

EXPLORING FACTORS INFLUENCING  
PERSONAL DIGITAL ASSISTANT (PDA) ADOPTION

By

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This document is dedicated to my loving parents, Jin-Gil Kim and Soon-Ae You.

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Abstract of Thesis Presented to the Graduate School  
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EXPLORING FACTORS INFLUENCING PERSONAL DIGITAL  
ASSISTANT (PDA) ADOPTION

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This present study explored factors influencing the adoption of a Personal Digital Assistant (PDA). Under rapidly changing new media environment, it is important to know what affects the adoption of innovations. With this purpose, this study examined a few relationships and showed the results of data analysis. The theoretical background of this current study is diffusion of innovations. In particular, this study focused on the persuasion stage and the decision stage of the innovation-decision process. This research presents eight hypotheses and three research questions: (1) Which factors influence perceived uncertainty toward a Personal Digital Assistant (PDA) at the persuasion stage of the innovation-decision process and which variables have the relatively strong or weak influence on attitude and perceived uncertainty? (2) Will factors affecting attitude and perceived uncertainty toward a PDA be useful in discriminating two purchase intention

groups (high or low)? and (3) Which functions of a PDA are related to attitude toward PDA and purchase intention?

To investigate hypotheses and research questions, a survey was conducted. This study recruited 191 students from a large southeastern university. This current study employed multiple regression, stepwise regression, t-test, and Pearson correlation analysis.

Consistent with past studies, some hypotheses were supported, while other hypotheses were not supported. This study partially supported diffusion theory. As expected, most perceived attributes of PDA were significant determinant in this study. Relative advantage, compatibility, trialability, and personal innovativeness were positively and significantly related to attitude toward PDA. This study found that relative advantage and complexity were significantly correlated to perceived uncertainty. In addition, only attitude toward PDA was a significant determinant to predict purchase intention.

The lack of support might be from limitations of this study. This study dealt with only a few parts of diffusion theory. There remain many topics to be dealt with in future PDA adoption research.

## CHAPTER 1 INTRODUCTION

Currently, the keyword of telecommunication industry is “convergence.” Good examples are Interactive TV (ITV) and a Personal Digital Assistant (PDA). ITV has several functions such as Electronic Programming Guide, Internet, Video On Demand (VOD), online shopping, Personal Video Recorder (PVR), and online game. In case of the PDA, most PDAs are used just as a digital organizer presently and only a few of models have digital organizer as well as other functions – e-mail, Web browsing, mobile phone, MP3 player, playing games, digital camera, word processing/spreadsheets, and Global Positioning System (GPS). Some communication industry analysts contended that a PDA will become the most popular personal communication device and the necessity for businessmen in the near future.

Computer Industry Almanac predicts that the PDA market will keep on growing and phone/PDA combos will become prevalent in 2003. In addition, by 2007, the common PDA will become a multifunctional communication device equipped with mobile phone, GPS, digital camera, etc., and the unit sales of PDA will reach more than sixty one billion units in the worldwide. eTForecasts (2002) also predicts that Pen-PDA, which is the leader in the PDA market, will be the market leader by 2008 among three kinds of PDAs (Pen-PDA, Keyboard-PDA, and Phone-PDA). Presently, total PDA sales are only about fifteen percent of total PC sales, but in 2008, PDA sales will reach about thirty three percent of total PC sales (eTForecasts, 2002). Based on data, it is evident that a PDA is the next generation of mobile computing.

## **Personal Digital Assistant (PDA)**

### **PDA Definition**

A Personal Digital Assistant (PDA) is “lightweight, hand-held computer designed for use as a personal organizer with communications capabilities” (Infoplease, 2003, 1<sup>st</sup> paragraph). It can be held in person’s hand, so it is sometimes called a “Handheld PC.” Many PDAs use a pen-like stylus to input information. Some PDAs work on a keyboard-based input system. Most PDAs adopt Window CE, EPOC, or PalmOS as an operating system. Currently, a PDA is used as not only an organizer or scheduler but also a cell-phone, fax-sender, and so on. According to International Data Corporation, the size of the PDA market will increase more than \$26 billion and 63.4 million units will be sold by 2004.

