additional network traffic driven by the increase of transactions. In other words DoCoMo keeps the traffic revenue, content providers keep their transaction revenue and if DoCoMo can provide some value added service such as a billing system then there would be an opportunity to share some revenue. The DoCoMo business model will be examined in greater depth in section three.

Professor Funk endorses DoCoMo's holistic view and suggests that Western MISPs need to create more comprehensive business models by taking a more integrated approach to developing new services with pricing and payment systems in order to maximize positive feedback and accelerate the speed at which the mobile Internet evolves. For example, in the West mobile billing vendors provide most of the billing systems while the Japanese service providers do most of the work themselves. For the West this has meant that billing vendors focus on responding to the requests of service providers not in creating comprehensive business models that support the creation of new content and phones.[85] Western service providers must rethink their business models and how they integrate the various elements including payment systems and content even if this means changing the current systems to accommodate things like packet billing and micro-payments. As it stands now, billing vendors are unlikely to propose wholesale changes to service provider billing systems that run counter to business models used by the vendors.

Professor Funk suggests that US service providers should increase their activation commissions in order to spur growth in the mobile Internet, but they should not increase them to the extent that Japanese service providers are paying. It would be a mistake for US service providers to sacrifice their low prices for mobile services in order to encourage greater mobile Internet usage. Even if US service providers do not implement high activation commissions, they can encourage positive feedback among mobile Internet users by offering lower priced services and more basic mobile Internet capable phones.

US service providers should also pay higher activation commissions for mobile Internet capable phones than for regular mobile phones since they potentially can command higher monthly incomes. In response to the concern expressed by Professor Faulhaber about flat rate billing in the US, Professor Funk believes that it is possible to include a certain amount of airtime, packet and contents in a single flat monthly charge. The critical issue is to encourage experimentation by users. Rate structures that confuse the user, or that charge them for obtaining access to contents outside the service provider's "walled garden" will not encourage usage or creation of positive feedback.[86]

Finally, alternative micro-payment schemes that use bank transfers, credit or prepaid cards or rely on fixed line phone bills do not appear to be generating much interest in Japan. The commissions are often high and the schemes are difficult to use. Many of the main users of the Japanese mobile Internet don't have credit cards or fixed line phone subscriptions. Therefore, there is still a need for a micro-payment system which will support users and creators of unofficial content as well as the official micro-payment scheme does. Creation of a portal site that offers a successful micro-payment scheme represents a significant opportunity for service providers to accelerate the development of the mobile Internet in the West. Business models will be discussed further in sections three and four.

2.3 Portals / Search Engines

With traditional media it has usually been difficult for buyers to obtain unbiased rich information at a reasonable cost. The Internet reduces the cost of obtaining rich information and thus threatens traditional information navigators such as salespeople, consultants and advertisements. Portals and search engines help users to navigate through the masses of data that are accessible on the Internet. Portals categorize, organize and screen information, while search engines typically include a broader set of sites in their database. The portals and search engines used on the PC Internet are significantly different from those used on the mobile Internet. Many of these differences are related to the difference in size of access device, costs and usage patterns. Mobile portals and search engines need to provide more screening of content than the PC Internet due to the smaller screens, relatively high transmission charges and shorter viewing times of the mobile Internet.

Portals and search engines help people move from the southeast quadrant (low richness, high reach) of the reach/richness domain (see figure 2.6) toward the northwest quadrant (high richness, low reach) of the reach/richness domain. But the limits of mobile phones constrain the extent to which users

can access rich information. PC portals and search engines help people to move throughout a large part of the reach and richness domain while mobile portals and search engines help them to move just within the southeast quadrant. PC Internet portals and search engines are able to provide the user with more richness of content. On the other hand, it is difficult to present the user with a great many choices on the small screen of a mobile phone.

Since portals categorize, screen and organize information and thus make it easier for people to find information than do search engines, they have higher reach but lower richness than search engines. On the other hand search engines typically include a larger number of sites in their database and thus can access this greater number of sites and provide richer information than portals.

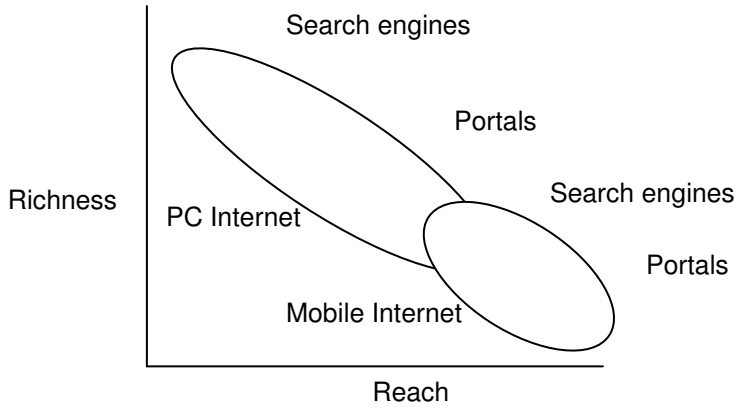

Figure 2.6 The role of navigators in the PC Internet and the mobile Internet [87]

2.3.1 Japanese Mobile Portals and Search Engines

DoCoMo's I-mode portal service can be characterized as a semi-walled approach. When users push the "i" on their phone they are presented with a menu of options that includes selections such as "Internet", "bookmark", and "I-mode menu". Since users can access regular home pages through selecting the "bookmark" or "Internet" options the I-mode service is not a pure "walled garden" approach like many mobile portals offered in the US where users can only access the official content that the service providers have prepared.

The "I-mode menu" option links to a portal site that provides easy access to DoCoMo's 3,000 official sites. Similar to Yahoo! Japan, DoCoMo categorizes, screens and organizes sites for users. There

are several differences between Yahoo! Japan's portal and DoCoMo's I-mode portal. The key differences include DoCoMo's micro-payment service and its restrictions on linkages to other sites, advertisements and portals. DoCoMo does not allow linkages between Web sites, including the creation of portals by official content providers. This accounts for why some people perceive I-mode as offering a "semi-walled garden" approach. This restriction on linkages actually impedes users' ability to access richer information and so discourages positive feedback even while it helps DoCoMo maintain the quality of official content. These restrictions and the difficulty that DoCoMo has experienced keeping up with the large number of applications from content providers provides a partial explanation for why there has been such huge growth in the number of unofficial content sites.

Screening of content is one of the most important services that mobile portals and search engines provide. A few services that can enhance the effectiveness of mobile Internet portals and search engines include user evaluations, simpler search routines, fixed line convergence and site customization services. User evaluations facilitate the screening of content by publishing user's ratings for mobile sites. Typically this takes the form of magazines that specialize in this subject. Simpler search routines include providing the ability to access sites by keying in a four or six digit code instead of an URL which can be up to 30 characters long. With fixed line convergence an operator of a fixed line Internet portal creates translations of its more popular fixed line Internet web pages to a format suitable for viewing on the mobile Internet. Meanwhile site customization enables users to configure web pages to display a customized mix of information whenever the user accesses the site. For example, a site may be configured to display the weather for his specific region and/or performance about his specific stocks. This reduces the number of inputs required from the user.

2.3.2 Discussion and Implications for US Mobile Internet Companies

In order to accelerate growth of the mobile Internet a critical element will be the creation of portals and search engines which not only screen and organize content but also add value by adjusting the content to devices' markup language and screen size. There are three different markup languages being used in Japan and there will probably be multiple markup languages used elsewhere in the world due to the gradual convergence of WAP and cHTML. In the short term this convergence will probably increase the number of markup languages used, since different content providers and phone manufacturers will move to the new versions of the markup languages at different speeds. Furthermore, Java programs are

handset specific and so content providers are forced to develop Java-based content for each type of handset.

This ability to access and optimize the display of content will be especially valuable for the weaker service providers. In Japan many content providers design their content to work best with I-mode first since I-mode has by far the largest number of subscribers. Content providers may or may not create versions of their content optimized to work with the handsets of KDDI and J-Phone. What happens is that I-mode attracts the biggest number of content providers because I-mode is the biggest service provider. And because I-mode attracts the most content providers it also attracts the most users which helps it to maintain its lead as the biggest service provider. This circularity is positive feedback in action. Smaller service providers such as KDDI and J-Phone could overcome their smaller size, at least partially, by creating mobile portals and search engines which enable users to access content created for their larger rivals. Yahoo! Japan is already providing such a service enabling its subscribers to view content from I-mode and J-Phone.

Content providers can expect the size and format of mobile screens to evolve over time. Although displays on Japanese mobile Internet phones are much larger than those found outside of Japan and became even larger in 2000 with the success of NEC's large screen phones, it is expected that even larger screen phones and more innovative input devices will become available in the future. For example PDAs are already available that can access the mobile Internet. Thus a mobile portal or search engine which self adjusts may be the best solution in order to achieve the optimal display of content.

Finally, service providers can lever their resources by avoiding a walled garden approach when developing their mobile portals and search engines. Since it has been shown that the creation of unofficial content grows much faster than even the most well resourced service provider can possibly keep up with US service providers can benefit from the packet charges that such extra traffic generate by designing portals and search engines which can accommodate this unofficial content.

2.4 Disruptive Technologies

In many cases the initial users of a new technology are the lead users of an old technology. However there is a special class of technologies that operates differently. These technologies improve some aspects of product performance while sacrificing others, thus making the new technologies appropriate for a new set of customers (Christensen 1997)[88]. For example, each new generation of new

computing technology has first been used by a set of new customers. Mini-computers, PCs and PDAs have each offered lower computing power at a much lower price. Because the new technology offered less power it was deemed unappealing to the incumbent customers and the companies that served them. This allowed new companies to develop the new technology while serving a new set of customers until its capability converged with and surpassed incumbent customers' expectations (see figure 2.7). History is littered with companies that realized only too late that the new technology had improved to the point where it had become a viable competitor. In his book, The Innovator's Dilemma, Clayton Christensen showed how computer hard disks and hydraulic excavators are examples of disruptive technologies that followed just such an evolutionary path. The PC Internet has also been a disruptive technology for some companies. New companies such as Dell, Ebay, Amazon.com, Travelocity and Charles Schwab have exploited the initially lower richness of the PC Internet to make inroads against established firms such as IBM, Sotheby's, Barnes & Noble, Carlson Wagonlit, and Merrill Lynch.

The mobile Internet is also proving to be a disruptive technology. The unique characteristics of the mobile Internet have made it initially appropriate for a new set of users, young people and a new way of accessing information – opt in mail. The mobile Internet has limited functionality (due to the small screen and keypad) but greater portability than the PC Internet. As mentioned earlier, the lower richness and greater reach of the mobile Internet is less appealing to older users who tend to have diverse interests, a relatively less mobile lifestyle and may have grown use to the richness/reach mix of the PC Internet. However, the lower richness and portability is especially appealing to young people because they are more mobile (higher reach) and less specialized (lower richness) than older people. Opt in email compensates for small screens and keyboards by having the user subscribe to email services covering the topics of interest rather than having to search for information using the small screen and keyboard.

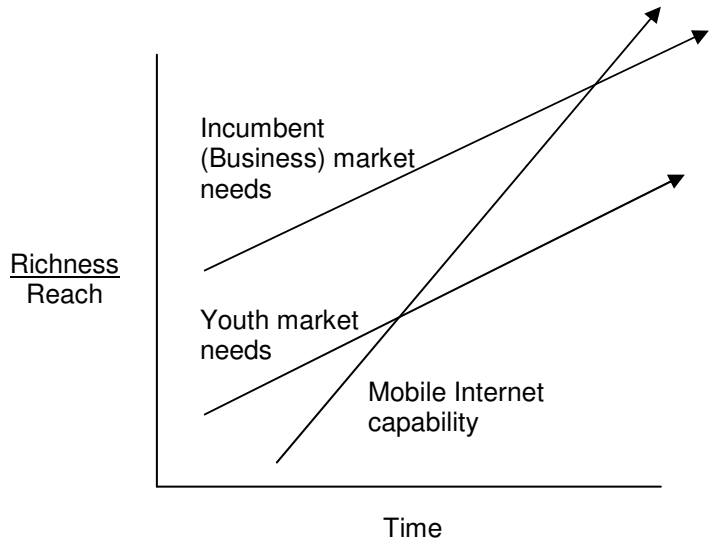

Figure 2.7 Disruptive technologies are not suitable for incumbent markets initially

The disruptive nature of the mobile Internet has meant that Japan's PC Internet content providers such as Yahoo! Japan, Nikkei Shimbun and Rakuten have not been successful in extending their leadership positions to the mobile Internet. Rather it is a whole new set of content providers such as Cybird, Index and Bandai that are leading the way. A similar situation has occurred with portals. The leading PC Internet portals have not succeeded in extending their leadership to the mobile Internet. Rather it is a whole new set of companies that have evolved to fill this role. One of the leading independent portal sites on the Japanese mobile Internet is called Girls Walker and is operated by Xavel.[89] Girls Walker did not start until April 2000, more than one year after the start of I-mode. Initially Xavel focused on mail magazines for women and used viral marketing to promote the creation of these mail magazines. Xavel now offers over 17,000 types of mail magazines that are written by 1,700 different writers. The most popular mail magazines are personal diaries. In 2001 Xavel made money by sending targeted mail to 3.4 million users, a figure that was estimated to reach 10 million users by the end of fiscal 2002. Xavel has also used its strength in mail magazines to create contents and shopping portals. It has 75,000 users registered on its contents portal and receives 8.4 million page views each day.[90]

Magic Island is another very successful independent portal which utilizes email and the concept of viral marketing. Magic Island enables users to create their own home pages and to link these to their email as a way of enhancing communications. As of mid 2001 its users had created 1.4 million home pages and the Magic Island site and its home pages were receiving 22 million page views per day. [91]

Some portals have achieved success by offering an innovation that compensates for the small screen and keyboard of the mobile Internet. Companies such as Softbank and Giga Flops are companies that employ versions of the simpler search routines mentioned earlier which assign four or six digit codes to sites for a small fee and provide a portal site where users can access individual sites by inputting the codes instead of the URLs which can be up to 30 digits long.

2.4.1 Discussion and Implications for US Mobile Internet Companies

Professor Jeffrey Funk contends that the America's misunderstandings about the mobile Internet reflect common mistakes concerning new technology. Firms often focus on complex technological solutions when they could obtain better results with a simpler approach. In the case of the fixed line Internet complex technologies and business models do play a key role. But the mobile Internet needs to evolve into these technologies and business models by first starting at a simpler level and building positive feedback, which will mirror market acceptance. Furthermore, firms often focus too much on existing users, even when the technology is more appropriate for new or different users. Often such firms also modularly modify their systems when an entirely new system, including new business models, is needed. Finally, many mobile service providers are trying to create closed systems when today's economy requires openness.[92]

Content Providers

The disruptive nature of the mobile Internet has resulted in three important implications for content providers. First, PC content providers that now wish to supply content to the mobile Internet must simplify their content for the smaller screens and keyboard of the mobile terminal. Second, mobile contents do not intrinsically have high reach. Therefore, content providers must offer services that make it easier for users to access contents. Two such services that make it easier for users to access contents are site customization and opt-in mail services. Both mail and site customization services enable users to avoid using the small screen and keyboard to search for specific information on the site. For the content provider, the advantage of customization services is that they don't have to send mail, which costs them and their users money. On the other hand, opt in mail makes the information more accessible to the user, since it makes it unnecessary for users to remember and actually access the site.

