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# Wireless Technology Diffusion: An Evaluation Model for Wireless Services

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# Wireless Technology Diffusion: An Evaluation Model for Wireless Services

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## Abstract

*The last few years have witnessed the successful diffusion of a number of wireless technologies including the increasing popularity of mobile phone services and wireless web services. As mobile communication now moves towards its next and much awaited milestone-3G services, it is imperative that equipment manufacturers, service providers and application developers must address the diffusion issue to a greater extent. A lot of planning and financial investments are going into 3G projects, hence it is necessary for industry players to understand the user requirements, attitude, behavior patterns and expectations before introducing these services. There have been successes and failures in mobile telephony in the past and many lessons can be learned from those experiences, which can be applied to 3G related services. Hence, to assist companies in successfully diffusing wireless technologies to the end users, this article proposes a Wireless Technology Diffusion Model (WITD Model) which can be used to understand and predict the diffusion of wireless technologies by those who have a stake in provision of mobile services, be it the telecommunication service provider, software developer, equipment manufacturer or a corporate adopting the mobile environment for its employees.*

**Keywords**: Wireless, technology diffusion, wireless services, innovation diffusion, GSM, WAP, i-Mode, SMS, mobile phone diffusion, wireless application

## Introduction

The Mobile Phone industry is fast converging to offer newer and more exciting services. The 3G services will converge the Internet with Mobile services in a more efficient manner (Pedersen 2002). No doubt the mobile services industry is facing a very exciting prospect but with this the following questions emerge-Do we really understand the consumer? Do we really know their requirements when it comes to mobile services? Will they be able to absorb the new technology based services? Will the concept of Mobile Internet be able to effortlessly diffuse itself into the user community?

For mobile services adoption, the end-users implicitly specify a set of demand-side requirements. To understand these requirements, analysis of the context specific behavior of end-users should be conducted (Pedersen 2002).

Many factors need to be considered before researchers and industry players can claim that 3G services would be successfully adopted by the target audience. All mobile services must meet certain criterion for them to be successful and this criterion should take into account the technological, behavioral, societal and demand-side factors concerning the end-user. The focus of this study is to bring out these factors using the WITD Model in a structured way to help both researchers and industry players to successfully introduce mobile services into their respective markets.

To understand these factors, Innovation Diffusion Theory (IDT), discussed in this paper has been taken as the base theory. To complement IDT, elements from the Technology Adoption Model (TAM) have also been used in the WITD model. The model addresses the critical adoption issues for the industry players. In the next section, the findings of existing literature on wireless technology adoption are discussed followed by the introduction and explanation of the WITD Model. WITD model is validated

using four wireless technologies and applications and their adoption process. The implications of this study apply to both researchers and practitioners.

## Literature Review

Only a few literatures have attempted to define the final perimeters that would impact the diffusion of mobile phone services & technology. Most studies have used the empirical research findings to define adoption patterns (Chaterji 2002) and a few of those studies have devised mobile phone service adoption models by extending existing adoption research models (Pedersen 2002). Their emphasis has been more towards quantitative methodologies in comparison to qualitative comparisons. The problem with quantitative methodologies is that they do not take into account the complex market environment and provide only a snapshot of the situation instead of the process. Numerous studies have also been devoted to cellular phone terminal designs, interface designs, handset features and how handset menus and software can be adapted to individual user requirements. Chan, et al. (2002) discusses the usability findings pertaining to mobile applications such as user tasks, content presentation, navigation systems, and the design constraints imposed by form factors. It also provides design guidelines for designing wireless interfaces. Buchanan et al. (2001) defined usability guidelines for WAP and future mobile approaches that reflect a lot on the importance of interface design.

Similarly, Chuang, et al. (2001) has defined useful parameters for mobile terminal design. The usability studies do provide a valuable insight on the future services and are useful for product and interface design professionals. These studies have also indicated the usability challenges that are preventing the wide acceptance of wireless devices as a major platform for Internet access.

As teenagers are considered the fastest growing segment of mobile phone users, sizable research work has been conducted on their usage behaviour and how the teenage consumer can help to understand the cellular phone usage patterns and how these studies can be applied to devising future mobile services. Many studies have provided useful conclusions on the popularity of the text messaging amongst teenagers e.g. (Eldridge and Ginter 2001); (Karlsen et al. 2001). Taylor et al. (2001) emphasise the direct relationship between practice of gift exchange and increased mobile phone and mobile phone content usage. Gift exchange implies that more and more teenagers are receiving mobile phones as gifts from family and friends thus leading to increased usage. Some research works attribute usage of mobile phone with the fashion factor among the teenagers (Ling 2001). There have been many studies with respect to the social context such as (Ling 2001) that provides an insight into how social context factor influences mobile innovations. The studies have concluded on the relationship between demographic factors, how adoption behavior age factor affect user adoption and continued use of mobile services.

Research has also focused on the use of mobile phones in everyday life and how mobile services manage to erase to a large extent the boundary between work and leisure (Green et al. 2001). Some studies such as (Palen et al. 2001) have also defined the various uses of mobile phones in everyday life and leisure. These studies bring out the adoption and post adoption patterns helpful in devising new mobile phone services. Pedersen (2001) and (2002) are by far the most significant research papers that define the parameters of mobile services adoption and their continued use. In his study Pedersen (2001) has created an extended and modified version of TAM and decomposed theory of planned behavior to study the use and adoption of mobile services. The model has been designed to evaluate the adoption potential of new mobile services.