### **Operation Systems of PDA**

The operation system is one of the most important factors to be considered when consumers purchase a PDA. It is likely that consumers should choose either a Macintosh or an IBM PC when they purchase a personal computer (Freudenrich, 2003). There are three operation systems: (1) Palm OS (3Com), (2) EPOC (Psion), and (3) Pocket PC (formerly Windows CE).

Currently, Palm OS dominates the operation system market. It accounts for more than 70 percent of market share. Pocket PC, however, is encroaching on the territory of Palm OS (Freudenrich, 2003). Relatively, EPOC accounts for only a small portion of the market. Pocket PC supports color displays, graphics, standard packages software (e.g., MS Word, Excel), MP3, MPEG movie files and etc. Palm OS takes up less memory, so it runs faster. On the other hand, Pocket PC takes up more memory and runs slower.

Generally, Palm OS is easier to use than Pocket PC (Freudenrich, 2003). However, the greatest advantage of Pocket PC is familiarity because most consumers are accustomed to use Windows as an operating system on their PC.

According to eTForecasts (2002), Microsoft's Pocket PC, Compaq, HP, Toshiba and several other leading PC companies have introduced Pocket PC-based products that are now growing faster than the overall market. In addition, Linux-based PDAs are developing and appearing. By 2008, Pocket PC-based products and PalmOS-based products will account for almost the same portion of PDA operation system market share in the U.S. (eTForecasts, 2002).

### **A History of PDA**

The origin of PDA is in the UK technology company Psion in 1984. The first model, the Psion I, was a bit thicker, longer, and narrower than a large pack of cigarettes. It had 10K of non-volatile character storage in cartridges, a search function, an LCD display, calendar etc. The Psion II superseded the Psion I in the mid-1980s. The highest version of the Psion II had 64K ROM, 32K RAM and a 4 X 20 character display. The next model, the Series 3a, opened the new generation in Psion's evolution. It had the function to transfer, convert, and synchronize data between the different places. In addition, it had a 40 characters X 8 line mono LCD and 58-key keyboard in the base. These models enabled Psion to dominate the PDA market over more powerful models; Series 3c and Series 5 followed (PCTechGuide, 2003).

One of the notable commercial PDA models is Apple Computer's Newton Message Pad, a milestone of the information age. Soon after, other companies – Hewlett-Packard Co., Motorola Inc., Sharp Electronics Corp. and Sony Electronics Inc. –

attempted to make a handheld communication device. The Newton model was not successful because it was too big and expensive. In particular, its handwriting recognition system was too complicated for users to understand. Even if the Newton's handwriting recognition technology was improved outstandingly compared with the first model, it never would be appealing to consumers. So, Apple gave up continued development of the Newton operating system in 1998 (Freudenrich, 2003; PCTechGuide, 2003).

In 1996, Palm Computing, Inc. introduced Pilot products. This PDA had distinctive characters such as a palm-sized form, remarkably developed graphic interface, and the synchronization between the PDA and other computers. It had a different data input system with Apple's Newton handwriting recognition technology. It enabled consumers to manage their personal and business information, schedules, and other matters anywhere and anytime. Pilot's data input device was either a stylus or a touch-sensitive screen. Pilot was small and light, used AAA batteries as an electronic power supply, and was easy to put to use. That's why a Pilot was popular among consumers. In 1999, Palm Pilot devices were upgraded with excellent Personal Information Management (PIM) software and 160 X 160 pixel backlit screen. PIM software included personal address/phone book, diary, scheduler, calculator, personal account software, watch with alarm function, to-do list and so on. At that time some models were equipped with Graffiti power writing software, an enhanced version of Palm Computing, which enabled consumer to input data with ease. Since the advent of Pilot, Palm Computing has dominated the PDA market. In 2001 the sales of Palm rose to about 13 million (Freudenrich, 2003; PCTechGuide, 2003).

## **Applications of PDA**

A PDA is one of the “convergence” communication devices. A PDA has several applications: Personal Information Management System (PIMS), mobile phone, Internet, E-mail, wordprocessing/spreadsheet, MP3/movie file player, video games, digital camera, global positioning system, and so on.

Like other new technologies, a PDA can be used for several motivations and needs. PDA functions can be categorized into three types: information, entertainment, and communication. PIMS, internet, global positioning system, wordprocessing/spreadsheet and digital camera can be classified as information function. Video games and MP3/movie file player are categorized into entertainment. Finally, as communication functions, mobile phone, and e-mail are classified.