The third implication relates to the balance between reach and richness that content providers must strike as the mobile Internet evolves. Content providers must expand their contents in a way that is

interesting to the major users of the mobile Internet. This is because the potential reach of a device is defined in terms of the major users of that device. The concepts of reach and richness and the experience in Japan suggest that initially the major users of the mobile Internet will be young people. Thus, content providers must initially design their content and mail so that they appeal to young people. Later on, as the capability of device screens and user interfaces improves, it will be feasible to provide richer more complex, specialized content that appeals to a more diverse set of users including older users. Some content can be converted from the PC Internet but it must be specifically formatted for the mobile Internet owing to the smaller size of the mobile Internet screen size and keyboard.

Portals

US portals will also need to take a fresh approach if they wish to capture a portion of the mobile Internet market. Simply treating the mobile Internet the same as the PC Internet is unlikely to succeed as the limited success of some Japanese companies in doing so has shown. One such portal Oh! New? started in early 1999 about the same time as I-mode. It first focused on cataloguing sites and was receiving 500,000 page views a day by late 2000. Unfortunately, 18 months later the number of page views had only increased slightly. The problem appears to have been that Oh! New? took a PC Internet approach and focused on content instead of mail. Oh! New? did not screen contents until early 2001 and it did not provide rankings for the most visited sites. Essentially, the Oh! New? service was similar to what could be found on the PC Internet where the problems of small screen and keyboards do not exist. US portals will likely have more success if they start from scratch and treat the mobile Internet as an entirely new medium. Screening and ranking contents will help overcome the limitations of a small screen and keyboard. In Japan many of the largest users of the mobile Internet are not users of the PC Internet and so they see no benefit from an incremental approach which tries to make the interface between user and the mobile Internet similar to that between the user and the PC Internet. Companies such as Yahoo! Japan have discovered that such an approach is not very appealing to most users of the mobile Internet.

Section 3 - Case Study: NTT DoCoMo and Complexity Theory

It may not seem unusual to learn that 600,000 people regularly log on to the Internet to download their favorite cartoon characters or even that they pay $0.20 each time. Nor is it surprising to discover that Japan's largest ISP, NTT DoCoMo, is a division of the phone company. What is startling is that we are talking about Internet access via cellular phones with screens no larger than two square inches. Moreover, the service is markedly profitable, helping to make NTT DoCoMo Japan's third largest company, judged by stock market value, with $41 billion USD in revenues in 2001.[93]

Of the 81% of the world's mobile Internet users that reside in Japan 6 out of 10 are subscribers to DoCoMo's mobile phone service.[94] In effect DoCoMo has captured about 48% of the world's mobile Internet users making it the biggest mobile Internet service provider in the world.[95] The overwhelming success of DoCoMo's business model makes it an obvious choice when looking for mobile Internet companies to study.

Other reasons:

- As of February 2003, 86 percent of DoCoMo's 43 million mobile phone subscribers had signed up for at least one fee-based service via I-mode. This is in stark contrast to many wired ISPs which are lucky to get a few hundred or a few thousand subscribers to a fee-based service.[96]
- Subscribers to DoCoMo's I-mode mobile Internet service use their phones for voice communications about 20% more than do mobile users without data access.
- In June 2000 I-mode's users sent 7 emails per day and accessed the web 12 times per day. As a comparison, Deutsche Telecom launched a WAP based service about the same time as DoCoMo launched I-mode. However, Deutsche Telecom had only 175,000 subscribers and they accessed the Web only once every 5 days on average.[97]

3.1 Factors Contributing to I-mode's Success

Director of I-mode Strategy, Takeshi Natsuno, claims that the vision for I-Mode was based upon Bill Gates' concept for a "wallet PC", a computer that could fit in your hand, but with a twist. While Gates' idea was to make existing computers more compact, Natsuno's idea was to take a simpler device (a mobile phone) that was already connected to a network and to add computing functions to it.[98] The logic was that shrinking a computer would require choosing which features to exclude, an approach that would be counterproductive to stimulating technological progress. Psychologically, removing features would

seem like retreating while adding features would feel more like advancing. Another factor considered was that unit sales potential for mobile phones was much higher than for personal computers. This is true for most industrialized countries except the United States (see figure 3.1) Natsuno believes that technology tends to converge on products that sell in large quantities. As an example, the shift to color screens happened faster with mobile phones than with personal computers, simply because the potential sales volume was higher. In other words, a large population makes it easier for a positive feedback loop to get started. [99] The greater number of mobile phones than PCs was compelling for handset manufactures as well as other potential stakeholders such as content providers and application service providers. The relative ubiquity of mobile phones vs. PCs in Japan also meant that a mobile Internet device that looked like a mobile phone was more likely to meet with consumer acceptance. Natsuno reasoned that many people who can't use a computer do use mobile phones but the reverse is not true.

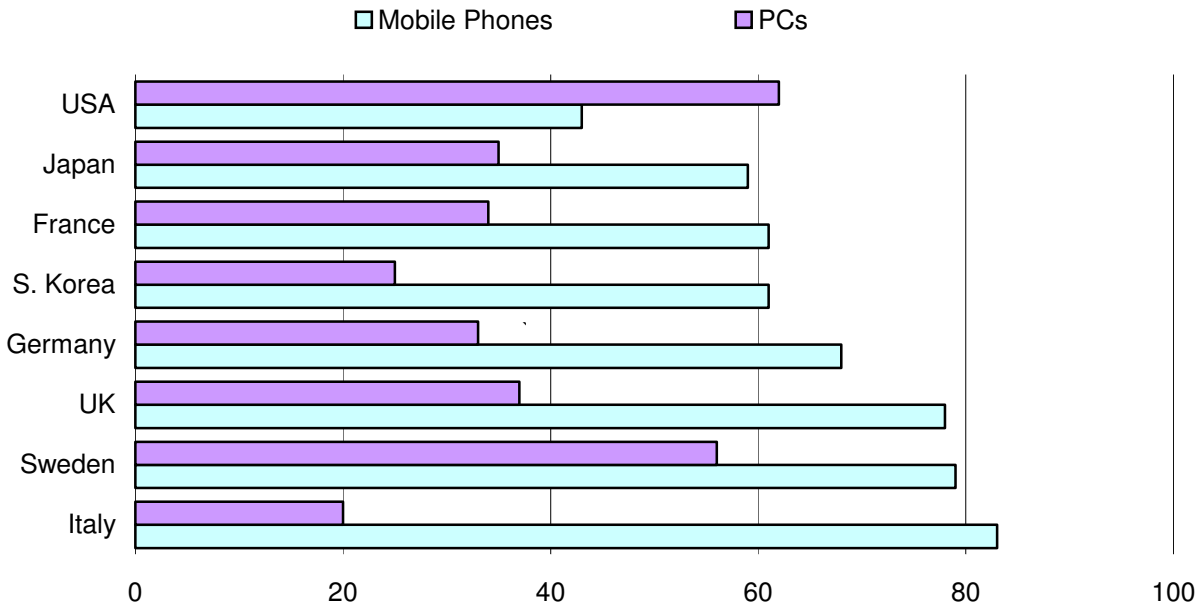

Figure 3.1 Mobile phones and PCs per 100 inhabitants [100]

Natsuno claims that most strategic decisions regarding the design of I-mode were based on what is known as complex systems theory. Bruce Abell, Managing Director for the Santa Fe Center for Emergent Strategies defines a complex adaptive system (a business) as being composed of interacting agents (employees, managers, board members, customers, suppliers, competitors and regulators) following rules (blueprints, values, ethics, laws, economics, organizational/political, friendship, profit

maximizing), exchanging influence (goods, ideas, money, trust) with their global environments (from the cubicle to the global market) and altering the very environment they are responding to by virtue of their "simple" actions.[101]

In a complex systems theory model, all phenomena are comprised of many constituent elements of many different types, all interacting with each other. Those constituent elements can, in response to a stimulus, exhibit self-organizing activity as a collective whole, despite no conscious awareness on the part of the elements. Self-organization means that the system comes to possess a certain order. The stimulus for self-organizing activity can come either from the elements that make up the system or from the outside.[102] The organization can evolve in either time or space, maintain a stable form or show transient phenomena. General resource flows within self-organized systems are expected (dissipation), although not critical to the concept itself.[103]

The example that Natsuno used to explain self-organizing activity was a flock of geese in flight. At first, when taking off, the geese fly in no particular order, but gradually they organize themselves into the familiar V arrangement. While the formation is clearly organized, the individual geese flying in it have no conception of the formation as a whole. There is no central authority controlling the organization of the flock. In fact each goose is thinking not of the flock but its relationship to the neighboring geese and to the earth's surface.[104]

Furthermore, using a computer simulation researchers found that it was possible to create a virtual flock of geese that behaved very much like real geese by inputting only three simple commands for each goose: "fly this direction", "maintain this angle and separation with respect to your neighbors in flight", and "maintain this height above the earth's surface". Conventional thinking could not explain how to maintain leadership over the flock as a whole without programming the flock as a whole. But with complex systems theory, it is possible to account for the flock's behaving in a coherent, purposeful fashion despite only inputting information for individual members.

Given two or more technologies to choose from complex systems theory can also be used to predict which technology is likely to dominate in the market. We include not just technology itself but also the peripheral elements – the service as a whole – in explaining the outcome. In effect, complex systems theory helps us take a marketing perspective rather than a technology perspective. Consumers when comparing services using different formats usually do not compare the separate technologies but rather

look at the service as a whole and evaluate that. Users gravitate to the best overall value proposition. The more users that are attracted to a particular platform the more motivation that designers will have to create more applications for that platform. The more applications that are created for a particular platform the more compelling the value proposition becomes and the more users it is likely to attract. It is a virtuous cycle that eventually produces an overwhelming victory for one side in the competition. Those overwhelming victories are the result of what is called, in complexity theory, increasing returns.[105] Well known examples of this phenomenon include VHS vs. Beta video tape formats and Microsoft vs. Apple computer operating systems. The virtuous cycle is the same concept that Professor Funk referred to when he described the positive feedback that the mobile Internet industry created between its users, business models, content, marketing, portal/search engines and services (see figure 3.2).

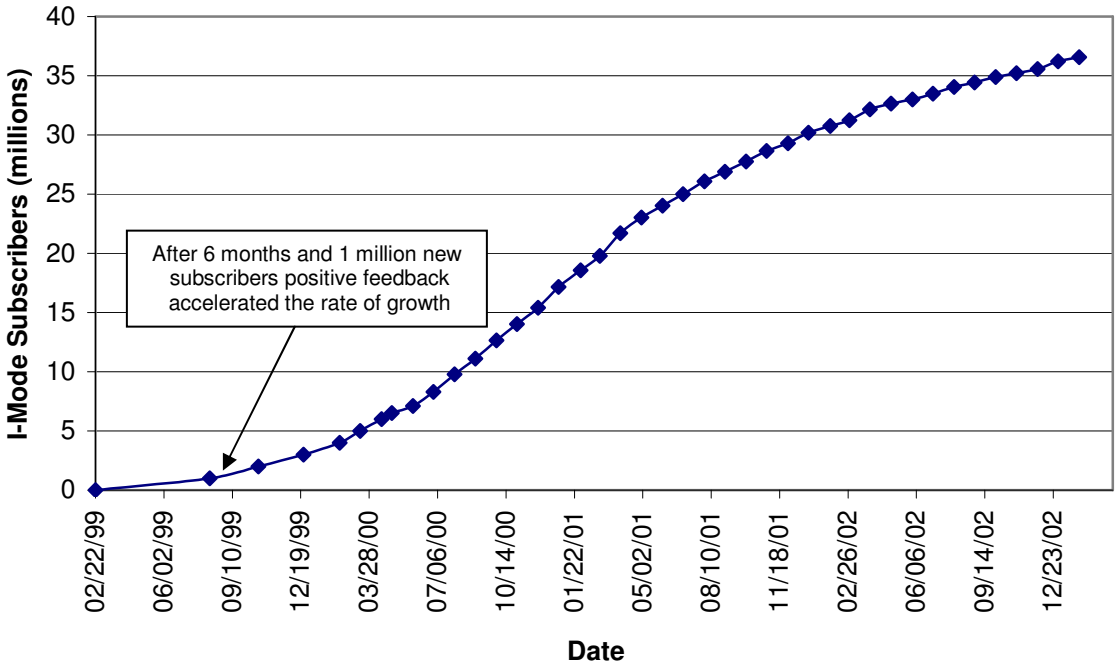

Figure 3.2 NTT DoCoMo I-mode subscribers [106]

In order to create this virtuous cycle it is necessary to create a business model that makes it simple for as many companies and their technologies, as possible to voluntarily participate in the service. DoCoMo's role has been to create the conditions, which motivate the various players to participate. The most important action to get the virtuous cycle started was DoCoMo's decision to ensure that there was an extensive, attractive line up of content available for the start of I-mode service.

3.2 Why cHTML and Not WAP?

A critical factor in convincing many companies to participate in I-mode was minimizing the risk and cost of participating by deciding to employ cHTML (compact hypertext markup language) instead of the more efficient WML (wireless markup language) used by WAP** (wireless access protocol). cHTML is a sub set of HTML code typically used to format how text appears on most Web sites. Because of its similarities to HTML, cHTML makes it easier for developers to write applications without having to learn an entirely new computer language.[107] Content providers for the PC Internet can also convert their HTML content into an I-mode compatible format with only minor revisions. Using cHTML also minimized changes needed in scripts and other code used by the Web server and the main host. In effect, using cHTML dramatically lowered the barriers to participate and helped accelerate positive feedback between the various elements of the mobile Internet. This was a key consideration because there was already plenty of HTML content available. This key technology decision enabled DoCoMo to gather together 67 leading corporations, including 21 banks, as official content providers before I-mode service even started. Choosing to go with cHTML also made it easier for people to create unofficial content. The result is that DoCoMo's I-mode service has become a mass-market success and it is considered by many to have out-staged WAP.

"Accessing the Internet via current WAP phones proved a disappointment for many, due to slow connections and limited content."[108] The fact that I-mode is neither high speed nor provides true Internet access does not matter to the market. It is perceived to be high speed because it is packet based and so there is no waiting for a connection as with WAP. In a survey conducted by the UMTS Forum most respondents agreed or strongly agreed that WAP represents only an intermediate solution and that longer-term mobile users will demand full HTML Web browsing capability.[109]

In Europe the release of new WAP enabled phones in early 2000 was met with under-whelming consumer response. Slow connection speeds and dull services resulted in a mere 2 million frequent users not the 10 million originally expected.[110] A test of M-commerce based on WAP technology published by

***WAP is the worldwide industry-established standard for delivery of information to digital wireless devices (cell phones, pagers and PDAs). WAP uses Wireless Markup Language (WML), a technology that reduces the size of the format to a unit suitable for the small screens and the low speeds of cellular phones. WML is read by a micro-browser built into the cell phone's handset. Wireless devices typically have screens capable of displaying fewer than 30 words at a time, and operate at speeds of 14.4 Kbps to 19.6 Kbps. WAP relies on protocols that send data faster and more efficiently over wireless networks than traditional Web languages of HTML, HTTP, TLS and TCP.*

Business 2.0 in March 2001illustrates one of the reasons for the slow take up of WAP. An attempt to order a book via My Yahoo!'s M-commerce platform involved numerous dropped connections, unclear information on status of the order and required repeated re-keying of entries. Keying in information via the limited keyboard of a cellular phone was particularly slow going. The combined time spent on the entire process before receiving a successful executed order was more than one hour.[111] So while WAP may be a superior technology compared to cHTML in some ways, had DoCoMo chosen to employ WAP it would have required content providers to do more work and would have resulted in a less appealing user experience.