Pedersen (2002) suggests that technology based models are insufficient to explain the mobile commerce adoption process. Instead, it introduces a model that focuses on the demand side (end-user) for judging the adoption criteria of mobile services. A triangulation of three perspectives on the mobile commerce end-user is suggested to understand and explain the end-user adoption process. The three perspectives view the end-user as a technology user, a consumer and a network member.

After close evaluation of all the studies conducted, it has been found that the existing studies do not address the different wireless platforms and are concentrating only on the cellular services while not focusing on other wireless handheld services. The studies that defined the evaluation of mobile services adoption criteria did not consider the demand side and supply side factors as a whole and hence there is a need for a model that can be used from both an end user and the service provider perspective. Most studies failed to recognize that introduction of newer innovations in the wireless industry is very frequent in the mobile services industry and hence there is a strong need to address this factor.

This prompted the creation of the WITD model, which can be used universally by various stakeholders involved in wireless services. The model can be applied to various global markets and user communities and is not restricted to the user preferences

and implementation issues of individual markets. The WITD model was designed to address all the issues listed above. In the next section the Innovation Diffusion Theory (IDT) which has been the main basis of the WITD model is discussed.

## Innovation Diffusion Theory (IDT)

IDT is often associated with research on technology innovation. Most of the innovations studied in IDT research are technology innovations. Developed by Rogers (1963, 1985, 1995), IDT aims to explain, among many things, the process of the innovation decision process, the determining factors of rate of adoption, and different categories of adopters. It helps predicting the likelihood of adoption and rate of adoption of an innovation. One of the major contributions of IDT is the innovation decision process, which starts with one's knowledge about the existence of the innovation and ends with the confirmation of the adoption/rejection decision. Five stages are involved in the innovation decision process (Figure 1). In the knowledge stage, users are first exposed to the innovation and gain initial understanding of the innovation. In persuasion stage, the decision making unit forms the attitude towards the innovation. In the decision stage, the decision to adopt/reject is reached. In the implementation stage, users actually use the innovation. Finally, the adoption/rejection decision is reconfirmed or reversed in the confirmation stage.
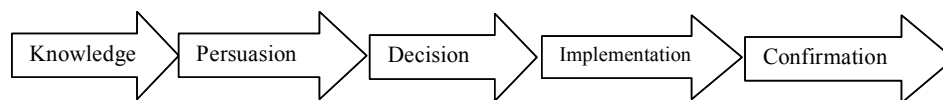


**Figure 1. Innovation Decision Process**
(Source: Rogers 1995)

Another major contribution of IDT is the set of innovation attributes it provides. These innovation attributes, perceived by individuals, help to explain the different rate of adoption. A brief definition of these attributes is given below:

- **Relative advantage** – the degree to which the innovation is superior than the practice it supersedes.
- **Compatibility** – the degree to which the innovation is consistent with the existing facilities and practice.
- **Complexity** – the degree to which the innovation is easy to learn and use.
- **Trialability** – the degree to which one can experiment with the innovation before making the adoption/rejection decision.
- **Observability** – the degree to which the result of the adoption of the innovation is observable to others.

IDT identified five adopter categories (Rogers 1995). The different **adopter categories** are identified as:

- **Innovators** – Represent 2.5 % of the average members of a system. They are characterized by their venturesomeness.
- **Early adopters** – Represent 13.5 % of the average members of a system. They are respected by their peers and are "checked with" before the adoption of an innovation
- **Early majority** – Represent 33 % of the average members of a system. Their deliberation time is longer than innovators and early adopters.
- **Late majority** – Represent 33 % of the average members of a system. They only adopt innovation after the majority of members have done so.
- **Laggards** – Represent 16 % of the average members of a system. They tend to resist innovation.