### **A PDA as an information device**

**Personal information management system (PIMS).** A PDA was originally invented as a personal organizer that allows consumer to access, store, and organizer personal information. Most models have these functions such as personal book (addresses, phone numbers, e-mail addresses), diary, scheduler, take notes/write memos, calculator, personal account software, watch (alarm function), and to-do list.

*E-Mail and Web browsing:* The new communication technology allows consumers to send or receive e-mail and surf the Internet through a PDA without connecting with a desktop or notebook. Even though consumers should pay some fees for wireless service, they can use a PDA as mobile computer. Without wireless service, consumers should be able to download e-mails and Internet content from a desktop or notebook by connecting with some PDAs. Some models allow consumers to write e-mails, but not to send them.

In order to send them, consumers must later send them through their computer. Some PDAs need some software for accessing e-mail accounts and Internet.

**Word processor/spreadsheet.** Keyboard-based PDA can provide attributes such as word processor, spreadsheet, and related softwares.

**Getting information.** Because most PDAs have application for accessing the Internet, they allow consumers to get information like news, stock quotes, or something from the Internet.

**Digital camera and Global Positioning System (GPS).** Some PDA models can be used as digital camera and GPS receiver.

#### **A PDA as an entertainment device**

**MP3 and movie file player.** Some PDAs have entertainment functions such as playing mp3 music files and mpeg movie files.

**Video games.** Some PDA models provide consumers with video games that can be played by oneself or with other people through wireless network.

#### **A PDA as a communication device**

**Mobile phone.** The latest PDA model includes mobile Phone. This model does everything a mobile phone does.

#### **The Competitive Products of PDA: Smartphone and Pocket PC**

Smartphone is defined as “a mobile, digital telephone that has features not associated with traditional home or mobile phone” and Pocket PC is defined as “an upgraded version of Windows CE that offers greater stability and a new interface. Features include mobile Internet capabilities, an e-book reader, and handwriting recognition” (Yahoo!, 2003). Smartphone is a new technology in mobile phone that

combines voice and data communication. Like a PDA, Smartphone has functions such as personal information management, sending or receiving e-mails, Internet surfing, playing mp3 and movie files etc. A PDA is based on PIMS, whereas Smartphone is based on a mobile phone with other functions added. These days, however, it is difficult to differentiate among a PDA, a Pocket PC, and a Smartphone because they have almost the same applications. Some specialists suggest that the classification of PDA, Pocket PC, and Smartphone is meaningless.

### **Objective of the Study**

In Korea, which is one of the leading countries for information technology industry, the sales of PDA were decreased in 2002 compare to the previous year. Generally, it was predicted that the sales of PDA would increase every year. A decrease in sales of PDA was not expected by a number of specialists, professor, and analysts of electronic and communication industry. As reasons for this situation, some analysts proposed that the price of PDA is still too high or a PDA does not give consumers better benefits compared to other new communication devices. Considering this present situation of PDA, this study wants to identify which variables affect consumers' adoption of PDA. In addition, even though PDA will become an important communication device in the near future, there is little research about PDAs. This study expects that research about the adoption of PDA will be helpful for marketers or developers related to a PDA at this time.

This study focuses on only two stages of adoption process because of the novelty of PDA (Eastlick, 1996). This research intends to investigate eight hypotheses and three research questions: (1) "Which factors influence perceived uncertainty toward a Personal

Digital Assistant (PDA) at the persuasion stage of the Innovation-Decision process and which variables have the relatively strong or weak influence on attitude and perceived uncertainty?” (2) “Will factors affecting attitude and perceived uncertainty toward a PDA be useful in discriminating two purchase intention groups (high or low)?” and (3) “Which functions of PDA are related to attitude toward PDA and purchase intention?”

Through research hypotheses and questions, this present study will explore the relative influence of perceived characteristics of innovation, ownership of new technologies, personal innovativeness, and attributes of a PDA in exploring attitude toward a PDA, perceived uncertainty for a PDA and adoption of a PDA, based on a model of the Innovation-Decision Process of Diffusion theory.