3.3 Selecting Other Technologies

In addition to the markup language there are several other component technologies for displaying content on I-mode. In each case, DoCoMo followed the same logic as when they chose cHTML. Their priority was to make the barrier for content providers as low as possible. For the graphic data format DoCoMo chose the Graphical Interchange Format (GIF) because it was the most commonly used format on the Internet. Competitor J-Phone chose the PNG format, which offers superior file compression but is less common. For the ring tone download function DoCoMo chose the compact MIDI format because there was already a huge library of music data available in MIDI format. Again the overriding criteria was what would help accelerate positive feedback not what would be the superior technology. When DoCoMo had to choose between several different technologies it usually went with the de facto standard in order to minimize the barriers to entry for partners such as applications developers or content providers.

When it came to technical decisions other than those related to content, DoCoMo again gave the greatest weight to the impact their decisions would have on other components of the complex system they were constructing, just as they did in choosing cHTML. Those technical elements can broadly be divided into technologies for mobile phones and those for the network system.

In developing I-mode capable phones DoCoMo's assumption was that most people are quite conservative. This assumption was based upon mobile phone sales trends. It was clear that most Japanese consumers would reject new phones if the emphasis was on high performance and multiple functionalities.[112] Therefore, the decision was made to begin by creating I-mode phones, which looked and operated similar to regular mobile phones. This topic of product development is discussed in greater depth in the section on knowledge creation.

The other technical issue concerned the network system which consists of the wireless network connecting subscribers and base stations, the gateway servers connecting to the Internet and the application servers operated by DoCoMo's application service providers. The network system had to be built in a way that balanced the characteristics of wireless transmission – slow speeds and high rates of transmission errors – while providing a system that content providers would be able to work with easily. DoCoMo designed its system so that content providers would have to make no changes to their Web servers whatsoever.[113] They are able to use the same Web servers that they use to serve content to the PC Internet to also serve content to I-mode. Again the overriding consideration was how to lower barriers to participation and so facilitate the positive feedback necessary to accelerate growth of the mobile Internet.

Other aspects of DoCoMo's business model which have contributed to the company's success:

- Access is via a packet switched network meaning that the phones are always connected to the network so long as the battery is charged. Users are only billed for the packets received not the time connected. That means people can take their time viewing content and writing messages. Better still, there is no need to wait for a computer to start up. Access for most handsets is at a relatively slow 9.6 Kbps (kilobits per second) though some 2.5G handsets released in May 2002 are capable of 28.8 Kbps. Either way this technology seems sufficient to handle the array of applications available on I-mode.
- DoCoMo has complete control over which devices I-mode subscribers can use, even to the point of mandating the number of pixels on a handset screen. This means that developers design applications for only one form factor, rather than the multitude available for WAP. On the other hand, WAP developers must support the lowest common denominator for many devices.[114]
- I-mode was never marketed as the Internet. This meant that users were less likely to make comparisons between the fast access and rich multimedia that is offered by PC Internet access vs. the relatively slow and more sparse offering of I-mode. Therefore, it was less likely that I-mode users would feel disappointed by the experience.

By being the first to start building positive feedback between the various elements of the mobile Internet DoCoMo appears to have created an insurmountable lead over its competitors, J-Phone and KDDI. DoCoMo continues to widen the gap between itself and its competitors by investing heavily in new ideas

for the mobile Internet (see figure 3.3). In 2000 DoCoMo invested more than $927 million USD in R&D and had over 1,000 R&D personnel.[115]

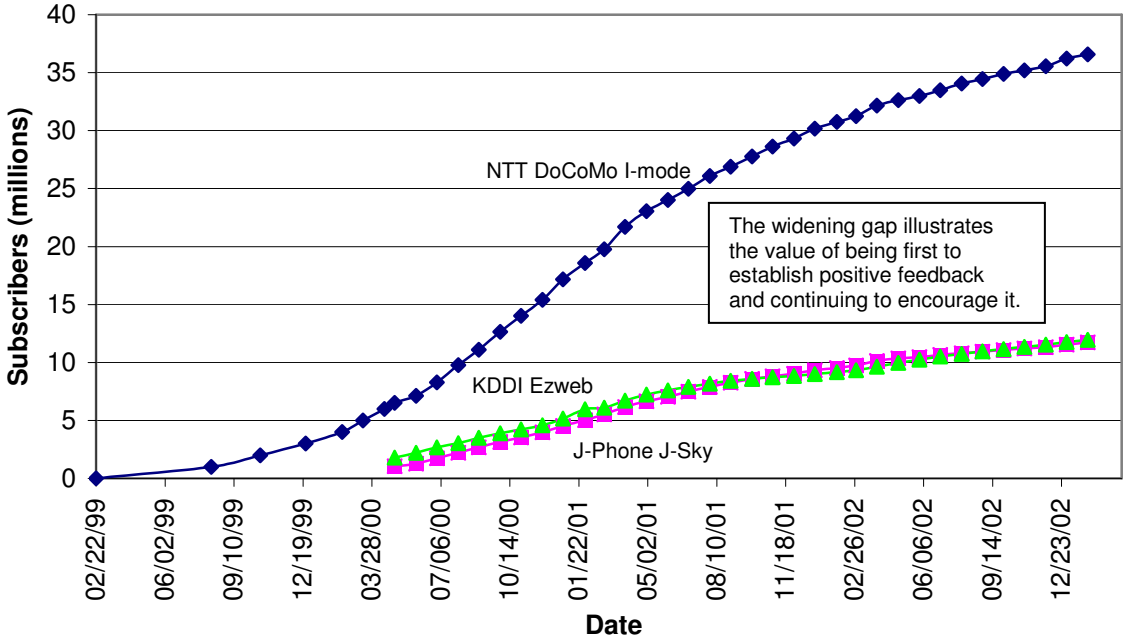

Figure 3.3 Mobile Internet subscribers in Japan [116]

NTT DoCoMo incorporated complexity theory into not just its technology platform but also into its service design and business model. DoCoMo's goal was to build the ideal environment in which self-organization and emergence could take place. In terms of complexity theory emergence has been defined as the appearance of a property or feature not previously observed as a functional characteristic of the system. Generally, higher level properties are regarded as emergent. For example, an automobile is an emergent property of its interconnected parts. That property disappears if the parts are disassembled and just placed in a heap.[117] With I-mode the hoped for emergent quality was, of course, an extremely robust and profitable mobile Internet ecosystem characterized by rapid growth. In this regard the most important task was to decide on the division of labor between DoCoMo, which provides the platform, and the content and applications providers, which develop the services to run on it.[118]

Had DoCoMo been using "telecom thinking" it would likely have chosen to exercise its influence to the maximum degree possible providing not only the platform but also everything else including the content. This might have meant developing content entirely on its own, purchasing content from others or

paying content providers a subsidy. These are approaches used by mobile communications providers in Europe and the United States. Such approaches would have been in conflict with a complex systems model. Content providers would have been less enthusiastic about developing content that meets the needs of end customers. Instead content providers would have either focused on meeting the platform provider's preferences or else they would have seen themselves in competition with the platform provider. Ultimately, DoCoMo decided to limit its role to merely ensuring that official I-mode content conformed to a uniform level of high quality.

3.4 Technology Alliances

In creating I-mode DoCoMo has endeavored to develop business relationships which benefit all stakeholders, an approach that Natsuno describes as "internet thinking". This approach extends to its technology alliances which promote the development of mobile phones and mobile phone services, portal alliances that promote the development of portals operated by DoCoMo, and platform alliances that expand the range of times, places and occasions in which mobile phones are used. Platform alliances increase the convenience and utility of I-mode horizontally by providing links with other platforms while technology and portal alliances evolve vertically (see figure 3.4).

DoCoMo's first technology alliances were with handset manufacturers. Adding new features to phones stimulates new and replacement demand for phones. When a telecommunication provider's introduction of new services is timed to coincide with the manufacturer's launch of new types of phones required to use these new services, it stimulates demand from subscribers. The provider's revenues usually also increase since adding new applications increases traffic.[119] Mobile phone evolution has been a process of adding new features a few at a time. There were two reasons for this approach. First, manufacturers were unable to make many additions while keeping weight, size and price point within acceptable limits. Second, as mentioned earlier, DoCoMo believed that subscribers would be reluctant to accept radical changes to the appearance or functionality of their mobile phones.

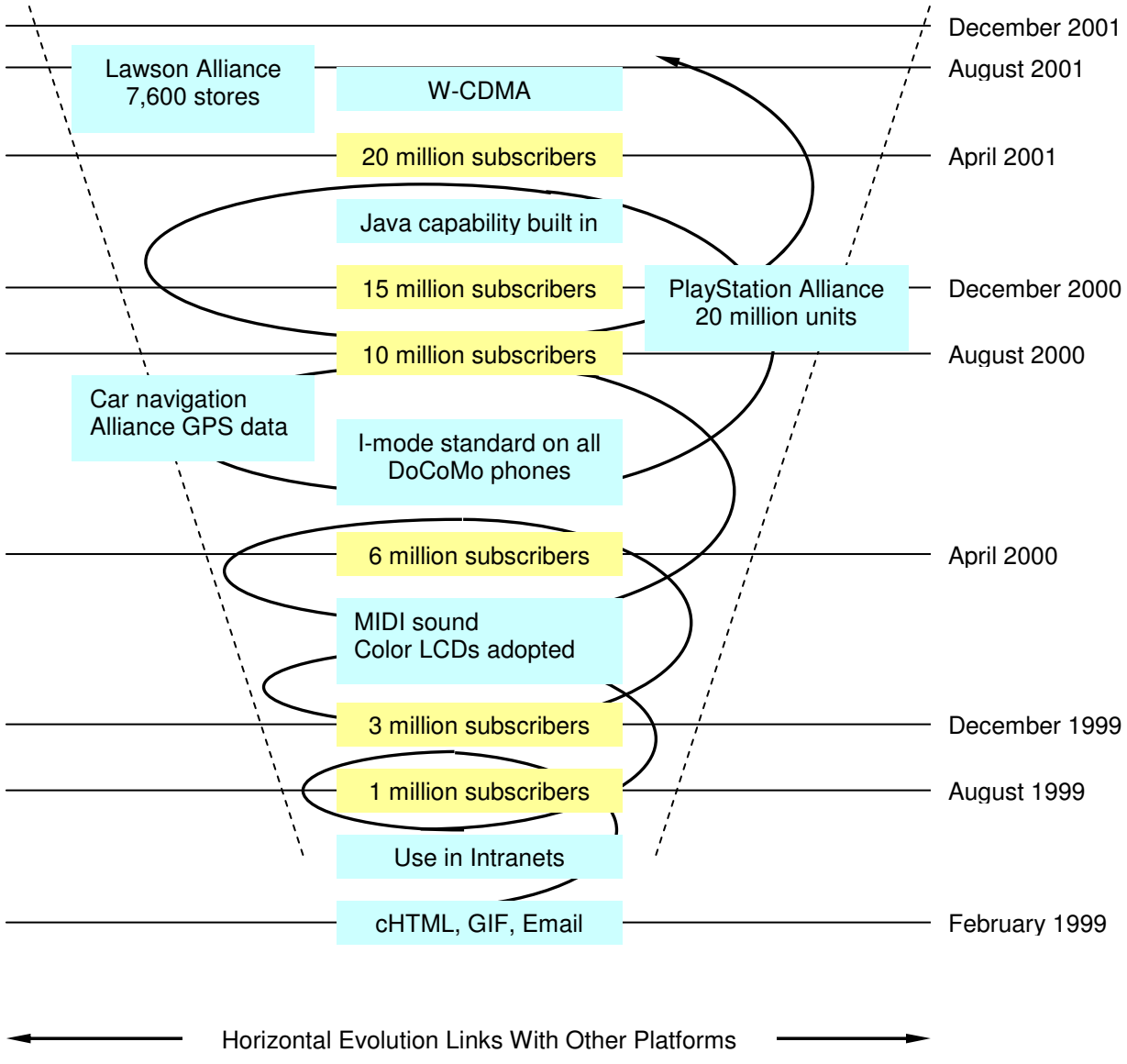

Figure 3.4 Evolution of I-mode alliances [120]

The following is a brief summary of the basic evolution of DoCoMo's mobile phones. Until I-mode, personalizing handsets was limited to external accessories such as hand straps or stickers. From the beginning I-mode handsets were designed to permit users to customize the phone's software as well. When introduced in February 1999, the 501i series mobile phone added packet data transmission and an HTML browser to the conventional features of mobile phones, making it possible to browse the Web and to send and receive email. The 501i series also introduced the ability for users to adjust the display to

show the information best suited to user's needs. Subscribers could even choose what wallpaper design to display on the screen while in call-waiting mode.

The 502i series, introduced in December of 1999, added MIDI sound processing features and support for downloading ring tone melodies. This innovation not only created a huge market for downloadable ring tones but also drove a sharp increase in sales of I-mode phones. Color displays were also introduced with the 502i series. By the second half of 2000 a wealth of color content had appeared and from that point on virtually all new handsets were equipped with color displays.

The 503i series, launched in December of 2000, were equipped to handle the Java programming language, which allowed phones to handle many new applications. Java improves the data security for online transactions, allows users to download video games and interactive content and is expected to spur location-based capabilities such as chirping when the user nears a store that is holding a sale so long as the user has opted in for this application.[121]

DoCoMo launched its FOMA (freedom of mobile multimedia access) handset series in May 2001 as part of the world's first true 3G mobile phone service. The FOMA series increased the data transmission speed to 384 Kbps and added video streaming capability. Later models added a built in camera and the ability to view and email video clips as well as the ability to accept memory cards for storing high resolution video.

The 504i series, introduced in May 2002, increased the packet transmission capacity from 9.6 Kbps to 28.8 Kbps. It also increased the Java archive capability from 10 Kb to 100 Kb and added 3D video display capability enabling users to access a much broader and more exciting range of content and applications. Built in cameras were added to some versions and an IrDA (infrared communications) port was also added to facilitate data exchange between handsets, point of sale and multimedia devices.

DoCoMo and its handset providers are dependent on each other. In order to encourage the development of phones which subscribers will want to buy DoCoMo has chosen to share some of the manufacturers' risk. DoCoMo works with several mobile phone manufacturers, determining the specifications and carrying the inventory risk. For a new design DoCoMo places orders in small lots. Typically, the lots are just large enough to enable the manufacturer to break even. This approach frees manufacturers from the inventory risk on the initial lots of new phones. If the initial lot of a new design

does not sell out DoCoMo does not reorder. Therefore, manufacturers have a strong incentive to create designs which subscribers will want to buy.[122]

3.5 New and Future Developments

DoCoMo launched the world's first true 3G wireless communication system on a limited basis in May 2001 and then on full commercial status in October 2001. The system enables wireless transmission of ISDN quality data including music, full-motion video and voice from one mobile terminal. As an example, camera equipped videophones let users send live video to friends overseas in real time.[123] Initially, corporate users were expected to be the only ones interested in 3G services, which are priced beyond the reach of most individuals. Take up of DoCoMo's 3G service has been much slower than expected reaching only 154,000 subscribers by February 2003, 17 months after starting. Meanwhile competitor KDDI racked up a whopping 5.3 million subscribers for its 3G service by February 2003 only 11 months after start up (see figure 3.5).