The five categories accurately depict the various types of adopters in a system, hence understanding their characteristics enable researchers and practitioners to introduce innovations more effectively to different audiences. Research has found that different adopters differ in terms of their socio economic status, personality variables, and communication behaviour; therefore the characteristics of the five categories of adopters can be used for audience segmentation (Ryan and Gross 1943; Rogers 1962; Coleman et al. 1966). IDT is chosen as the base theory for the WITD model because the characteristics of IDT are best suited for the explanation of the adoption of a technology innovation. IDT helps to clearly define the various user segments, their behavior pattern and the innovation attributes. This helps to devise adoption strategies for different user groups.
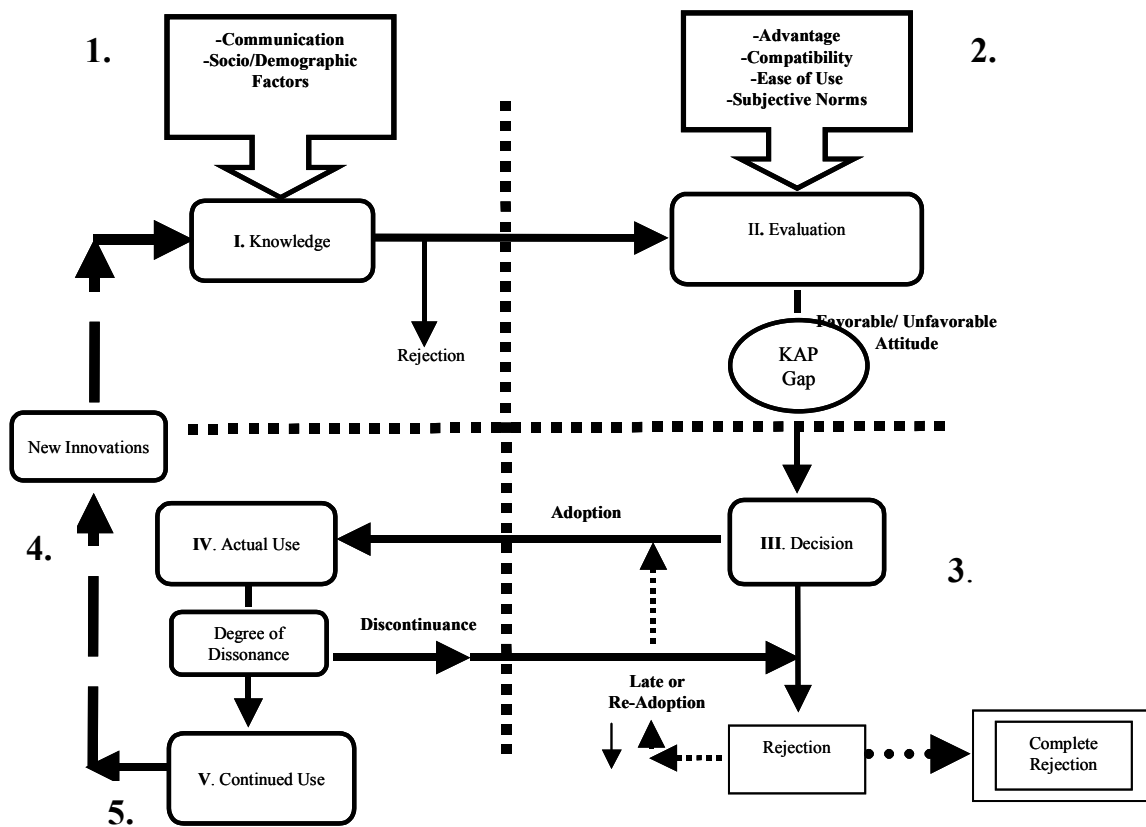
**Figure 2. Wireless Technology Diffusion (WITD) Model**

## Explanation of the WITD Model

The model as depicted in Figure 2 has been created to assist wireless service / content providers and equipment manufacturers in successfully diffusing the wireless technologies amongst consumers. The framework has two-fold objectives. First it allows the stakeholders to assess the potential success/failure of their new wireless applications or services prior to their launch. Second, the model assists the company in proactive planning of their strategies for the entire diffusion process of their new wireless applications / services. The model tries to cover all four phases of a wireless technology. The four phases include knowledge acquisition, user-assessment, decision & actual use and adoption process. Also to be noted is that this model can be applied to both B-2-C environment and B-2-E environment (sales force automation using wireless technology).

The five stages and different components of the model are described below:

### Knowledge

This is the phase during which the user becomes aware of a new service/application. For any innovation to be able to influence the user, the user must gain the **"How to Knowledge"** (Rogers, 1995)**.** The **"How to Knowledge"** consists of information necessary to use an innovation properly. For a new wireless service, the how-to-knowledge includes the basic knowledge about an innovation and what is the purpose of the innovation and how it can help the user. The lack of How-to Knowledge can lead to rejection of the wireless service at the knowledge stage. The two most common ways through which the users get knowledge about a product/service are as follows:

**Communication**: Communication here implies various communication media through which users learn about the new services. A user can learn about the service / application via various forms of advertising, promotion, news and educational media. The communication media that are able to reach the user may differ based on the user's personal and social environment. The effectiveness of a communication medium may differ based on the product and user preference.

**Socio/Demographic Attributes**: The socio/demographic attributes include factors that define and influence the user behavior. They include the social surroundings of the user, the user's personal & professional interaction groups, the user's income level, gender, age etc. An individual's socio/demographic attributes are a good determinant of the level of How to Knowledge that the individual is bound to gain about an innovation. Thus, these factors can affect the user's knowledge level which to an extent influence the future usage of the service/application by the user. For example, a person working at a technology company is likely to get more advanced information about a wireless service/application as the workforce in a technology company is supposedly technology savvy, while a worker at a Food & Beverage processing plant is likely to acquire a lower level of knowledge about a wireless service/application. Therefore socio-demographic attributes of a user help determine the level of knowledge the user has about a wireless service/application.

**Evaluation**

During this stage, a user or a decision making unit may develop a favorable or unfavorable attitude towards a wireless service/ application. There are various factors that contribute towards the development of a favorable / unfavorable attitude. These factors are as follows:

**Advantage**: Advantage implies the perceived advantages that a user expects to achieve by using the service / application. For e.g. College Students users foresee an immediate cost advantage in using the SMS service as it serves their need of keeping in touch with each other i.e. constant connectivity at a lower price.

**Compatibility**: Compatibility implies whether a user perceives an application/service to be compatible with his/her needs or lifestyle. For e.g. in a professional environment, an insurance agent on the move is likely to find a cellular phone more compatible with his need than a secretarial person in an office.

**Ease of Use**: When the users have acquired knowledge about the innovation, their perception of how easy is an application to use is a key attribute to the ultimate adoption of the application. For e.g. SMS service took some time to take-off in the US market because the perception of the users was that it was cumbersome to type on small cellular phone keyboards. It caught on well once handset manufacturers embedded added features in the cellular phones such as mobile keyboards and usable menus to send SMS messages.