## CHAPTER 2 LITERATURE REVIEW

This present study intends to examine the relative influence of perceived characteristics of innovation, personal innovativeness, attributes of PDA in exploring attitude toward PDA, perceived uncertainty toward PDA and adoption of PDA. First, a literature review focuses on Roger's diffusion of innovation theory. The diffusion of innovations perspective will be helpful in explaining key concepts of the adoption of PDA. Second, previous adoption studies will be introduced and reviewed. Variables that have been investigated to explain adoption of other new technologies will be examined.

### **Diffusion of Innovations**

Rogers (1995) defined diffusion as “the process by which (1) an innovation is (2) communicated through certain channels over (3) time among the members of (4) a social system” (p. 5). Rogers investigated more than 2,000 empirical diffusion research studies and 3,000 publications (Severin and Tankard, Jr., 1992). Among voluminous diffusion studies, “one of the most influential is ‘The Iowa Hybrid Seed Corn Study’ (Ryan and Gross, 1943) (cited in Severin and Tankard, Jr., 1992).” The investigation of the diffusion of hybrid-seed corn in Iowa affected the methodology, theoretical framework, implications, and interpretations for later diffusion studies and established the classical diffusion paradigm (Rogers, 1995; Severin and Tankard, Jr., 1992). The Iowa hybrid corn study interviewed 259 farmers to investigate when and how they adopted hybrid seed corn and to get information about them and their farm operation. The Iowa study found that the rate of adoption was S-shaped and various communication channels played

important and different roles during the diffusion process. In addition, the Iowa study found the four main component of diffusion: (1) an innovation, (2) the communication channels, (3) time, and (4) a social system.

### **The Innovation**

An innovation is “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers, 1995, p .11). According to Rogers (1995), an individual’s reaction to innovation depends on the perceived newness of the idea and whether an individual thinks the idea novel, so it could be innovation. An individual exhibits “newness” of an innovation as knowledge, persuasion, or a decision to adopt. Most of the new ideas are related to technological innovations, so sometimes “technology” (p. 12) is used as a synonym of “innovation” (Rogers, 1995). Thomson (1967) and Eveland (1986) proposed that a technology is an instrumental design which can decrease the uncertainty in cause-effect relationships in order to fulfill a desired goal. A technology is generally composed of two elements: hardware and software (Rogers, 1995). Rogers (1995) asserted that hardware consists of “the tool that embodies the technology as a material or physical object” (p. 12) and software consists of “the information base for the tool” (p. 12). New technology usually has both a hardware aspect and a software aspect. According to Bayus (1987), a company intends to sell the hardware at a relatively low price in order to capture market share, and then sell the software at a relatively high price in order to improve profits. For example, Xbox and Playstation 2 are currently sold at \$199, a relative low price, whereas game softwares for Xbox and Playstation 2 are sold at prices ranging from \$40 to \$50, a relative high price.

A technological innovation usually provides not only a sort of uncertainty about expected consequences, but also an opportunity to reduce uncertainty (Rogers, 1995). In order to reduce uncertainty about an innovation, an individual seeks information. There are two kinds of information in terms of a technological innovation: *software information*, “which is embodied in a technology and serves to reduce uncertainty about the cause-effect relationships in achieving a desired outcome” (p. 14) and *innovation-evaluation information*, “which is the reduction in uncertainty about an innovation’s expected consequences” (p. 14).

### **Perceived characteristics of innovations**

“What perceived attributes of innovations influence the rate of adoption?” This research question is important in diffusion research studies. Many previous diffusion studies focused on the characteristics of adopters. Little effort, however, has been made to investigate what properties affect rate of adoption (Rogers, 1995). Rate of innovation is “the relative speed with which an innovation is adopted by members of a social system and a numerical indicator of the steepness of the adoption curve for an innovation” (Rogers, 1995, p. 22). The five perceived attributes of innovations may explain rate of adoption from 49 to 87 percent of the variance (Rogers, 1995). The five attributes are (1) “relative advantage”, (2) “compatibility”, (3) “complexity”, (4) “trialability”, and (5) “observability” (p. 206). In addition, there are other variables: (1) “the type of innovation-decision”, (2) “the nature of communication channels diffusing the innovation at various stages in the innovation-decision process”, (3) “the nature of the social system in which the innovation is diffusing”, and (4) “the extent of change agents’ promotion efforts in diffusing the innovation” (p. 206).