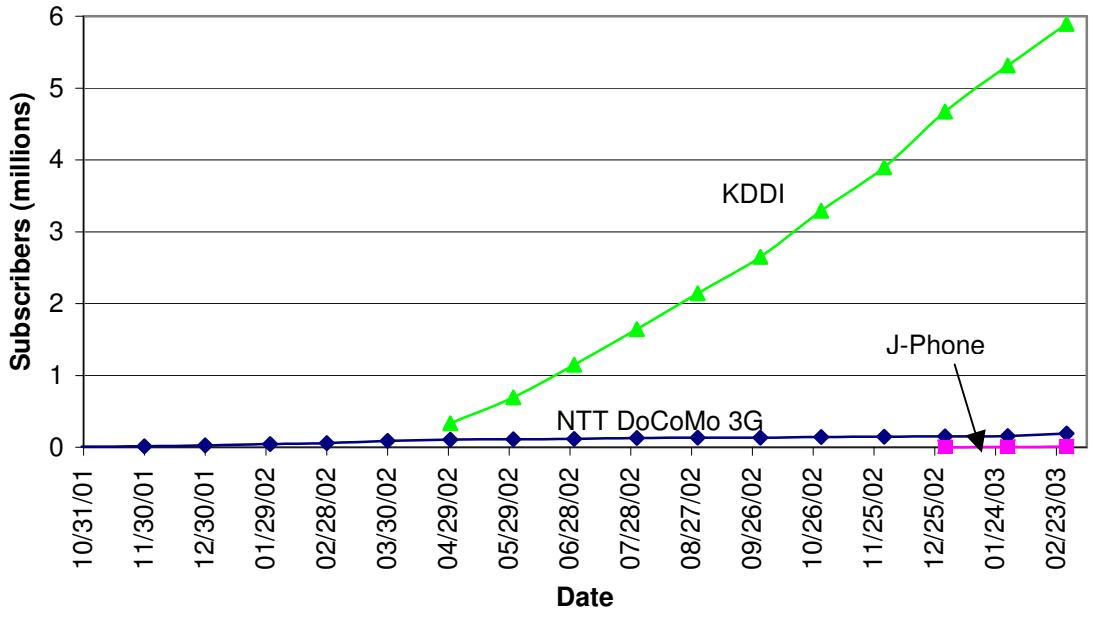

Figure 3.5 3G Mobile phone subscribers in Japan[124]

The failure of DoCoMo's 3G service to grow as expected or even to keep up with its rival has been attributed to a limited service area, short battery life, higher prices and fewer models of FOMA

handsets compared with PDC handsets.[125] The slow take up rate casts doubt on DoCoMo's ability to successfully roll out the many services and applications proposed for its 3G network (see figure 3.6).

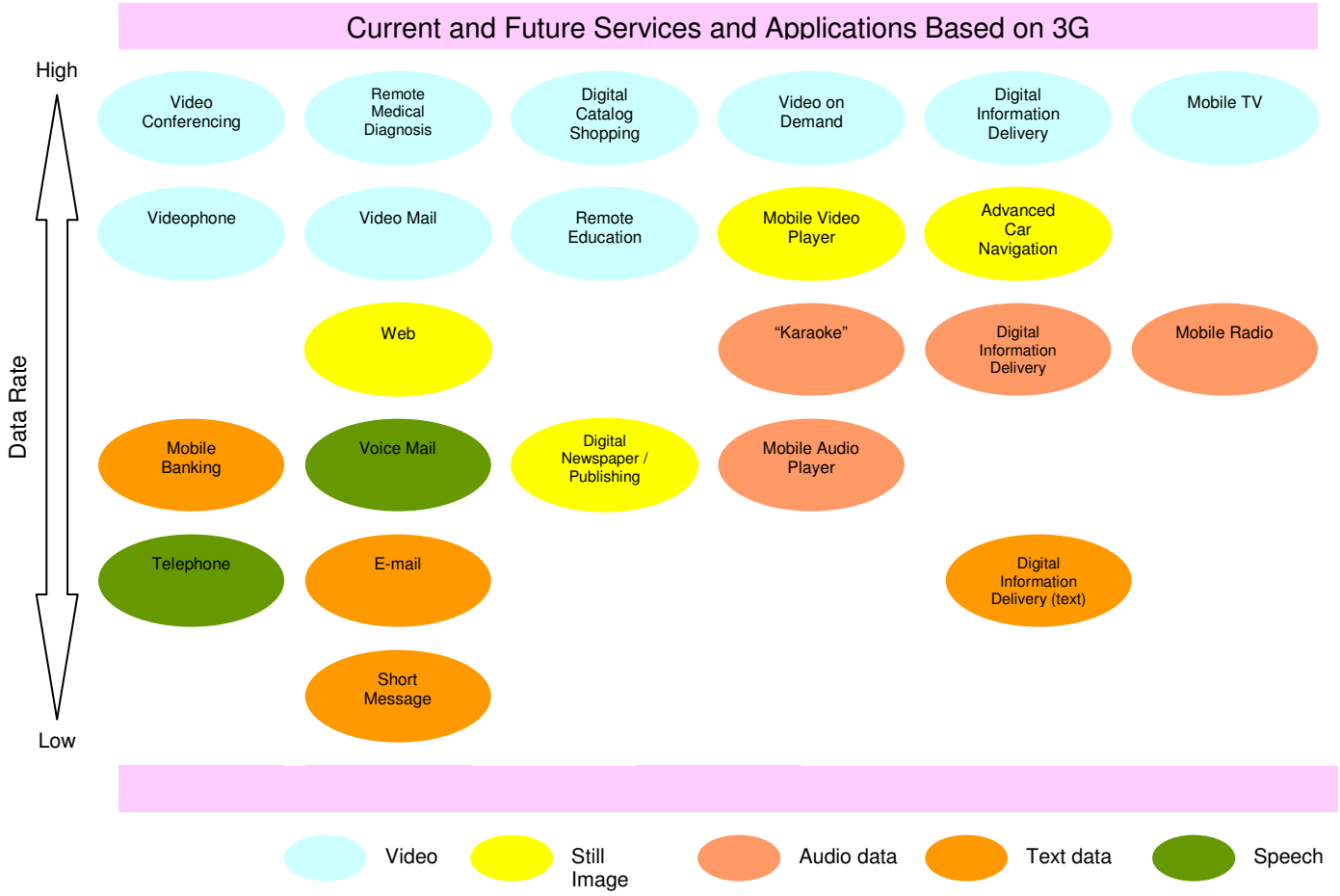

Figure 3.6 NTT DoCoMo's current and future services and applications based upon 3G technology [126]

Finally, DoCoMo decided to allow rival MISPs and telecommunications providers to use its I-mode Internet communications network beginning March 2003. DoCoMo will open access for other MISPs and new common carriers to its technical specifications such as protocol exchanges used for the I-mode network. Access to the specifications will enable rival firms to link their Internet networks directly to I-mode exchanges. To cope with the possible overflow in network capacity, DoCoMo plans to spend up to $410 million USD to fortify its system.[127]

3.6 Discussion and Implications for US Mobile Internet Companies

Clearly, DoCoMo had several factors working in its favor when it launched its mobile Internet service which US carriers have to a lesser extent or not at all. Some of these factors include:

- Japan is a highly regulated market and DoCoMo serves a dense population that is heavily dependent on public transportation and so people spend significant time waiting for transportation or commuting. This idle time is well suited to activities such as browsing a mobile Internet device.
- Japan's relatively low PC penetration rates and high phone access charges impede the spread of the PC Internet. Thus many people have little or no experience with the PC Internet against which to benchmark their mobile Internet experience against.
- NTT DoCoMo and its parent corporation have plenty of funds to invest and a long term perspective on achieving a return on their investment.

These factors suggest that the growth potential for the mobile Internet in the US is weaker than in Japan. However, this does not eliminate the mobile Internet as a viable industry in the United States. When one includes person to machine and machine to machine communications, which DoCoMo is currently exploring, the potential market for mobile Internet applications in the United States is still huge. That being the case what lessons from DoCoMo can help US companies make the best of this opportunity?

1. US MISPs should favor the de facto standard when choosing which technologies to use in order to make it as easy as possible for the various members of the mobile Internet value chain to participate. This must be done in a way that is equitable and permits all members to share in the profits if the business model is to be sustainable and to help accelerate growth. A change in operating methods may be required in order to liberate managers from a "telecom mentality" in which the carrier performs most of the value chain functions.

2. US carriers can leverage their investments by working with handset manufacturers to manage the pace of handset technology evolution so as to not overwhelm users with a multitude of features but rather phase in the features gradually. US carriers could also encourage industry excitement while minimizing churn among subscribers by working with manufacturers to share inventory risk and develop new products, perhaps in exchange for access to exclusive product designs.

3. DoCoMo's failure to achieve comparable success with its 3G offering despite being the mobile Internet leader should chasten carriers who might be inclined to cut corners on new product launches.

When launching a new mobile Internet service a carrier's best chance for success in creating positive feedback happens with the initial launch. If the carrier stumbles at the beginning, whether due to technical failures or failure to ensure that all elements of the value chain have strong incentives to participate, chances are that the carrier will have created a negative perception in the mind of potential subscribers which will only serve as another obstacle that the carrier will have to overcome. As the success of DoCoMo's competitor KDDI has shown with its highly successful 3G service, subscribers care little about whether you are the market leader. What is more important is the overall value proposition. Each interaction with a user is a chance to build equity in the customer relationship but that equity can evaporate quickly if the customer perceives that a better value proposition exists elsewhere. Therefore, when a change of handsets is likely, such as when a new service or feature becomes available, carriers should be careful not to overestimate the strength of their relationship with subscribers.

4. With regard to the mobile Internet US carriers should revise their role to one of providing a few key gateway services and they should strive to create an environment in which emergence and self-organization can take place between telecom providers, service providers, manufacturers and users. If a carrier is going to encourage the growth of a healthy, thriving mobile Internet ecosystem the various players must have a fair chance to earn a profit and must be assured that the carrier is not going to turn around at some point and become a competitor.

5. US MISPs should take a marketing approach which emphasizes the benefits that subscribers will receive not the technology involved. Gaining an initial understanding of and continuously identifying customer's needs is imperative. US MISPs should carefully gauge subscriber's willingness to adopt new technology and let subscriber's needs drive the speed of technology introduction. Otherwise, the MISPs may discover that they have invested in technology that subscribers are unwilling to pay for or that some potential subscribers choose not to become users because they are intimidated by the technology.

Section 4 – Knowledge Creation

This section uses a framework created by Professors Ikujiro Nonaka and Hirotaka Takeuchi in order to illustrate how knowledge creation supports technology innovation in Japan's wireless industry. Nonaka and Takeuchi (N&T) contend that one of the main reasons that Japanese companies have been successful is because of their expertise at "organizational knowledge creation", the capability of a company to create new knowledge, disseminate it throughout the organization and embody it in its products, services and systems on a continuous basis. Knowledge creation is, in effect, a precursor to technology innovation. N&T demonstrated that continuous innovation has been characteristic of Japanese companies in the automobile, motorcycle, consumer electronics, sewing machine and air conditioning equipment industries. What is unique about the ways that Japanese companies bring about continuous innovation is the linkage between the inside and the outside of the company. Knowledge that is accumulated from the outside is shared widely within the organization, stored as part of the company's knowledge base and utilized by those engaged in developing new technologies. The key to understanding why Japanese companies have been successful is the conversion process that takes place from outside to inside and back outside again in the form of new products, services and systems. It is the dual internal and external activity that fuels continuous innovation, which in turn leads to competitive advantage.

Japanese companies tend to view knowledge as being primarily tacit, something not easily visible or expressible. Tacit knowledge is highly personal and hard to formalize making it difficult to communicate or share with others. Subjective insights, intuitions, images, symbols and hunches fall into this category of knowledge. Tacit knowledge is also deeply rooted in an individual's action and experience, as well as in the ideals, values and emotions he or she embraces. In contrast, the Western tradition tends to focus on explicit knowledge, which is knowledge that can be easily "processed" by a computer, transmitted electronically, or stored in databases. The subjective and intuitive nature of tacit knowledge makes it difficult to process or transmit the acquired knowledge in any systematic or logical manner. For tacit knowledge to be communicated and shared within the organization it has to be converted into words or numbers that anyone can understand. It is during the process of conversion that organizational knowledge is created.

N&T contend that the creation of knowledge is as much about ideals as it is about ideas. The essence of innovation is to re-create the world in a particular vision. Creating knowledge is not simply a matter of learning from others or acquiring knowledge from the outside. Companies in Japan believe that new and proprietary knowledge cannot be created without intensive outside-inside interaction. To create knowledge, the learning that takes place from others and the skills shared with others need to be internalized, reformed, enriched and translated to fit the company's self image and identity.

Knowledge creation in Japanese companies usually includes three key characteristics: 1. A heavy reliance on figurative language, symbolism, metaphor and analogy. 2. Disseminating knowledge requires that an individual's personal knowledge is shared with others. 3. New knowledge is born in the midst of ambiguity and redundancy. Redundancy is important because it encourages frequent dialogue and communication. The organizational logic of redundancy helps explain why Japanese companies manage product development as an overlapping process in which different functional divisions work together in a shared division of labour versus the Western tendency to follow a sequential process. Furthermore, Japanese product development teams are usually divided into competing subgroups that develop different approaches to the same project and then argue over the advantages and disadvantages of their proposals. This redundancy encourages the team to look at a project from a variety of perspectives. Front-line employees, middle managers and senior managers all play a part in the knowledge creation process.

Differences in Japanese and Western knowledge creation practices can be traced to differences in intellectual tradition and epistemology (theory of knowledge). Western epistemology tends to accord the highest values to abstract theories and hypotheses. This tendency can be seen in the long tradition of valuing precise, conceptual and systematic sciences, which can be traced back to Descartes. In contrast, Japanese epistemology tends to value the embodiment of direct, personal experience. The emphasis of "on the spot" personal experience in Japanese management is a real manifestation of such an epistemological tendency.

Furthermore, Western tradition emphasizes a separation between subject and object, the knower and the known, humanity and nature, the student and that being studied. In contrast, Japanese tradition emphasizes the oneness of self and the other. (Interestingly, Sherman and Shultz in Open Boundaries, their book on complexity theory and business innovation, also emphasized a related idea. They noted that

the observer and the observed are not independent of each other and that this way of thinking disregards where innovative ideas come from.) [128] This tendency is evident in the Japanese language in which the message is often communicated through the use of context. The ambiguous nature of the Japanese language asks one to be equipped with some tacit knowledge of each context .

N&T's model is divided into ontological and epistemological dimensions (see figure 4.1). The ontological dimension is necessary because in a strict sense knowledge is only created by individuals. An organization cannot create knowledge without individuals. The organization provides contexts for individuals to create knowledge. Organizational knowledge creation, therefore, can be understood as a process that "organizationally" amplifies the knowledge created by individuals and crystallizes it as part of the knowledge network of the organization. This process takes place within an expanding community of interaction, which crosses intra and inter-organizational levels and boundaries. The epistemological dimension divides knowledge into tacit and explicit.