**Subjective Norms**: Subjective Norms consist of "**normative beliefs**" and "**motivation to comply**". **"Normative Beliefs"** mean beliefs about what specific individuals / groups think you should (or should not) do. **"Motivation to Comply"** means motivation to go along what those specific individuals think you should do **e.g.** college students buy a mobile phone because their friends own a mobile phone and believe that they should also get it. Similarly, SMS use also escalated because of the motivation of people to go with the group behavior of using SMS to keep in touch. Once a user assesses all or most of these factors, a favorable/unfavorable attitude is formed in the mind of the user.

**KAP Gap**: KAP stands for **Knowledge-Attitude-Practice**. Once a user forms a favorable/unfavorable attitude, it is assumed that this will lead to subsequent adoption or rejection i.e. consistent with the attitude held. However, in some circumstances, formation of favorable/unfavorable attitude does not lead to an adoption/rejection decision. This inconsistency in decision with the actual attitude is called KAP Gap. For e.g. a user might decide not to use a cellular phone due to the cost factor. But a sudden reduction in prices may prompt the user to buy the cellular phone.

**Decision**

The Decision Stage in the WITS model occurs when an individual or a decision making unit engages in activities that lead to a choice to adopt or reject a service/application. Adoption is a decision to use the service/application as the best course of action available. Rejection is a decision not to adopt a service/application. Most individuals will not try a service/application without trying it on a probationary basis in order to determine its usefulness in their own situation. This small scale trial is often part of the decision to adopt.

**Actual Use**

During this stage, the user decides to put the service/application to use. Until this stage, the whole process had been a mental exercise and during this stage, the service/application is actually put into practice. The knowledge attained during the knowledge stage is quite useful at this stage as further adoption of the service/application is quite dependent on that. Also, at this stage the user assesses the actual use experience with the perceived experience.

**Degree of Dissonance**:  It means the inconsistency between the perceived & actual use i.e. the beliefs that the user had when trying the service/application and the actual result of using the technology. If there is lesser inconsistency then continued adoption happens whereas if there is lot of inconsistency and discrepancy between the results of beliefs and actions, then the user will discontinue the use of the service/application. For e.g. a user bought a pager believing it will serve his mobility needs, but realizes that the pager is not able to serve his mobile voice communication needs, hence due to inconsistency between beliefs and actual use, the user realized that paging is not the service for his need for mobility. Hence the use of the pager is discontinued by the user.

**Continued Use**

If the degree of dissonance is low enough i.e. the user has recognized the benefits of using the service/application then the user moves towards the continued use stage. This results in integration of service/application into the ongoing lifestyle/routine of the user and in-effect, the user begins to take the proportion of a service/application advocate. Thus it can be said that potential discontinuers can be differentiated from continued adopters of technology based on their sources of influence (external & interpersonal), perceived service attributes (usefulness & compatibility) and service utilization during their time of initial adoption (Parthasarathy and, Bhattacharjee 1998).

**New Innovations**:  The wireless market is a rapidly ever-changing and evolving market with new applications & technologies on an average of every 9-12 months. For each new technology/application, the user has to go through "**stage 1-4**" all over again. The reason behind this is that each technology is an improvement upon the existing one and promises to revolutionize the user's life "one more time". Thus the process to convince for the adoption of the new technology/application begins afresh.

**Rejection**:  Rejection implies an unfavorable attitude of the user towards the service/application. It is of two types:
  a) **Active Rejection/Discontinuance :** Consists of the user considering adoption of the service/application even after its trial but then deciding not to continue its use.
  b) **Passive Rejection**:  Also called non-adoption, which consists of user never really considering the use of the service/application.

**Late/ Re-Adoption**:  Once a user has decided on passive or active rejection of the service/application, many factors might contribute towards the late adoption or re-adoption of the service/application. This implies that those factors due to which the user rejected the application have either been removed or rectified. These factors could be re-innovation i.e. improvement of the service/application, change of user's socio/demographic environment, shift in subjective norms etc. For e.g. if an office based executive rejected the use of a cellular phone due to lack of visible advantage may decide to take the cellular phone if the nature of his job changes to frequent visits outside the office.

**Complete Rejection**:  It means total rejection of the application and there is no chance of the user trying out the service/application ever again.

## Case Studies

This section contains four prominent case studies based on the WITD model. Each case study has been divided into the four main stages of the WITD model that signifies the relationship between each stage and explains the success and failure as the case may be. The case studies are unique because they capture the success and failures that have taken place in the mobile phone industry and identify the reasons for the success or the failure using the WITD model. The first case describes the factors that led to the success of mobile voice telephony, while the second one describes how the text messaging innovation was successfully diffused into the right target audience and the reasons for its success. The third case identifies the reasons for the failure of WAP when it was first introduced in the market. The fourth case describes the successful diffusion of i-mode in Japan. Since all the four cases

have been evaluated using the WITD model, this section demonstrates to both the researchers and the practitioners, how the WITD model can be used to asses the wireless applications/services and hence judge the potential for their success/failure.

## *Case Study (A): Cellular Voice Telephony*

The first case study describes the diffusion process of mobile voice telephony. Using WITD, the case presents how the mobile telephony is on the upsurge and why it has grown in various markets. Available market data has been used to demonstrate how perceived attributes of use matched the actual user experience of various users and how all this has led to continued adoption of mobile phones.