Rogers (1995) defined the five characteristics as the followings; (1) relative advantage is “the degree to which an innovation is perceived as better than the idea it supersedes” (p. 212), (2) compatibility is “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (p. 224), (3) complexity is “the degree to which an innovation is perceived as relatively difficult to understand and to use” (p. 242), (4) trialability is “the degree to which an innovation may be experimented with on a limited basis” (p. 243), and (5) observability is “the degree to which the results of an innovation are visible to others” (p. 244). The perceived relative advantage, compatibility, trialability, and observability are positively associated with the rate of adoption, but complexity is negatively related to the rate of adoption (Rogers, 1995).

There have been several researches intended to explain adoption of innovations by the perceived attributes of innovations as predictors of adoption (LaRose and Atkin, 1992; Eastlick, 1993 & 1996; Lin, 1998; Parthasarathy et al., 1998; Du, 1999). Eastlick (1993) examined whether relative advantage, compatibility, complexity, and trialability would affect the adoption of videotex more than other properties of the innovation. Relative advantage and compatibility properties were more significant predictors than other properties (Eastlick, 1993). Lin (1998) proposed that in adopting a personal computer, consumers considered relative advantage of personal computer, but complexity was not a real apprehension. LaRose and Atkin (1992) found that compatibility was not a good predictor in explaining the adoption of Audiotext. Du (1999) contended that the complexity and relative advantage of internet was significantly related to adoption of

Internet in China. Based on previous studies, this study expects that perceived attributes of the innovation should be the important variables affecting adoption of PDA.

### **Communication Channels**

Communications is “a process in which participants create and share information with one another in order to reach a mutual understanding” (p. 35), and a communication channel is “the means by which messages get from one individual to another” (p. 36) (Rogers, 1995). According to Rogers (1995), usually, communication channels includes two kinds of channels: mass media channels and interpersonal channels. Mass media channels include any mass medium such as television, internet, radio, and so on, which transmit messages to one or more individuals, so mass media channels are more rapid and efficient channels to send potential adopters information about innovations than interpersonal channels. Interpersonal channels are more effective in encouraging an individual to adopt an innovation, because interpersonal channels involve a face-to face exchange between two or more individuals who are in similar in socioeconomic status (Rogers, 1995).

### **Time**

Time is one element in the diffusion process (Rogers, 1995). Rogers (1995) showed several processes relative to the time dimension in adoption of innovations: (1) “the innovation-decision process”, (2) “the innovativeness of an individual or other unit of adoption compared with other members of a system,” and (3) “an innovation’s rate of adoption in a system” (p. 20).

### **The innovation-decision process**

The innovation-decision process is “the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision” (Rogers, 1995, p. 20). Rogers (1995) operationalized five steps in this process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. This process is “an information-seeking” and “information-processing activity” (p. 20), by which an individual intends to get information in order to reduce uncertainty about innovations (Rogers, 1995). Rajagopal (2002) conceptualized the six steps into (1) initiation, (2) adoption, (3) adaptation, (4) acceptance, (5) routinization, and (6) infusion. Grover and Goslar (1993) suggested three steps of adoption: (1) initiation, (2) adoption, and (3) implementation.

The knowledge stage occurs when an individual is exposed to an innovation’s existence and obtains some information about how it functions (Rogers, 1995). At the persuasion stage, an individual develops a favorable or unfavorable attitude toward the innovation. At the decision stage, an individual takes part in activities to choose adoption or rejection of an innovation. The implementation stage occurs when an individual puts an innovation into use and at this stage, re-invention is likely to occur. And finally, at the confirmation stage, an individual intends to discover “reinforcement of the innovation-decision already made or reverses a previous decision to adopt or reject the innovation if exposed to conflicting messages about the innovation” (Rogers, 1995, p. 181).

In this study, the persuasion stage and the decision stage will be focused on.