N&T's view of the organization is one in which the organization recreates itself by destroying the existing knowledge system and then innovating new ways of thinking and doing things. (This appears to be consistent with Professor Clayton Christensen's theory on disruptive technology in which incumbent firms are occasionally blindsided by new technology because of their strong adherence to an incremental approach and reluctance to destroy the existing knowledge system). N&T's theory can be described as an expanding spiral in which the interaction between tacit and explicit knowledge is elevated dynamically from a lower epistemological level to higher levels while a second knowledge spiral moves across the ontological dimension. The core of N&T's theory lies in describing how such spirals emerge.

There are four modes of knowledge conversion that are created when tacit and explicit knowledge interact with each other. The four modes – socialization, externalization, combination, and internalization – constitute the engine of the entire knowledge creation process. These modes are what the individual experiences. They are also the mechanisms by which individual knowledge gets articulated and amplified into and throughout the organization. There are also five conditions, which enable or promote N&T's spiral model of organizational knowledge creation: intention, autonomy, fluctuation and chaos, redundancy and requisite variety. Furthermore, the knowledge creation process can be broken into five distinct phases: sharing tacit knowledge, creating concepts, justifying concepts, building an

archetype and cross leveling of knowledge. Some of these phases correspond closely with the modes of knowledge creation. Each element will be examined briefly.

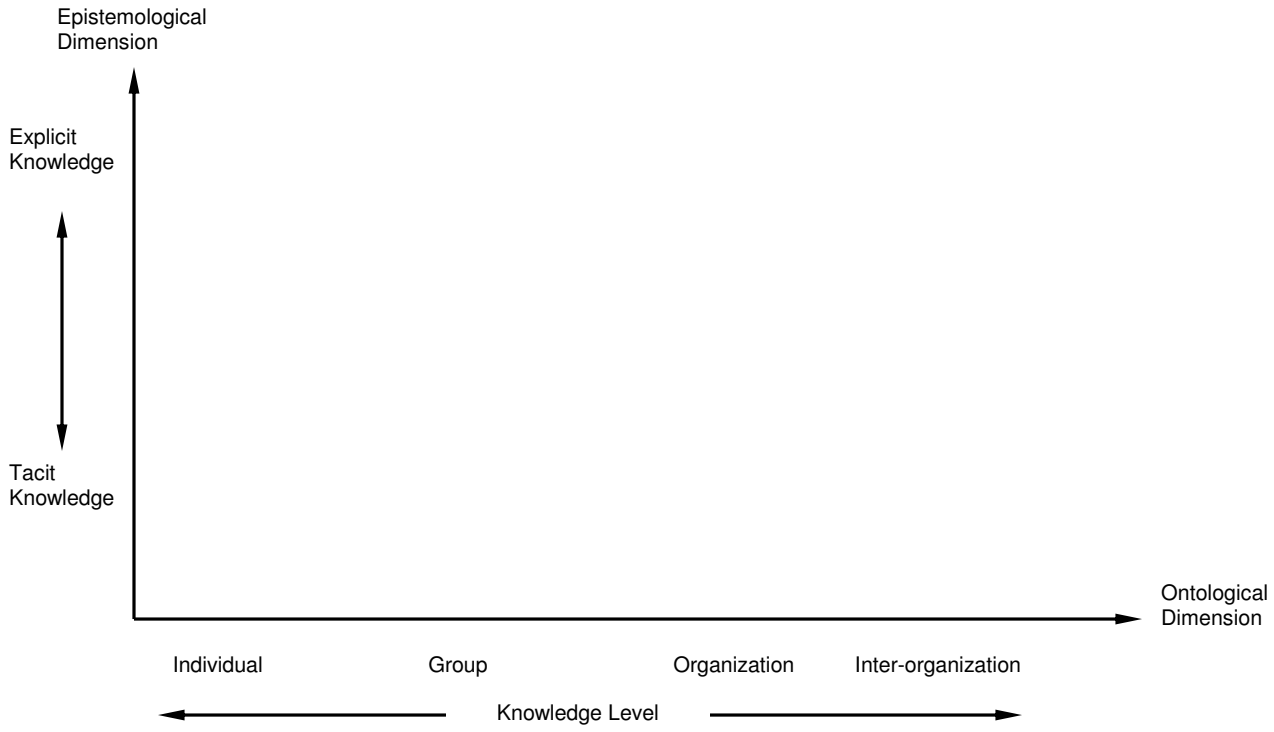

Figure 4.1 Two dimensions of knowledge creation [129]

Tacit knowledge (Subjective)	**Explicit knowledge (Objective)**
Knowledge of experience (body)	Knowledge of rationality (mind)
Simultaneous knowledge (here and now)	Sequential knowledge (there and then)
Analog knowledge (practice)	Digital knowledge (theory)

Tacit knowledge includes cognitive and technical elements. The cognitive elements consist of "mental models" in which humans create working models of the world by making and manipulating analogies in their minds. Mental models, such a schemata, paradigms, perspectives, beliefs and viewpoints help individuals perceive and define the world. On the other hand the technical element of tacit knowledge includes concrete know-how such as crafts and skills. The articulation of tacit mental models is an important factor in N&T's theory. The N&T model of knowledge creation is anchored to a critical assumption that human knowledge is created and expanded through social interaction between tacit

knowledge and explicit knowledge. In other words, this interaction or knowledge conversion is a social process between individuals and not confined within an individual.

4.1 Four Modes of Knowledge Conversion

4.1.1 Socialization: From Tacit to Tacit

Socialization is a process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills. An individual can acquire tacit knowledge directly from others without using language. For example, apprentices work with masters and learn craftsmanship not through language but through observation, imitation and practice. The key to acquiring tacit knowledge is experience. Without some form of shared experience it is extremely difficult to project oneself into another individual's thinking process. A classic example of this occurred when several Matsushita software engineers apprenticed themselves to a master baker in order to learn how to knead dough as a precursor to designing Matsushita's extremely successful automatic bread making machine.

An example from Japan's wireless industry comes from NTT DoCoMo's Director of I-mode Strategy, Takeshi Natsuno. Before joining DoCoMo he worked at an Internet startup company. This experience he credits with helping him to conceptualize I-mode using "internet thinking" in everything from the selection of technologies to proposing a business plan to acting on it. [130] "Internet thinking" meant designing a system which is indifferent to the platform on which content is being viewed and which encourages third parties to think up attractive services and provides a means for micro-payments to flow from users to content providers. "Internet thinking" also meant enabling communications to flow freely between content providers and users. For Natsuno socialization occurred when he learned about Internet concepts while working for the Internet startup and again when he worked through the creation of I-mode with the members of his team. Contrast this with a "telecom thinking" approach, essentially a closed, unidirectional system in which all infrastructure, standards and content is created and managed by the telecom company and it alone receives the revenue. This approach would have resulted in a system, which is much less responsive to customers. One in which content is much less diverse and much less fresh than the current offering. The contribution of I-mode content to encouraging positive feedback and growth of the mobile Internet would have been much less as well.

4.1.2 Externalization: From Tacit to Explicit

In externalization, tacit knowledge becomes explicit, taking the shape of metaphors, analogies, concepts, hypotheses or models. When we attempt to conceptualize a model we express its essence mostly in language – writing is an act of converting tacit knowledge into explicit. The externalization mode of knowledge is typically seen in the process of concept creation and is triggered by dialogue or collective reflection. A frequently used method to create a concept is to combine deduction and induction. Externalization is a non-analytical alternative for expressing an image. In this case figurative language and imagination are used to elicit tacit knowledge from project members.

For Natsuno this process began by using figurative language to conceptualize a business model for the new enterprise. He began by categorizing the world of information into a kind of information map or food table classifying everything into “proteins, carbohydrates and so on”. “Making the right choice of ingredients when preparing a meal will keep the body healthy, but those eating the meal may not think in terms of proteins or vitamins.” Natsuno showed what ingredients or information were the most effective. In other words, what ingredients not only tasted good, but were also nutritious for the user. [131]

Metaphors create novel interpretation of experience by asking the listener to see one thing in terms of something else and creating new ways of experiencing reality. Thus, metaphors are one communication mechanism that can function to reconcile discrepancies in meaning. Once explicit concepts are created they can then be modeled. In a logical model, no contradictions should exist and all concepts and propositions must be expressed in systematic language and coherent logic. In business terms, models are often only rough approximations, far from being fully specific.

Natsuno created a model or content portfolio by drawing up a navigational chart for the sea of information. The first zone of his map was the “transaction” sector, covering banking services, as well as tickets and hotel reservations. The second zone was “life information”, which covered weather forecasts, stock market updates, and a large variety of local information. The third zone was the “database” sector of restaurant guides, transport schedules and so on. The fourth and final zone was the “entertainment” sector of games, fortune telling services and karaoke information. [132]

4.1.3 Combination: From Explicit to Explicit

This mode of knowledge conversion involves combining different bodies of explicit knowledge. Individuals exchange and combine knowledge through such media as documents, meetings, telephone

conversations or computerized communication networks. Reconfiguration of existing information through sorting, adding, combining and categorizing of explicit knowledge (as conducted in computer databases) can lead to new knowledge. Knowledge creation carried out in formal education and training schools usually takes this form. An MBA education is one of the best examples of this kind.

In the business context, the combination mode of knowledge conversion is most often seen when middle managers break down and make operational corporate visions and business / product concepts. Middle management plays a critical role in creating new concepts through networking of codified information and knowledge. For example, Asahi Breweries grand concept “live Asahi for live people” was made more explicitly recognizable through the mid range concept of “richness and sharpness” a new product concept which was used to develop Asahi Super Dry beer. Creative uses of computerized communication networks and large scale databases facilitate this mode of knowledge conversion.

As an example from Japan’s wireless industry, when I-mode was being formulated meetings tended to be particularly long, sometimes taking up entire afternoons because so many people had ideas to contribute. Mari Matsunaga, the Manager of I-mode Content Development, explained, “A kind of synergy develops when everyone is brought up to speed on the other briefs including content, business, and system planning. People in charge of other areas start making unexpected suggestions.” [133]

4.1.4 Internalization: From Explicit to Tacit

Internalization is closely related to learning by doing. When experiences through socialization, externalization and combination are internalized into individuals’ tacit knowledge bases in the form of shared mental models or technical know how they become valuable assets. For organizational knowledge to take place, however, the tacit knowledge accumulated at the individual level needs to be socialized with other organizational members, thereby creating a new spiral of knowledge creation. For explicit knowledge to become tacit, it helps if the knowledge is verbalized or diagrammed into documents, manuals or oral stories. Documentation helps individuals internalize what they experienced thus enriching their tacit knowledge. When a mental model is shared by most members of the organization, tacit knowledge becomes part of the organizational culture. This practice is prevalent in Japan, where books and articles on companies or their founders abound.

Organizational knowledge creation is a continuous and dynamic interaction between tacit and explicit knowledge. This interaction is shaped between different modes of knowledge conversion, which

are in turn induced by several triggers. First, the socialization mode usually starts with building a “field” of interaction. This field facilitates the sharing of members’ experiences and mental models. Second, the externalization mode is triggered by meaningful “dialogue or collective reflection,” in which using appropriate metaphors or analogies helps team members to articulate hidden tacit knowledge that is otherwise hard to communicate. Third, the combination mode is triggered by “networking” newly created knowledge and existing knowledge from other sections of the organization, thereby crystallizing them into a new product, service or managerial system. Finally, “learning by doing” triggers internalization.

The content of the knowledge created by each mode of knowledge conversion is different. Socialization yields what can be called “sympathized knowledge”, such as shared mental models and technical skills. The tacit skill of kneading dough in the Matsushita example is sympathized knowledge. Externalization outputs “conceptual knowledge.” The concept of “Tall Boy” used to create the Honda City automobile is an example of conceptual knowledge created through the metaphor of “automobile evolution” and the analogy between a sphere and the concept of “man-maximum, machine-minimum.” Combination gives rise to “systemic knowledge,” such as a prototype and new component technologies. KDDI’s Sha-mail camera / phone handset is an example of a product resulting from systemic knowledge which included input from numerous technology suppliers to create the final product. Internalization produces “operational knowledge” about project management, production processes, new product usage, and policy implementation. An example of operational knowledge of policy implementation is when Matsushita workers gained the physical experience of attempting to complete their work while capping their work time at 150 hours per month after they had grown used to spending much more time at the office.

The contents of knowledge interact with each other in the spiral of knowledge creation (see figures 4.2 and 4.3). For example, sympathized knowledge about mobile Internet user’s wants may become explicit conceptual knowledge about a new-service concept through socialization and externalization. Such conceptual knowledge becomes a guideline for creating systemic knowledge through combination. For example, a new-product concept steers the combination phase, in which newly developed and existing component technologies are combined to build a prototype. Systemic knowledge turns into operational knowledge for mass production of the product through internalization. In addition, experience based operational knowledge often triggers a new cycle of knowledge creation. The user’s

tacit operational knowledge about a product is often socialized, thereby initiating improvement of an existing product or development of an innovation. For example, operational knowledge of increasing traffic congestion on the original I-mode network designed to transfer data at 9.6 Kbps helped spur creation of DoCoMo's FOMA 3G system capable of 384 Kbps.