### Knowledge Stage

The target market place for mobile phone has been very popular in the up market and young adult segments in most of the major mobile phone markets of the world. One of the prime reasons that these people have been the early adopters is because generally people in this age group have a large social network, hence knowledge level becomes higher due to higher interaction. The reason for this has been that the "How to knowledge" i.e. how the mobile phones function and the various uses that mobile telephony can be put to by the users was diffused to the right audience. A study by Eurescom revealed the following about the importance of the size of the social network with respect to the mobile phone use. Figure 3 depicts the direct relationship between the size of social network with respect to the age-group and the related mobile phone use. It shows that large social networks do have an impact on the mobile phone usage.
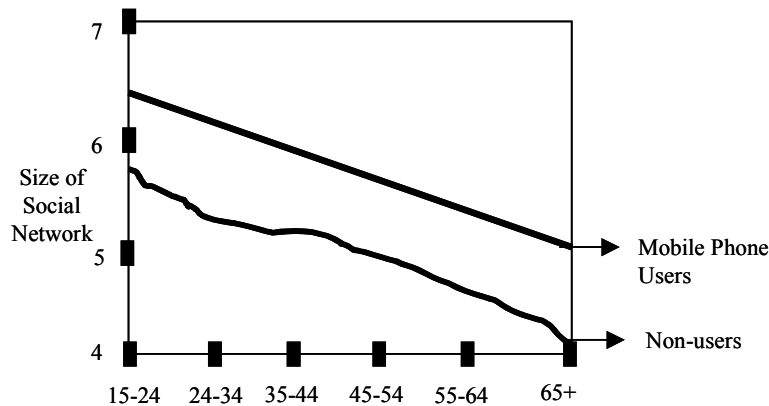


**Figure 3. Size of Social Network and the Use of Mobile Phones**
(Source: Eurescom)

### Evaluation

Most of the target audience that evaluated the mobile telephony technology in the pre adoption stage perceived mobile phones as compatible with their lifestyle. They felt that it gives them the advantage of mobility and saves on time and also acted as a great device for emergency situations. Figure 4 depicts the results of a research report by Eurescom that shows the percentage of people in Europe that tend to regard mobile phones as a useful device for emergency situations.

Most pre-adoption stage users perceived mobile phones as a device that is compatible with their lifestyle, easy to use, advantageous as shown by figure 4. It was suddenly very easy for people to keep in touch with their loved ones. Also the subjective norms acted in favor of mobile phones as people saw everyone around them with a mobile phone e.g. college students, colleagues, friends and thus this led to people following the group behavior i.e. acquiring a mobile phone.

**KAP GAP**: Although many people favor the idea of using mobile phones, a portion of these people failed to adopt the technology due to the KAP GAP factor. According to Eurescom, here are some the reasons given by people for non-adoption of mobile phones:
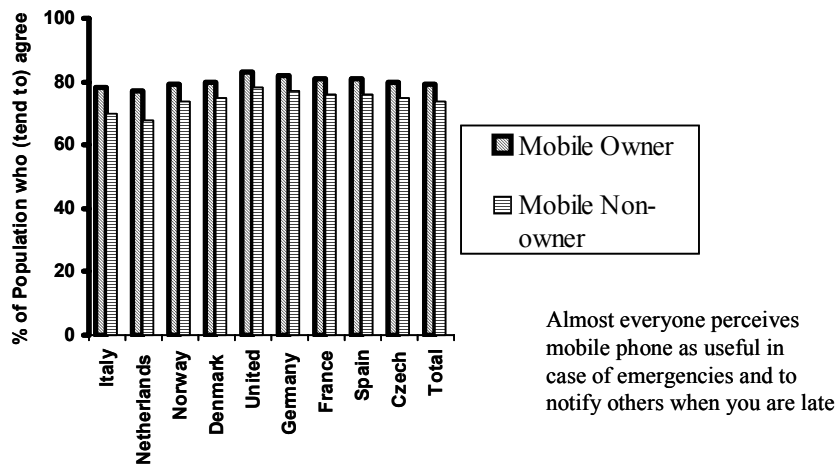
**Figure 4.  Use of Mobile Phones in an Emergency**
(Source:  Eurescom)

- **No need, no interest**:  Many people felt that mobile phones were not compatible with their lifestyle and that it added no real value to their existing lifestyle. Hence Mobile Phones were of no interest to them.
- **The device itself**:   Most people found mobile phones devices as extremely cumbersome and use-unfriendly in terms of ease of use. Thus these people who reached the trial stage, ended up not using the mobile phones
- **Economic factor**:   At the time of their introduction, mobile phones were quite expensive. This was one of the predominant factors that hampered the diffusion of mobile phone technology in the beginning.
- **Health hazard**:  Mobile phones received their share of negative publicity in mainstream media and were regarded in some reports as tumor and cancer causing devices. This also contributed to mobile phones not reaching the adoption stage.

**Decision and Late Adoption**

Most people rejected the mobile phones initially due to the cost factor or the lack of need, but now most of these barriers have come down due to better designs by the company, continued distribution of mobile phones in the market and significant reduction of the handset and service price. The technological and cost related changes led to re-evaluation of the technology by consumers who had initially rejected the services.

**Adoption Stage**

The reason that mobile phones have been successful is because that they matched the perceived usefulness of the users and were able to imbibe themselves in the lifestyles of the target segment in almost all the markets. Below is some data that supports the findings on the application of mobile telephony through the Wireless Technology Diffusion Model.