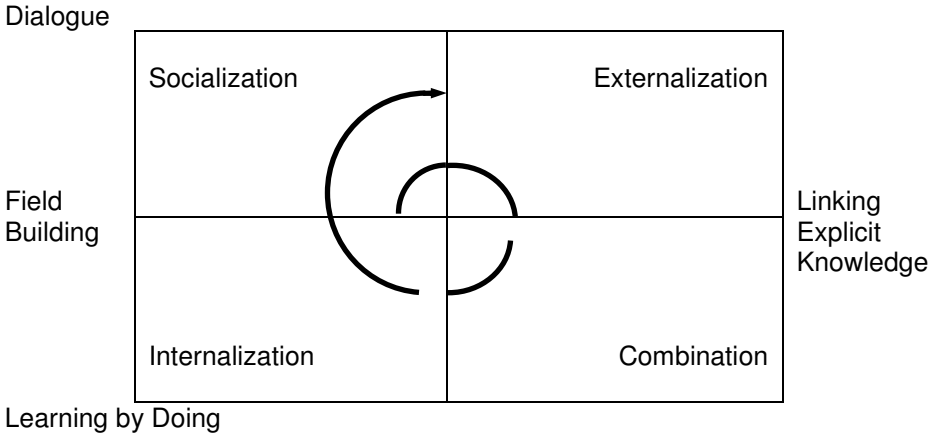

Figure 4.2 Knowledge spiral [134]

		To	
		Tacit Knowledge	Explicit Knowledge
From	Tacit Knowledge	(Socialization) **Sympathized Knowledge**	(Externalization) **Conceptual Knowledge**
	Explicit Knowledge	(Internalization) **Operational Knowledge**	(Combination) **Systemic Knowledge**

Figure 4.3 Contents of knowledge created by the four modes [135]

N&T also characterize organizational knowledge creation in the ontological dimension as a spiral process, starting at the individual level and moving up through expanding communities of interaction, that crosses sectional, departmental, divisional and organizational boundaries. The transformation process within the two knowledge spirals is the key to understanding N&T's theory. If viewed in three dimensions the knowledge spiral at the epistemological level rises upward, whereas the knowledge spiral at the

ontological level moves from left to right and back again to the left in a cyclical motion. Innovation emerges out of the interaction of the two knowledge spirals over time (see figure 4.4). [136]

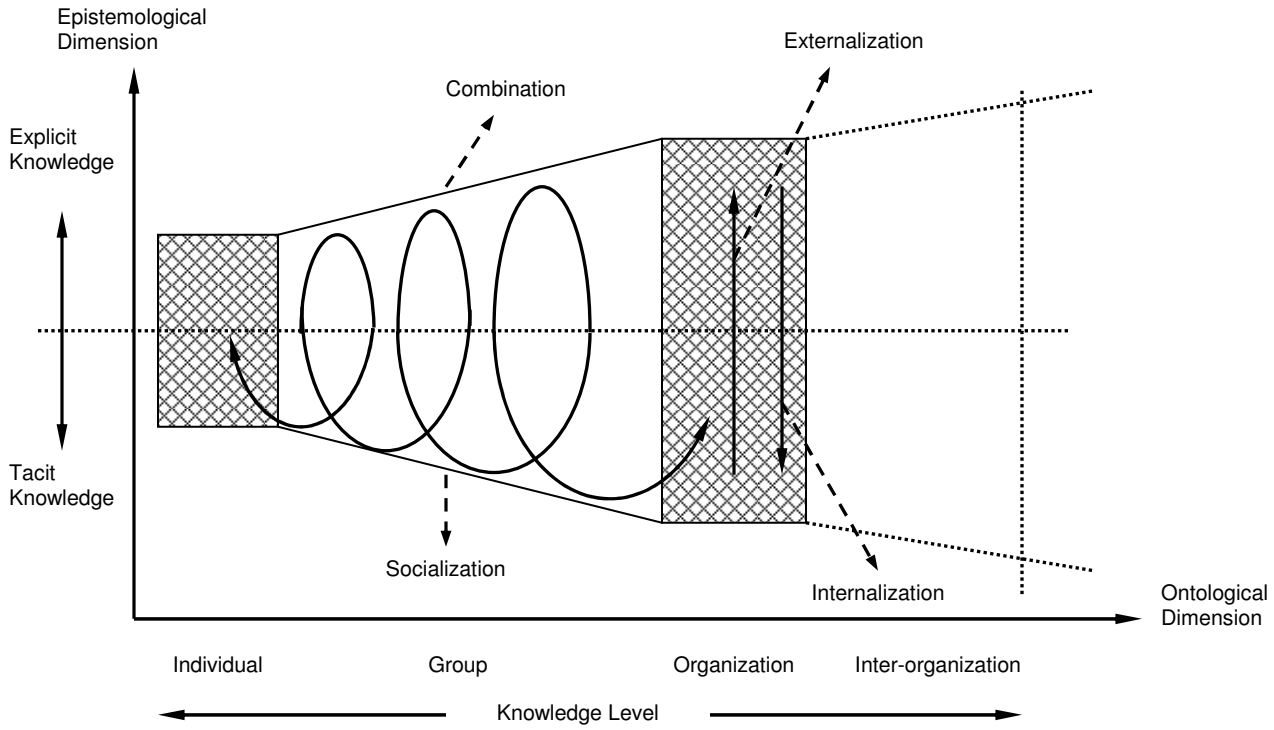

Figure 4.4 Spiral of organizational knowledge creation [137]

This process is exemplified by product development. Creating a product concept involves a community of interacting individuals with different backgrounds and mental models. While members from the R&D department focus on technological potential, those from the production and marketing departments are interested in other issues. Only some of those different experiences, mental models, motivations and intentions can be expressed in explicit language. Thus, the socialization process of sharing tacit knowledge is required. Furthermore, both socialization and externalization are necessary for linking individuals' tacit and explicit knowledge. Many Japanese companies have adopted brainstorming camps as a tool for that purpose. [138]

As an example, former Manager of I-mode Content Development Mari Matsunaga, described how she used brainstorming sessions to develop ideas for I-mode content. She explained that as a magazine

publisher, there were always two things that she did when launching a new magazine: establish who the target audience is and what context they should use the magazine in. This same approach was applied to I-mode. Usually targets were defined in terms of specific groups, such as “female high school students” or “men in their thirties with an annual income of x”. Matsunaga tried to come up with a clear vision of the particular kind of individual she was trying to reach. Matsunaga thought about things such as what that individual’s fashion sense would be like, and where he or she would go for fun. The next step was to imagine a group of 200,000 or 300,000 individuals like this one. Brainstorming was used to figure out what a group like this really wants and to define those wants in clear and simple terms. [139]

In her first I-mode brainstorm session Matsunaga assembled a group of internal and outside experts and tossed them the theme “providing a new means of distributing information via mobile phones.” Matsunaga recounted how starkly the behavior of the media industry participants contrasted with that of the business school graduates. “The seemingly pointless ramblings of the people working at TV stations or magazine publishing houses appeared to contrast sharply with the logic of the management consultants present. A meandering conversation about luxury hotels, cute waiters and concierges led to the conceptualization of I-mode as a personal, exclusive concierge service”. This first brainstorming session was a catalyst for what would later become known as “Club Mari”, a place where people from various industries could enjoy a relaxed exchange of ideas with DoCoMo representatives about potential information services. [140]

According to the N&T framework the next step is to take the product created by this collective and cooperative process and review it for its coherence with mid-range and grand concepts. Even if the newly created product has superior quality, it may conflict with the divisional or organizational goals expressed by the mid-range and grand concepts. What is required is another process at a higher level to maintain the integrity of the whole, which will lead to another cycle of knowledge creation in a larger context.

4.2 Five Enabling Conditions for Organizational Knowledge Creation

The role of the organization in the knowledge creation process is to provide the proper context for facilitating group activities as well as the creation and accumulation of knowledge at the individual level. The following section discusses five conditions required at the organizational level to promote the knowledge spiral.

4.2.1 Intention

The knowledge spiral is driven by organizational intention, which is defined as an organization's aspiration to its goals. Efforts to achieve the intention usually take the form of organizational knowledge creation. The essence of strategy lies in developing the organizational capability to acquire, create, accumulate and exploit knowledge. The most critical element of corporate strategy is to conceptualize a vision about what kind of knowledge should be developed and to make it operational through a management system for implementation.

Organizational intention provides the most important criterion for judging the truthfulness of a given piece of knowledge. If not for the intention, it would be impossible to judge the value or knowledge created. At the organizational level, intention is often expressed by organizational standards or visions that can be used to evaluate and justify the created knowledge. To create knowledge, business organizations should foster their employees' commitment by formulating an organizational intention and proposing it to them.

4.2.2 Autonomy

The second condition for promoting the knowledge spiral is autonomy. At the individual level, all members of an organization should be allowed to act autonomously as far as circumstances permit. By allowing them to act autonomously, the organization may increase the chance of introducing unexpected opportunities. Autonomy also increases the possibility that individuals will motivate themselves to create new knowledge. Original ideas emanate from autonomous individuals, diffuse within the team and then become organizational ideas. From the viewpoint of knowledge creation, such an organization is more likely to maintain greater flexibility in acquiring, interpreting and relating information. It is a system in which the "minimum critical specification" is met as a prerequisite for self-organization, and therefore autonomy is assured as much as possible. [141]

Autonomous individuals and groups in knowledge creating organizations set their task boundaries by themselves as they pursue the ultimate goal expressed in the higher intention of the organization. A powerful tool for creating circumstances in which individuals can act autonomously is the self-organizing team. Such a team should be cross-functional, involving members from a broad cross-section of different organizational activities. Japanese firms frequently use cross-functional teams at each phase of the innovation process. Such teams usually consist of 10-30 members with diverse functional backgrounds,

such as R&D, planning, production, quality control, sales and marketing and customer service. In most companies there are 4 to 5 core members, each of whom has had career experience in several functional areas. [142]

N&T's perspective on autonomous, self-organizing teams is consistent with the idea of self organizing systems expressed in complexity theory. In each case the goal is to create conditions that offer the most flexibility and the minimum of constraints. DoCoMo as a company and the I-mode department in particular were given considerable autonomy from their respective parent organizations. Autonomy and innovation are also encouraged throughout the mobile Internet value chain in Japan through the use of the self-organizing, open framework established by DoCoMo. According to Richard Siber, a partner in Accenture's telecommunications practice, I-mode's platform is about as open as is possible. [143]

4.2.3 Fluctuation and Creative Chaos

This third element stimulates the interaction between the organization and the external environment. Fluctuation is different from complete disorder and characterized by "order without recursive ness". If organizations adopt an open attitude toward environmental signals, they can exploit those signals of ambiguity, redundancy or noise in order to improve their own knowledge system. [144]

When fluctuation is introduced into an organization, its members face a disruption of routines, habits or cognitive frameworks. Such a disruption provides an opportunity to reconsider our fundamental thinking and perspective. In other words we begin to question our basic attitudes toward the world. Such a disruption demands that we turn our attention to dialogue as a means of social interaction, thus helping us to create new concepts. This continuous process of questioning and reconsidering existing premises by individual members of the organization fosters knowledge creation. Disruptions are created naturally when the organization faces a real crisis such as a rapid decline of performance due to changes in the market needs or significant growth of competitors. It can also be generated intentionally when the organization's leaders try to evoke a "sense of crisis" among the organizational members by proposing challenging goals.

Takeshi Natsuno described I-mode as being born out of a sense of crisis. [145] In July 1996, NTT's President Koji Ohboshi (now chairman) created a sense of crisis and focused corporate attention when he released an analysis, which forecast a flattening of revenues as the rate at which new mobile phone

subscribers signed up began to approach saturation levels (see figure 4.5). If the growth rate flattened, as it must eventually do, he concluded that telecommunications provider's capacity to generate growth would decline. He offered the war of attrition fought by US fixed line telephone business as ample proof of what happens when heated competition goes after a limited pool of subscribers: one month free for changing phone companies, rebates and other discounts that cut into revenues. Such a scenario was described as eroding the strength of all the participants and potentially leading not only to a decline in capacity to develop new services but also to a risk of a fall in the level of service provided by the industry as a whole. This scenario was described as following an S shaped growth curve. Ohboshi's solution to flattening subscriber numbers was to offer an alternative by creating the concept of a second S-curve. That is, instead of devolving into a zero sum war over a limited pool of subscribers, DoCoMo could create a new market, data communications, in addition to voice communications and thereby move into another growth phase. [146] Riding the second S-curve would require pioneering a service that would increase subscriber's use of phones, a new service that would generate data traffic. I-mode was to become that service. **(One can see a similar scenario emerging as the number of new I-mode subscribers appears to be leveling off in figure 3.2. In this case NTT DoCoMo CEO Tachikawa has been touting the creation of a 4G mobile communications network. His vision is to have up to 570 million devices connected via mobile networks in order to track anything that moves from pets to bicycles, deliveries and personal belongings.[147] He envisions the increased bandwidth also being used for new services such as electronic wallets, person to machine and machine to machine communications, and virtual reality displays that incorporate three dimensional visuals, audio and even air pressure fields, see figure 4.5).

In addition to evoking a sense of crisis by proposing challenging goals Japanese companies often resort to the purposeful use of ambiguity and "creative chaos." Top management often employs ambiguous visions in order to intentionally create a fluctuation within the organization. Top management's ambiguity with respect to philosophy or vision can lead to a reflection or questioning of value premises as well as of factual premises upon which corporate decision making is anchored. Chaos is sometimes created independent of top management's philosophy. An individual organizational member can set a high goal in order to increase the challenge to himself or his team. Such high goals enhance personal commitment and may intensify individual wisdom. It should be noted that the benefits of "creative chaos"

can only be realized when organizational members have the ability to reflect upon their actions. Without reflection, fluctuation tends to lead to “destructive chaos”.

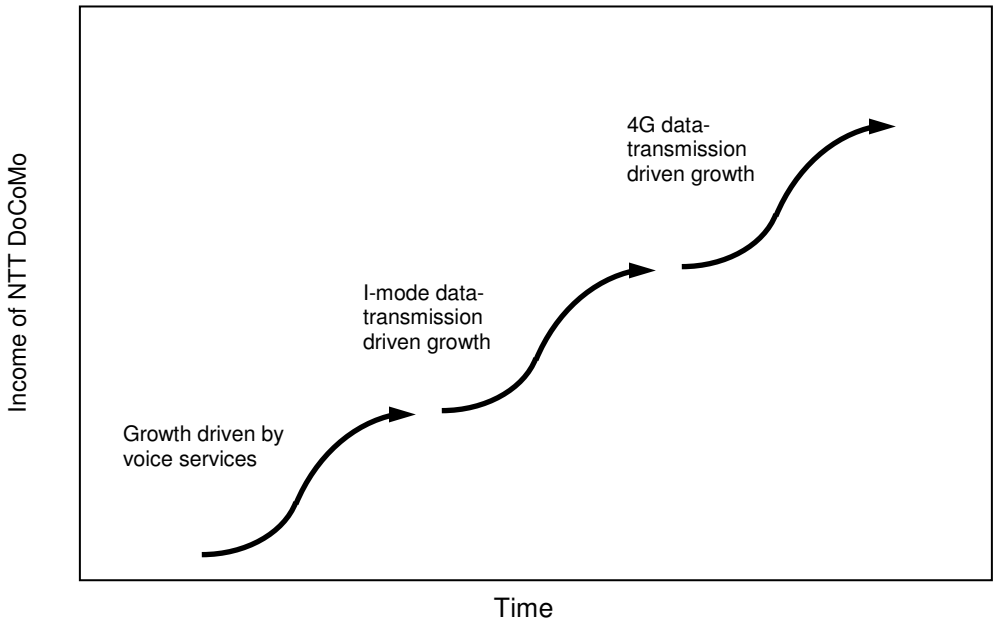

Figure 4.5 NTT DoCoMo revenue growth forecast

4.2.4 Redundancy

One of the most notable differences between Japanese and Western organizations is the value placed upon redundant information. What N&T mean by redundancy is the existence of information that goes beyond the immediate operational requirements of organizational members. In business organizations, redundancy refers to intentional overlapping of information about business activities, management responsibilities and the company as a whole. [148] For organizational knowledge creation to take place, a concept created by an individual or group needs to be shared by other individuals who may not need the concept immediately. Sharing redundant information promotes the sharing of tacit knowledge, because individuals can sense what others are trying to articulate. In this way, redundancy speeds up the knowledge creation process. Redundancy is especially important in the concept development stage, when it is critical to articulate images rooted in tacit knowledge. At this stage, redundant information enables individuals to cross into each other’s functional areas and to offer advice or provide new information from different perspectives.

There are several ways to build redundancy into the organization. One is to adopt an overlapping approach, as illustrated by the Japanese companies' "rugby-style" product development in which different functional departments work together in a "fuzzy" division of labor. The use of internal competing teams encourages the company to look at the project from a variety of perspectives. Under the guidance of the team leader, the team eventually develops a common understanding of the best approach.

Another way to build redundancy into the organization is through a "strategic rotation" of personnel, especially between vastly different areas of technology or functions such as R&D and marketing. Such rotation helps organizational members understand its business from multiple perspectives, thereby making organizational knowledge more fluid and easier to implement. It also enables each employee to diversify his or her skills and information sources.