**Continued Use**

Mobile phone technology has been successfully diffused in markets around the world because the benefits experienced by users in the adoption stage matched the perceived benefits of use. According to a study by Eurescom, the perceived attributes of mobile services seen by the target users that were experienced by users upon using mobile phones are as follows:

**In Terms of Mobility**
  — I am much more mobile than I used to be
  — I used to stay home when I expected a call. Now I leave home when I want to
  — The mobile phone allows you to organize last minute meetings

    — I feel more mobile now, as I am able to mail to my friends abroad

**In Terms of Time**
    — Mobile phone helps to coordinate activities
    — Mobile phone gives stress reduction

Figure 5 illustrates one of the perceived benefits that matched the actual benefits i.e. people believed that mobile phones would allow them to work from home and upon using the mobile phones, the perceived benefit changed to an actual benefit.
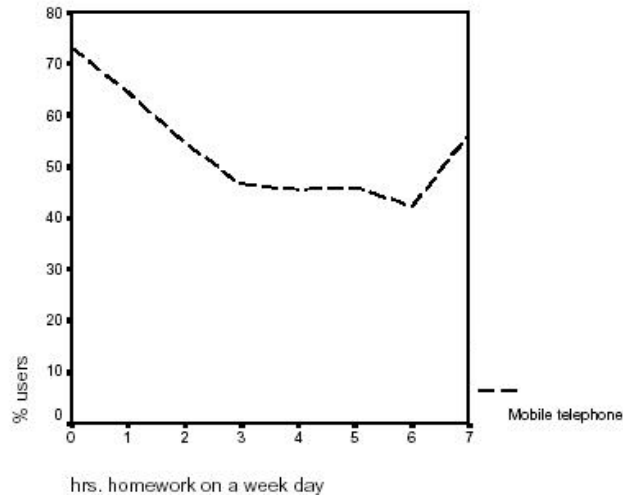


**Figure 5.  Relationship between Working at Home and Mobile Telephone Use**
(Source:  Eurescom)

**Summary**

The case study shows that mobile telephony is successful and is being continually used because knowledge was transferred to the right target audience and it matched the bulk of perceived Attributes of use such as Compatibility, Visible Advantage to a person, Ease of Use and it has embedded into the subjective norm factors that affect the users. The continued innovation and reduction in price have prompted more people to adopt this technology. The transformation of mobile telephony from a technological innovation to a cultural phenomenon has ensured the continued adoption of this technology.

## Case Study (B):  Application-Innovation in Cellular Voice Telephony — SMS/ Mobile Messaging"

This case study is about the successful introduction and subsequent popularity of text messaging service in various markets. The case study reviews SMS (using the WITD model) as a new innovation to the concept of mobile telephony and how its adoption amongst the existing users had to go through the same steps as the adoption process of mobile telephony. It must be acknowledged that text messaging is more popular outside the United States because many countries unlike United States have standardized on interconnected GSM networks. Users can easily send messages to others, regardless of what mobile phone service they use or, for that matter, what country they're in (Magid 2001). Another reason that wireless communication has been slow to pick up in United States is that the need for wireless access in United States is diminished by the dependable Internet and telecommunications infrastructure in comparison to Europe and Asia (Singer 2002).

**Knowledge Stage**

One of the main factors for the success of SMS has been the knowledge transfer to the right segment of users. The biggest user segment of SMS has been the youth (15-30 year old) segment. "One of the biggest markets for SMS services is person-to-person messaging, especially among teens," said John Whittington, senior business consultant for Nokia Networks in the Asia-Pacific.

Keeping the target audience in mind, various promotion methods were used by service providers that lead to the knowledge dissemination of SMS.

**Evaluation**

From the knowledge phase, the target audience saw SMS as an innovation that would be able to find way into their existing mobile lifestyle of users. SMS was perceived by the youth segment as an innovation that will be cost effective and compatible with their lifestyle traits and advantageous considering their social need to communicate.

**Decision**

According to AT Kearney, SMS has been largely rejected by the older segment largely due to the lack of need for short messaging service and the perceived difficulty to use and incompatibility. Also, considering that the 15-30 year old segment has a larger social network, the knowledge diffusion and hence the subsequent use is greater in this segment compared to the older segment.

**Adoption**

A recent report from A.T. Kearney and Cambridge University's Judge Institute of Management corroborates many of these findings. The study found that:
— Younger consumers are driving growth in mobile phones
— SMS is experiencing rapid growth due to low cost of messaging, ease of use in noisy environments, unobtrusive communication during meetings, communication options during urban traffic gridlocks and long train commutes, roaming agreements across nations, and the proliferation of premium services (e.g. downloadable ring tones, news alerts, sports scores, stock updates, targeted ads). Thus, SMS has been able to find a way into the mobile lifestyle of existing users due to low discord between the perceived benefits of the users and the actual benefits. According to Mobile Youth Market Intelligence Research by W2F, only 10% of SMS is being generated by adult users. Not only is significantly more number of youth using SMS but they are also generating more per sender. A typical British youth is sending, on average 2.02 text messages a day. In Germany, it is 2.75 and in the US, it is only a fraction at less that 1 every 5 days.

**Continued Use**

The continued use of SMS since its introduction can also be attributed to low degree of dissonance between perceived attributes of use and actual benefits derived from the use of SMS service. When introduced, SMS promised easy to use, low cost instant communication technology with a big scope for mobile networking especially for teenagers. As mentioned in the adoption section above, the report of AT Kearney confirms that SMS fulfilled its initial promise as an innovation to the mobile phone technology. In addition, SMS has proved to be extremely compatible with the lifestyle of its main target audience: the youth.

**Summary**

SMS as an add-on innovation to mobile telephony has been successfully diffused into the target segment-**The youth in Europe & Asia**. The operators realized where the potential lies for the SMS service and the agreement between the perceived benefits and the actual use led to the extensive and now continued SMS use in markets all across the world. The SMS innovation has paved the way to more graphic oriented Mobile Messaging Services (MMS) and 3G applications. The important point to notice is that although a new innovation is targeted mainly at the existing users, operators must look at creating adoption for these innovations by predicting their response using the Wireless Technology Dissemination model. It would be incorrect to assume that innovation will be adopted proactively by the existing users.

## *Case Study (C): Failure of WAP*

This case study discusses the reason behind the initial failure of WAP. Wireless Application protocol phones were introduced into the market with a lot of hype however, the intended applications and usage of WAP is yet to see the light of the day.

Operators and vendors alike expected WAP to take off to great heights, but the dream is yet to be realized. There are altogether 640 million GSM subscribers in the world and one tenth of them have Internet-enabled WAP phones although they rarely use their phones to access mobile Internet, although the use of SMS has become prevalent among users. In this case study, the WITD model is used to identify why WAP has not been a total success unlike SMS and mobile telephony.

**Knowledge Stage**

The WAP service was targeted at the emerging youth market and most of the knowledge spread process was targeted at this segment. Both operators and equipment makers thought that since SMS was a big hit and matched the needs of million of users worldwide, WAP would be welcomed with open arms by the target audience.

**Evaluation**

WAP was launched with a blaze of publicity. There was a huge waiting list, and the idea of happily surfing the web, and sending and receiving emails while sitting on the top deck of a bus would have appealed to many. Most people perceived

WAP as an application that will allow unbridled and easy access to the Internet based services on their mobile phones. WAP is a classic case in which knowledge dissemination raised expectations of the users.

**Decision**

An important factor that worked against WAP in the European and the US market is the vibrant Internet culture. Users had better options to access the Internet and find information rather than spending extra time on the keypad of a mobile handset completely low on bandwidth. Says James Pearce, UK director of the wireless developer's website Anywhereyougo.com ""You could say that WAP probably won't be successful in the UK and the US. You could argue that those cultures are already familiar with the wired Internet and have quite high expectations as to what it can bring them." Thus, WAP was rejected in the initial stage itself by many users.

**Adoption Stage**

According to various analysts in Europe, the harsh reality is that WAP offers the surfer a one-inch-square, black and green viewing screen with very little content of use. A fiddly keyboard and a connection speed slightly slower than an arthritic snail add up to what many consider to be an unsound investment. While WAP bears little resemblance to a normal web page, both have similar technical issues. Unavailable or downed WAP sites are easily encountered, and many handsets crash on a regular basis requiring a power recycle to respond again.

However, it didn't take long for subscribers to realize that the next new dawn in mobile communications had its own set of limitations. Slow connections and high call charges were only part of the problem. The lack of meaningful and useful WAP sites only made things worse.

> "WAP has been completely over-hyped with respect to what can be delivered today," says James Royan, chief technology officer of Message Central. "This is really unfortunate for WAP as it means the consumer base has been completely disenfranchised. They don't believe that WAP is going to deliver a useful technology in the future."

Thus the perceived attributes of use were not able to match the actual performance leading to a lot of disappointment amongst the users. In the fall of 2000, Nielsen Norman Group sponsored a field study of WAP users in London. Twenty users were given a WAP phone and asked to use it for a week and record their impressions in a diary. Traditional usability tests with users were carried out at the beginning and end of the field study. Half of the users operated an Ericsson R320s and the other half a Nokia 7110e. When users were asked whether they were likely to use a WAP phone within one year, a resounding 70% answered NO - a finding, which was recorded after respondents had used WAP services for a week. When users were asked whether they might get WAP within three years, the "no" responses dropped to 20%. Obviously users in Europe see potential in the mobile Internet, although it has not yet arrived. A major reason why WAP doesn't work lies in the time needed to perform standard tasks (see Table 1).

With WAP users paying for airtime by the minute, these times were a concern to many of the participants. But the study also suggested that good user interface design can alleviate some of the problems. Checking the headlines at The Guardian was quicker than the standard, built-in portal that came with the WAP phones, and that may be because the Guardian made more of an investment in usability. The main problem with the WAP phones was not their design but the very fact that they are telephones. The user experience will be much better on devices that are constructed with information display and manipulation as the main design goal. For example, direct manipulation is a dramatically better way to pick from menu choices and pop-up menus than a scroll wheel or indirect buttons that are placed away from the screen. The main conclusion of the Nielsen Norman Group study was that WAP is currently in a similar state to the one the Web was in around 1994. The greatest problem experienced by the participants was an inability to connect because of network failures, phones crashing, or services being down.

**Table 1. Time Taken to Perform Tasks on WAP Phones**
**(Source Nielsen Norman Group)**

| Task | Minutes | |
|---|---|---|
| | Start | End |
| Read World Headlines | 1.3 | 1.1 |
| Read Guardian's Headlines | 0.9 | .8 |
| Check Weather Forecast | 2.7 | 1.9 |
| Read TV Listings | 2.6 | 1.6 |

**Continued Use**

As witnessed during the adoption stage, the actual use of WAP could not match the perceived benefits of WAP and hence WAP has not been able to achieve the success it promised after its introduction. WAP has been found to be difficult to use, incompatible with the user lifestyle, expensive which is enough to discourage continued use of the technology.