Leading Japanese firms have institutionalized redundancy within themselves in order to develop new products and services swiftly in response to fast changing markets and technologies. Other devices used by Japanese organizations to increase redundancy and to facilitate the sharing of knowledge include frequent meetings and the use of formal and informal communication networks (e.g. drinking sessions after working hours).

NTT DoCoMo helped build redundancy into the knowledge creation process and facilitated the creation of communication networks through the establishment of Club Mari, a casual environment where people from various industries could exchange ideas with DoCoMo representatives about potential information services. [149]

Redundancy was also important in the way that DoCoMo chose to build a shared way of thinking about what sort of service I-mode is and should be. Initially, DoCoMo hosted frequent nationwide meetings lasting up to two days at a time in which content managers discussed whether proposed content would satisfy subscribers or not. Nothing would go on the official menu without the unanimous consent of all those attending these editorial meetings. As the participants went through the evaluation process again and again, what points to look for in checking content became clear and the participants came to have the same standards for making a judgment. [150]

At first very few of DoCoMo's personnel understood the essence or special characteristics of the Internet or had any understanding of what content ought to be available on the official I-mode menu. Those members that did understand led the discussion. One positive by-product of that process was that

more people learned how to evaluate content in terms of the nature of I-mode as a service and what DoCoMo should consider concerning content. [151] The problem of deciding how to act on the basis of that thinking is now left up to the various managers. Each individual acts according to his own understanding of what I-mode can be, adds his or her own tweaks and innovative touches, as those actions lead to results and all participants feel they have personally contributed to the success of I-mode. [152]

4.2.5 Requisite Variety

N&T contend that an organization's internal diversity must match the variety and complexity of the environment in order to deal with the challenges posed by the environment. Organizational members can cope with many contingencies if they possess requisite variety, which can be by combining information differently, flexibly and quickly, and providing equal access to information throughout the organization.

One of the more surprising aspects of I-mode's senior management team is its lack of telecommunications experience. Rather than hire a group of telecom veterans to build DoCoMo's new I-mode service General Manager Keiichi Enoki began by choosing someone who had virtually no knowledge about telecommunications. [153] To head up the I-mode content development team Enoki chose Mari Matsunaga, a 20 year veteran of the Japanese publishing industry and Chief Editor of classified ad magazine Recruit, a regular on Japanese National TV and a member of the Japan's National Tax Advisory Council. [154] Before coming to DoCoMo, Matsunaga had no experience with HTML and described herself as a technophobe who didn't even own a cell phone. [155] Based on N&T's theory the choice of Matsunaga makes sense when one considers her experience with marketing and starting up new magazines targeted at the new generation and Enoki's desire to use i-mode to initially target wives and youth. [156]

After hiring the first five members of the I-mode team Enoki observed that all the new members displayed a similar tendency. "…I've selected what you call eccentrics or highly individualistic people." [157] "…Mari must have seemed like an extraterrestrial to DoCoMo. She must have been akin to an encounter with an unknown species for the people at Human Resources…" Meanwhile, Enoki's second hire, Takeshi Natsuno worked for Osaka Gas before earning an MBA at Wharton and then working for an Internet startup. (Graduate education is still relatively rare in Japan where companies prefer to mold workers on the job.) Even Natsuno describes that initial group as a hodgepodge of people from various backgrounds. [158] According to Natsuno the resulting diversity of skills and attitudes was a major factor in

I-mode's success. [159] For example, the younger staff who were in their 20's at the time played a key role in creating the I-mode handsets. Having grown up using pagers and video games on virtually a daily basis they had the tacit knowledge that email was a crucial communication tool for the younger generation. They explained that communication between mobile phone users is the single most important feature that a handset could include. Consequently, email became an essential component. [160]

The younger staff also insisted that emails should be sent directly to the terminal even it this meant limiting message length to 250 characters. This approach was viewed as superior to requiring users to visit a server to collect their messages. The instant gratification encouraged by the immediate delivery appealed to the younger staff. The commercial appeal of such an approach is supported by the fact that 9:55 pm is the busiest time for email via I-mode. It's the time when popular TV dramas end and many people phone each other to discuss the latest episode. [161]

Many other commercially valuable ideas were attributed to the younger staff. One idea was the addition of symbolic characters. It emerged as an answer to the problem of how to condense meaning and convey feelings in a short e-mail. There had previously been a pager that had sold particularly well. Upon examining the reason for its success, it was discovered that only this particular model offered the symbol of a heart. Just the addition of the heart made a tremendous difference in sales. The younger staff came up with more than 200 symbols or "emoji" (a contraction between the words emotion and kanji – Japanese characters), for expressing emotion in short email messages. Without the participation of the younger staff this idea may well have not come to light. [162]

4.3 Five Phase Model of the Organizational Knowledge Creation Process

N&T combine the four modes of knowledge creation and five enabling conditions with a time dimension in order to create a five phase model of knowledge creation (see figure 4.6).

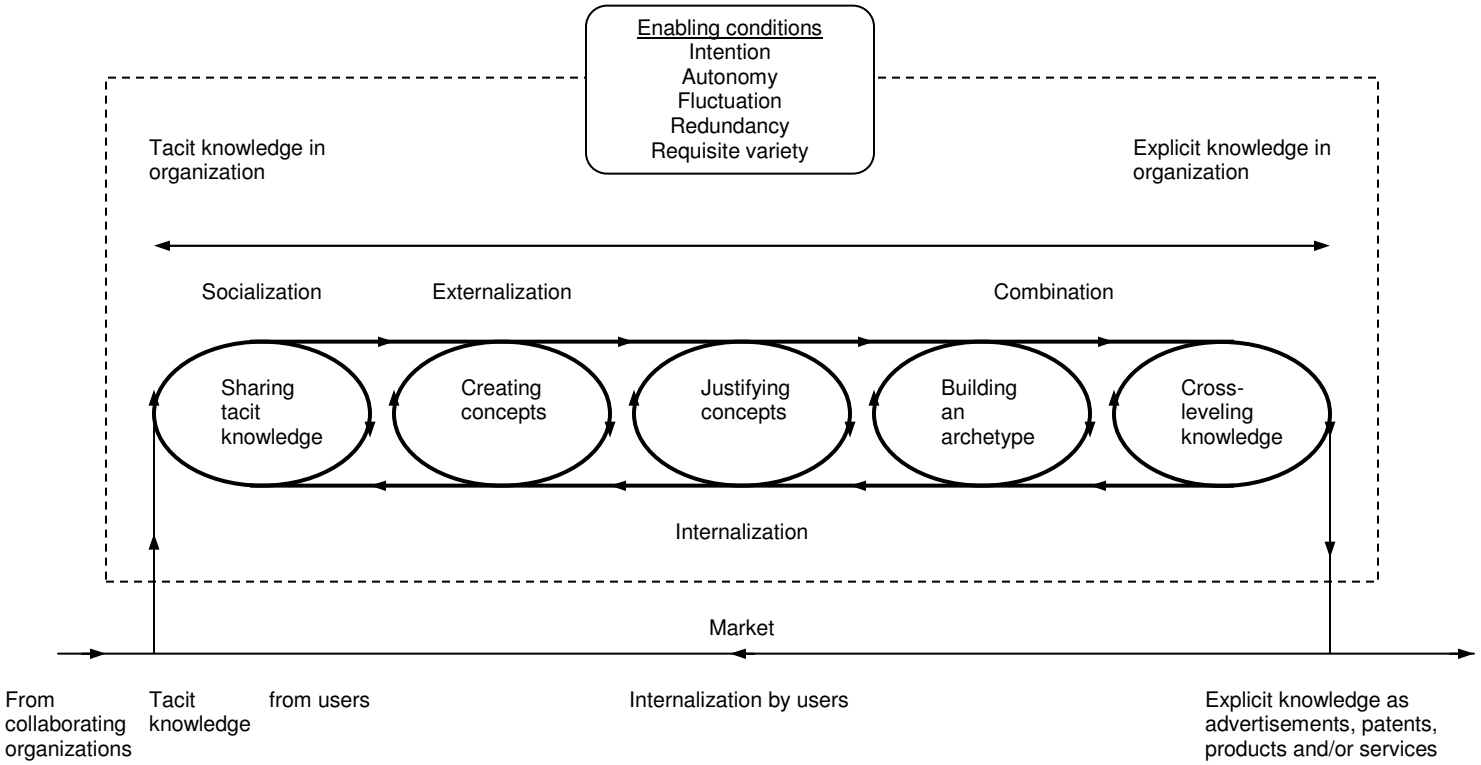

Figure 4.6 Five phase model of knowledge creation [163]

4.3.1 Sharing Tacit Knowledge

The creation of organizational knowledge begins with the tacit knowledge held by individuals. However, tacit knowledge cannot be communicated or passed onto others easily since it is acquired primarily through experience and is not easily expressed in words. Thus the sharing of tacit knowledge among multiple individuals with different backgrounds, perspectives and motivations (requisite variety) becomes the critical step for organizational knowledge creation to take place. The individual's emotions, feelings and mental models have to be shared to build mutual understanding.

This sharing is usually facilitated through the formation of self-organizing teams in which members of various functional departments work together to achieve a common goal. Management injects creative chaos by setting challenging goals and endowing team members with a high degree of

autonomy. An autonomous team starts to set its own task boundaries and begins to interact with the external environment, accumulating both tacit and explicit knowledge. Sharing of mental models can occur at work or when team members socialize after work. Therefore the phase one of organizational knowledge creation corresponds most closely to the socialization mode.

4.3.2 Creating Concepts

The most intensive interaction between tacit and explicit knowledge occurs in the second phase. Once a shared mental model is formed in the field of interaction, the self-organizing team then articulates it through further continuous dialogue, in the form of collective reflection. The shared tacit mental model is verbalized into words and phrases, and finally crystallized into explicit concepts. In this sense this phase corresponds to externalization.

This process of converting tacit knowledge into explicit knowledge is facilitated by the use of multiple reasoning methods such as deduction and induction. The quality of dialogue among team members can also be raised through the use of dialectics, which instills a creative way of thinking into the organization. It is an iterative and spiral process in which contradictions and paradoxes are utilized to synthesize new knowledge.

Concepts are created cooperatively in this phase through dialogue. Autonomy helps team members to diverge their thinking freely, with intention serving as a tool to converge their thinking in one direction. To create concepts, teams have to rethink their existing premises fundamentally. Requisite variety helps the team in this regard by providing different angles or perspectives for looking at a problem. Fluctuation and chaos also helps members to change their way of thinking fundamentally. Redundancy of information enables team members to understand figurative language better and to crystallize their shared mental model.

For DoCoMo their assumption that consumers would not buy Internet capable phones that looked much different from standard mobile phones led them to the development concept of “it’s a mobile phone, stupid.” What this meant was that in external appearance, size, weight, price, talk time and standby time, the chief objective was for the I-mode phone to be indistinguishable from existing mobile phone. Models with obviously different designs or ways of using them, such as a large crystal display with touch screen features, were eliminated from consideration. This mobile phone concept posed major restrictions because by the time that I-mode was in development, the shrinking of Japanese mobile phones had

advanced quite far. Most manufacturers were offering phones that came in under 80 grams and 80 cc in volume. DoCoMo concluded that bigger phones would be difficult to sell. The team decided on a maximum size for the I-mode phones would be 100 grams in weight and 100 cc in volume. This meant that the new features had to be crammed into this 100 gram, 100 cc package. [164]

4.3.3 Justifying Concepts

N&T's theory of knowledge creation defines knowledge as justified true belief. Justification involves the process of determining if the newly created concepts are truly worthwhile for the organization and society. It is similar to a screening process and is intended to check if the organizational intention is still intact and to ascertain if the concepts being generated meet the needs of society at large. For business organizations the normal justification criteria include cost, profit margin and the degree to which a product can contribute to the firm's growth. Justification criteria can be both qualitative and quantitative. The final justification of created concepts and their realized forms, i.e. products and services occurs in the marketplace.

In a knowledge creating company, it is primarily the role of top management to formulate the justification criteria in the form of organizational intention, which is expressed in terms of strategy or vision. Middle management can also formulate the justification criteria in the form of mid-range concepts. Organizational units may also formulate justification criteria using their own sub-criteria. A company's justification criteria should be consistent with the value systems or needs of society at large, which should ideally be reflected in organizational intention. To avoid any misunderstanding about the company's intention, redundancy of information helps facilitate the justification process.

The justification criteria that Takeshi Natsuno formulated for DoCoMo began with a vision of the future that was intended as a kind of filter against which to test new concepts. He summed up this vision in three high level concepts:

"DoCoMo is always with you from cradle to grave."

"Don't forget it, even when you are running away."

"Deathbed request: Delete all personal information."

The first phrase is self-explanatory. The second suggested that, even if a fire broke out, as long as you had your phone you could make calls as well as access all the information that you needed. The third phrase is intended to capture the last wish a mobile phone user might utter on his deathbed. "Since all

data and frequently used information were stored in the mobile phone, imagine the hullabaloo if someone got hold of your mistress' s phone number. Therefore, to avoid any family turmoil, the dying person would want to delete all their personal data." [165]

4.3.4 Building an Archetype

In this phase the justified concept is converted into something tangible or concrete, namely, an archetype. An archetype can be thought of as a prototype in the case of a new-product development process. In the case of a service or organizational innovation, an archetype could be thought of as a model operating mechanism. In either case, it is built by combining newly created explicit knowledge with existing explicit knowledge. Because justified concepts, which are explicit, are converted into archetypes, which are also explicit, this phase is akin to the combination mode. As this phase is complex, dynamic cooperation of various departments within the organization is indispensable. Both requisite variety and redundancy of information facilitate this process.

DoCoMo's business model is an archetype that was designed to act as a catalyst to an ever-widening cycle of positive feedback. Instead of simply buying information from information providers (IPs) DoCoMo sought to both minimize the risk for both buyer and seller associated with a one time transaction and instead create a situation in which each IP would be motivated to continually improve their information offering because they would receive an immediate and direct payback rather than merely a one time fee. The upside potential was unlimited for the IP. This was the basis for DoCoMo charging a only a 9% commission on sales by IPs through I-mode. [166] Contrast this approach with attempting to pay for content up front favored by some US MISPs. When Matsunaga investigated the idea of creating a Michelin guide to Tokyo within I-mode she was told it would cost at least $6 million USD and take at least a year to review the restaurants. [167] Such high upfront costs would have retarded the creation of positive feedback and the growth of the mobile Internet rather than encouraged it.

4.3.5 Cross Leveling of Knowledge

Organizational knowledge creation is a never ending process that upgrades itself continuously. The new concept, which has been created, justified and modeled, moves on to a new cycle of knowledge creation at a different ontological level. This interactive and spiral process, also known as cross leveling of knowledge, takes place both intra-organizationally and inter-organizationally. Intra-organizationally, knowledge that takes the form of an archetype can trigger a new cycle of knowledge creation, expanding

horizontally and vertically across the organization. An example of horizontal cross-fertilization can be seen within Matsushita, where the original invention of a fully automatic bread maker induced the creation of other product concepts, such as a fully automatic coffee maker within the same division and a new range of large scale TV sets in another division. Within Japan's wireless industry competitors have had some success in learning from DoCoMo and in some cases, such as KDDI's 3G service and J-Phone's Sha-mail camera phones, even outdoing DoCoMo.