**Summary**

The case study shows that the unsuccessful attempt of WAP to enter the market presents a situation where a mobile application was less compatible and difficult to use. Attach to this the cost of using WAP, it does come across as an unsound investment for the users. Hopefully, as and when 3G services take off, operators and equipment manufacturers would have learned from their WAP lesson and would be able to provide a seamless usability experience to the users. i-Mode as discussed in the next case study has proved that consumer satisfaction and Mobile Internet accessibility and usage can be delivered successfully.

## Case Study (D): The Success of i-mode

While WAP failed to live up to expectations, its rival technology i-mode by NTT DoCoMo has virtually captured the mobile Internet market in Asia. With 39 million cell phone subscribers and revenues last year of $39 billion, DoCoMo is certainly everywhere in Japan. New subscribers are still signing on at the rate of 43,000 a day, 1.3 million a month. In this case study, WITD model has been used to analyze and identity the reasons for the success of i-Mode. As per the WITD model, i-mode has been successful for all the reasons that lead to the failure of WAP.

**Knowledge**

i-mode was targeted at the youth mobile phone users with a special focus on the mobile women. As per NTT DoCoMo, I-mode is most popular among young users, 24 to 35 years of age. The heaviest users of i-mode are women in their late 20s (NTT DoCoMo 2002). The knowledge dissemination was done using various promotion methods that catered to the target audience.

### Evaluation

i-mode promised to be compatible with the lifestyle of the users, easy to use and cost-effective. It promised to empower users to do much more than just talk. It claimed to offer a whole new range of capabilities and provide users with easy dialing and simple Web access from their mobile phones.

### Decision
As noticed in WAP, i-mode has not been very successful with the older segment. It cannot be said that it has been rejected by the older segment, but research figures state that i-mode is more popular amongst the youth segment.

### Adoption

i-mode has been able to effectively match the expectations of the users and thus there has been a growing trend of i-mode adopters converting to continued use of the i-mode services. i-mode has been phenomenally successful in Japan because it is remarkably convenient for users. e.g.- The Web to function is users' one-touch connection to the Internet. For any i-mode-compatible Web site, they just click once to access the site directly. There's no need to enter the URL manually. E-mail, one of i-mode's most successful applications, enables users to send messages with the push of a button and receive messages automatically -- and at low cost. "Dialing up" the network is unnecessary, because the e-mail function is always "switched on". Other advanced i-mode applications bring multiple benefits to business and other users. According to NTT DoCoMo, the average total bill for i-mode data transmission is about US$13 per month as of November 2002. Compared to the present average monthly bills of US$ 50 in the US just for voice services, this figure is alarmingly low.

### Continued Use

The various features offered by i-Mode such as ease of use, compatibility with the user lifestyle, fast web access on mobile phones which the users expected when they started using i-mode had le**d** to its continued use. Also, the subjective norms and normative beliefs especially among women and teenagers worked towards large scale i-mode adoption in Japan.

### Summary

In the case of i-Mode, the degree of Dissonance between the perceived attributes and actual use experience has been extremely low. I-mode also identified its target audience and fed the right knowledge to them. Also, a very important factor for i-mode's success is that it designed the services and applications as per the socio-demographic profile of the target audience and that in turn matched well with the subjective norms of the users (as displayed by the heavy usage of I-mode amongst women). Unlike the WAP scenario, the initial curiosity levels of the consumers generated by an effective knowledge spread process were satisfied by the efficient and seamless services that lead to the growing brigade of i-mode users.

# Conclusion

As depicted in Table 2, for a wireless application / service to be successful the perceived benefits must be matched by the actual benefits otherwise the application / service is prone to rejection as noticed in case study (C) on the failure of WAP. The keys to success are all in the management of expectations and delivery upon those expectations to the end-users. While the wireless medium promises personalized, localized, interactive and immediate marketing opportunities, this potential could also be the potential achilles heel for the stakeholders, if not implemented in the right manner. As depicted by the WITD model, to ensure adoption and continued use of a wireless application, it must go through all the five stages listed by the WITD model.

The model can best be used by researchers, application developers, equipment manufacturers and wireless service marketers in creating end user- friendly offerings. Finally, even though the WITD model holds promise in providing explanation of adoption and continued use behavior, it should be adapted by service providers/ developers as per their requirement and their end user profile. The theoretical work done in this study provides a basis for understanding end-user needs and requirements and this research can be extended as and when the understanding of the diffusion process improves. The model would prove to be a useful

tool for industry players developing an agenda to determine the adoption potential of new services. In particular, the model will help to develop frameworks for services that are directed specifically at end-user categories.

**Table 2. Comparison of Discussed Case Studies as per the WITD Model**

| Perceived Benefits | Actual Benefits | | | |
|---|---|---|---|---|
| | **Cellular Voice Telephony** | **SMS** | **WAP** | **i-mode** |
| Advantage | ✓ | ✓ | × | ✓ |
| Compatibility | ✓ | ✓ | × | ✓ |
| Ease of Use | ✓ | ×* | × | ✓ |
| Subjective Norms | ✓ | ✓ | ✓ | ✓ |

*SMS was initially found by users as quite cumbersome till the handset manufacturers improved the SMS facilities in their product

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