Inter-organizationally, knowledge creation by the organization can mobilize the knowledge of affiliated companies, customers, suppliers, competitors and others outside the company through dynamic interaction. A customer's reaction or feedback to a new product concept may initiate a new cycle of product development. For example when product development engineers at Apple computer come up with ideas for a new product, they build a prototype that embodies those ideas and bring it to the customer to seek their reaction. In DoCoMo's case, before the full commercial launch of its new 3G FOMA service in October 2001 it created what amounted to a beta test starting from May 2001 in which it loaned free FOMA handsets to 4,000 customer's to test their reaction and ensure reliable operation for the full launch. Customers were exempted from paying communication charges in exchange for filling out questionnaires about the 3G services and offering comments and suggestions. [168]

For this phase to function effectively, it is essential that each organizational unit have the autonomy to take the knowledge developed somewhere else and apply it freely across different levels and boundaries. Internal fluctuation, such as the frequent rotation of personnel, redundancy of information and requisite variety will facilitate knowledge transfer. In intra-organizational cross leveling, organizational intention will act as a control mechanism on whether or not knowledge should be cross fertilized within the company.

4.4 Discussion and Implications for US Mobile Internet Companies

Having worked with many companies ranging from 20 employees up to 100,000 employees it has been the author's experience that the actual operation of companies more closely resembles what the army describes as the "fog of war" in which decisions are often made with scant details and a sense of urgency based on deeply internalized values and experiences rather than by working through a complex, extended, systematic process such as what N&T have conceptualized. Furthermore, most of the Japanese mobile Internet workers interviewed including some in NTT DoCoMo's I-mode Strategy Group

were unable to articulate how technology innovation occurs in their own industry. Therefore, the wholesale adoption of a complex knowledge creation process such as what N&T have articulated may be asking too much. However, Western mobile Internet companies could still benefit by choosing to selectively adopt portions of the N&T framework. It should also be recognized that Western companies do already employ some of the elements described in the N&T framework such as brainstorming, testing prototypes with focus groups of customers and rotating personnel to encourage the sharing of knowledge and broadening of skills. According to Jesse Berst of the Athena Institute, Microsoft employs a product development process similar to that described by N&T in that multiple groups create competing solutions at the same time. Furthermore, the value of autonomy is something that 3M has recognized for years in its practice of allowing researchers to use 15% of their time for personal research projects.

N&T have used their theory to explain why Japanese companies have been successful in creating new knowledge. They are quite certain that these concepts are not culture specific but can be employed by Western companies in creating knowledge and technology innovation. In fact, subsequent to the publishing of the N&T SECI knowledge creation framework in 1991 Professor Nonaka went on to document how non-Japanese companies such as Siemens, Unilever and Scandia have employed the SECI framework to promote knowledge creation. Controlling knowledge creation is extremely difficult. The following are a few ideas that Western mobile Internet companies can use to encourage knowledge creation and technology innovation.

1. Knowledge creation must be more than just the purview of a few individuals. Before all else the organization must establish a vision about what kind of knowledge should be developed. This is critical because this vision or intention will be the ultimate measure against which new knowledge will be evaluated. This vision should be articulated to all employees involved and should include a set of overarching criteria against which newly created knowledge will be measured to ensure the integrity of the whole. Involving employees in the creation of these criteria from the beginning will help maximize employee commitment later on in the process.

2. Organizations should encourage employees to take responsibility and to act autonomously wherever possible and practical. This may mean an individual acting independently or as part of an organization sub group. Individuals and sub-groups should be encouraged to set their own task

boundaries as they strive to achieve the organization's vision. This process can be encouraged by creating cross functional teams for tackling new challenges.

3. Recognize that ambiguity has a role to play by encouraging employees to rethink old assumptions and established ways of doing things. Constructive use of ambiguity can be encouraged by periodically creating a measured organizational fluctuation. Teaching employees how to use figurative language, symbolism, metaphor and analogy through behavior modeling by senior management will help them become more comfortable with and legitimize this "softer" approach to knowledge creation. Organizations can encourage an environment which values tacit knowledge by explicitly making an effort to incorporate subjective insights, intuitions, images and hunches into the knowledge creation process. An attempt should be made to capture as wide a swath of tacit knowledge as possible by recruiting people from diverse backgrounds. This diversity will contribute to the organization's requisite variety, one of the key enabling conditions for knowledge creation.

The ideal is to create an organization made up of personnel, which reflect the market segments being pursued. If the target segment is youth then make sure that your organization has a way for youth to participate in a meaningful way and to share their tacit knowledge. Pay attention to details that they describe as important even if you think that they are trivial. The idea of adding "emoji" such as a heart symbol to a handset is a detail that the typical adult might think is trivial but which the target youth segment clearly ascribes a significant value to when choosing which handset to buy.

4. A final key element of the knowledge creation process that Western mobile Internet companies should address is to provide a field of interaction, which facilitates frequent and new ways for stakeholders, their experience and knowledge to interact. This will create the potential for the organizational redundancy, socialization and sharing of tacit knowledge that is so important for knowledge creation to take place. This could include establishing institutionalized practices for regularly rotating personnel through different departments to "learn by doing". Another approach is to encourage formal and informal knowledge sharing meetings and activities both intra-departmentally and inter-departmentally. Redundancy of information will help minimize misunderstandings which might sidetrack efforts leading up to the step where new concepts are justified against the original organizational vision.

Conclusion

Clearly, mobile Internet companies in Japan have benefited from several factors which are unique to Japan. At the same time there is still huge potential for growth of the mobile Internet in the United States. The International Telecommunications Union has identified several factors hindering further market development of the mobile Internet. These include

- Low availability of adequate handsets (presumably they mean to imply handsets at a reasonable price).
- A plethora of languages/formats/ protocols which makes for a fragmented market.
- Lack of evolved billing models.

The mobile Internet represents an exciting opportunity to create stronger, more personal, mutually beneficial relationships between companies and customers. Based on the preceding analysis, a few of the more important steps that companies can take to encourage growth of the mobile Internet include:

- **Avoid pure tech-push plays.** Use a market based approach. Similar to Professor Funk's suggestion to start with simple technology that matches the needs of young people. Initially, focus on simple entertainment applications and the youth market, 14-25 years old who can lever corporate efforts through viral marketing. Then as the market evolves to a broader constituency more complexity can be introduced but only as quickly as the market is prepared to absorb it.
- **Manage expectations.** The United States has a high level of PC Internet penetration and so many potential mobile Internet users have a notion of what the Internet is capable of providing via a PC. Given the small screen and user interface, limited access and processing speed of mobile Internet devices, content simply cannot be as rich as that offered through the PC Internet. In order to steer clear of comparisons with the PC Internet which would likely lead to disappointment among users, MISPs should market their platform as a unique branded communication service and avoid references to the Internet.
- **Promote open access platforms.** The experience in Japan has shown that it is possible to create a market success without having the latest technology. What is more important is how the various elements work together and to match the technology to the market's ability to absorb it. Choosing a platform that encourages people to participate by creating innovative and fresh content and using technology such as cHTML, GIF and MIDI, which are widely used, will make it

easy for a broad range of people to participate in the acceleration of the positive feedback necessary to grow the mobile Internet.

- **Increase partnerships and industry collaboration.** A telecom approach would be to try to supply the complete solution from building the network to providing the content to collecting the revenues. Increasing partnerships will encourage more innovation because a broader range of capabilities will be able to participate. Drawing on the inventiveness and entrepreneurial spirit of a broader group of people will result in a more compelling user experience.
- **Encourage sharing: revenues and resources.** Broader participation will only happen if the participants feel that they can earn a reasonable return for their efforts. Therefore, billing systems which are designed with the needs of content providers in mind are essential to encourage the creation of rich, compelling content.
- **Target users with fresh, contextual content.** Entertainment and sports have proven to be the two most popular content categories in Japan. Creating content which is personal and localized will leverage the unique characteristics of the mobile Internet. Creating a business model which encourages content providers to keep content fresh will encourage users to return frequently and will drive network traffic. Use of mobile search engines and personalized portals, and opt in services will help users access richer content.
- **Lever the personal nature and viral potential of the mobile Internet.** Mobile handsets are the most pervasive and personal networked device available. Mobile handsets are typically associated with individuals and so the mobile Internet has the potential to facilitate more targeted offers to users. Subscribers that perceive that the mobile Internet adds value to their lives will give permission for companies to make targeted offers through opt in arrangements. Targeted offers will provide much higher response rates than traditional media driving value for both companies and users. Targeted offers can be enhanced through viral marketing which depends on core messages being passed between friends, relatives and coworkers in an ever expanding network. When done well viral marketing is an effective and inexpensive means of rapidly gaining market presence. The consumer not only takes responsibility for the message, lending it added credibility, but also the work of passing it others and filtering it for those most likely to be interested or who trust their judgment. Virgin Net demonstrated the power of viral marketing by

emailing just 25 people with an offer for free movie tickets. In less than three hours, all 20,000 tickets had been given away and 22,000 of the 35,000 applicants opted in to receive Virgin Net's regular bulletin service. The real cost of the campaign was minimal given the number of unsold seats at most movie performances. [169]

- **Encourage employees to experiment with new processes for thinking, working and creating.** Companies interested in encouraging innovation should guard against the onset of sclerosis in internal work processes. When senior executives explicitly endorse and then model behavior which reinforces the ongoing testing of new ways of working then employees are more apt be innovative. N&T showed how companies can use figurative language, metaphors, analogies, ambiguity and redundancy in order to create new knowledge which can lead to technology innovation. A full blown adoption of the N&T framework may be overly ambitious for most companies. However, experimentation with some of the concepts, which may be new to employees, is likely to be rewarded with innovative results. Companies can assist this process by creating contexts which enable employees to share their tacit knowledge. Companies can do this by building more redundancy into their organizations through frequent formal and informal exchanges of information, strategic rotation of personnel and emphasizing diversity when creating autonomous work teams.

Appendix

NOTES

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GLOSSARY

Analog	The traditional method of modulating radio signals so they can carry information. Amplitude modulation (AM) and frequency modulation (FM) are the two most common methods of analog modulation. Today, most U.S. cellular systems carry phone conversations using analog, but are migrating to digital technologies.
CDMA	Code Division Multiple Access refers to any of several protocols used in so-called second-generation (2G) and third-generation (3G) wireless communications. As the term implies, CDMA is a form of multiplexing which allows numerous signals to occupy a single transmission channel optimizing the use of available bandwidth. The technology is used in ultra-high-frequency (UHF) cellular telephone systems in the 800- Mhz and 1.9-Ghz bands.
cHTML	Compact HTML, a subset of HTML 2.0, HTML 3.2, and HTML 4.0 specifications designed for limited hardware information appliances.
Gateway	A gateway is a software entity within the mobile network. It connects to the Internet or an Intranet in order to allow content and applications to be sent to WAP or cHTML enabled devices. Such gateways are expected to be able to handle a number of different markup languages.
GPRS	General Packet Radio Services is a packet-based wireless communication service that, when available in 2000, promises data rates from 56 up to 114 Kbps and continuous connection to the Internet for mobile phone and computer users. The higher data rates will allow users to take part in video conferences and interact with multimedia Web sites and similar applications using mobile handheld devices as well as notebook computers. GPRS is based on Global System for Mobile (GSM) communication and will complement existing services such as circuit switched cellular phone connections and the Short Message Service (SMS).
GSM	Global System for Mobile communications, is a digital mobile telephone system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access and is the most widely used of the three wireless telephone technologies (TDMA, GSM, CDMA).
HTML	Hypertext Markup Language is the set of markup symbols or codes inserted in a file intended for display on a World Wide Web browser page. The markup tells the Web browser how to display a Web page's words and images for the user. Each individual markup code is referred to as an element (but many people also refer to it as a tag. Some elements come in pairs that indicate when some display effect is to begin and when it is to end. HTML is a formal recommendation by the World Wide Web Consortium and is generally adhered to by the major browsers, Microsoft's Internet Explorer and Netscape's Navigator, which also provide some additional non-standard codes. The current version of HTML is HTML 4.0. However, both Internet Explorer and Netscape implement some features differently and provide non-standard extensions. Web developers using the more advanced features of HTML 4 may have to design pages for both browsers and send out the appropriate version to a user. Significant features in HTML 4 are sometimes described in general as dynamic HTML. What is sometimes referred to as HTML 5 is an extensible form of HTML called Extensible Hypertext Markup Language XHTML.
IMT 2000	International Mobile Telecommunications 2000 also known as the third generation mobile systems.
IP	Internet protocol.

PDC — Personal Digital Cellular is a wireless protocol used only in Japan.

PHS — Personal Handyphone System.

TDMA — Time Division Multiple Access is a technology used in digital cellular telephone communication to divide each cellular channel into three time slots in order to increase the amount of data that can be carried.

TDMA is used by Digital-American Mobile Phone Service, Global System for Mobile communications, and Personal Digital Cellular (PDC). However, each of these systems implements TDMA in a somewhat different and incompatible way. An alternative multiplexing scheme to FDMA with TDMA is code division multiple access, which takes the entire allocated frequency range for a given service and multiplexes information for all users across the spectrum range at the same time.

3G — 3G is an abbreviation for third-generation wireless, and refers to near-future developments in personal and business wireless technology, especially mobile communications. This phase is expected to reach maturity between the years 2003 and 2005.

The third generation, as its name suggests, follows the first generation (1G) and second generation (2G) in wireless communications. The 1G period began in the late 1970s and lasted through the 1980s. These systems featured the first true mobile phone systems, known at first as "cellular mobile radio telephone." These networks used analog voice signalling, and were little more sophisticated than repeater networks used by amateur radio operators. The 2G phase began in the 1990s, and much of this technology is still in use. The 2G cell phone features digital voice encoding. Examples include CDMA, TDMA, and GSM. Since its inception, 2G technology has steadily improved, with increased bandwidth, packet routing, and the introduction of multimedia. The present state of mobile wireless communications is often called 2.5G.

Ultimately, 3G is expected to include capabilities and features such as:

- Enhanced multimedia (voice, data, video, and remote control).
- Usability on all popular modes (cellular telephone, e-mail, paging, fax, videoconferencing, and Web browsing).
- Broad bandwidth and high speed (upwards of 2 Mbps).
- Routing flexibility (repeater, satellite, LAN).
- Operation at approximately 2 GHz to transmit and receive frequencies.
- Roaming capability throughout Europe, Japan, and North America.

UMTS — Universal Mobile Telecommunications System - Europe's approach to standardization for third-generation cellular systems.

WAP — Wireless Application Protocol is a specification for a set of communication protocols to standardize the way that wireless devices, such as cellular telephones and radio transceivers, can be used for Internet access, including e-mail, the World Wide Web, newsgroups, and Internet Relay Chat. While Internet access has been possible in the past, different manufacturers have used different technologies. In the future, devices and service systems that use WAP will be able to interoperate.

WCDMA — Wideband Code-Division Multiple Access is an ITU standard derived from code-division multiple access CDMA that is officially known as IMT-2000 direct spread. WCDMA is a third-generation mobile wireless technology offering much higher data speeds to mobile and portable wireless devices than commonly offered in today's market.

WCDMA can support mobile/portable voice, images, data, and video communications at up to 2 Mbps (local area access) or 384 Kbps (wide area access). The input signals are

digitized and transmitted in coded, spread-spectrum mode over a broad range of frequencies. A 5 Mhz -wide carrier is used, compared with 200 Khz-wide carrier for narrowband CDMA.

WML Wireless Markup Language.