**Innovativeness and adopter categories**

Innovativeness is “the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system” (Rogers, 1995, p. 22). Innovativeness is the criterion for adopter categorization, so Rogers (1995) categorized adopters based on the relative time at which an innovation is adopted: (1) innovators: venturesome, (2) early adopters: respect, (3) early majority: deliberate, (4) late majority: skeptical, and (5) laggards: traditional. Generally, the adopter distribution is closely bell-shaped. It means that the classification of adopters is almost the normal frequency distribution. Rogers (1995) found that the innovators accounts for about 2.5 percent, early adopters accounts for about 13.5 percent, early majority accounts for about 34 percent, late majority accounts for about 34 percent, and laggards accounts for the last 16 percent. Numerous researches have investigated which variables are related to innovativeness and the classification of adopters. Rogers (1995) summarized variables into three categories: (1) “socioeconomic status,” (2) “personality values,” and (3) “communications behavior” (p. 268). Rogers (1995, p. 269-274) asserted the following generalizations based on three categories (see table 1). According to him, earlier adopters are younger, better-educated, and higher-status than later adopters. In terms of personal variables, earlier adopters have greater empathy, ability to deal with abstraction, rationality, and intelligence than later adopters. In addition, earlier adopters are have more highly interconnected through interpersonal networks in their social system, more change agent contact, greater exposure to mass media communication channels and interpersonal communication channels, greater knowledge of innovations than later adopters (Rogers, 1995).

Table 2-1: Summary of the generalization of the adopters

<b>Socioeconomic Characteristics</b>	<ul style="list-style-type: none"> <li>● “Earlier adopters are not different from later adopters in age.”</li> <li>● “Earlier adopters have more years of formal education than later adopters.”</li> <li>● “Earlier adopters are more likely to be literate than are later adopters.”</li> <li>● “Earlier adopters have higher social status than later adopters.”</li> <li>● “Earlier adopters have a greater degree of upward social mobility.”</li> <li>● “Earlier adopters have larger units (farms, schools, companies, and so on) than later adopters.”</li> </ul>
<b>Personality Variables</b>	<ul style="list-style-type: none"> <li>● “Earlier adopters have greater empathy than later adopters.”</li> <li>● “Earlier adopters may be less dogmatic than later adopters.”</li> <li>● “Earlier adopters have a greater ability to deal with abstractions than do later adopters.”</li> <li>● “Earlier adopters have greater rationality than later adopters.”</li> <li>● “Earlier adopters have greater intelligence than later adopters.”</li> <li>● “Earlier adopters have a more favorable attitude toward change than later adopters.”</li> <li>● “Earlier adopters are better able to cope with uncertainty and risk than later adopters.”</li> <li>● “Earlier adopters have a more favorable attitude toward science than later adopters.”</li> <li>● “Earlier adopters are less fatalistic than later adopters.”</li> <li>● “Earlier adopters have higher aspirations (for formal education, occupations, and so on) than later adopters.”</li> </ul>
<b>Communication Behavior</b>	<ul style="list-style-type: none"> <li>● “Earlier adopters have more social participation than later adopters.”</li> <li>● “Earlier adopters are more highly interconnected through interpersonal networks in their social system than later adopters. Connectedness is the degree to which an individual is linked to others.”</li> <li>● “Earlier adopters are more cosmopolite than later adopters.”</li> <li>● “Earlier adopters have more change agent contact than later adopters.”</li> <li>● “Earlier adopters have greater exposure to mass media communication channels than later adopters.”</li> <li>● “Earlier adopters have greater exposure to interpersonal communication channels than later adopters.”</li> <li>● “Earlier adopters seek information about innovations more actively than later adopters.”</li> <li>● “Earlier adopters have greater knowledge of innovations than later adopters.”</li> <li>● “Earlier adopters have a higher degree of opinion leadership than later adopters.”</li> </ul>

### Rate of adoption

The rate of adoption is “the relative speed with which an innovation is adopted by members of a social system” (Rogers, 1995, p. 206). Generally, most innovations have an S-shaped curve and the stiffness of curve depends on the rate of innovations (Rogers,

1995). Rogers (1995) contended that five variables affect the rate of adoption of innovations: (1) “perceived attributes of innovations”, (2) “type of innovation-decision”, (3) “communication channels”, (4) “nature of the social system”, and (5) “extent of change agents’ promotion efforts” (p. 207).

Perceived attributes of innovations – relative advantage, compatibility, complexity, trialability, and observability – explain from 49 to 87 percent of the variance of the rate of adoption (Rogers, 1995). Rogers (1995) suggested that Innovation-decision falls into three types: “optional”, “collective”, and “authority” (p. 372) and defined the three types of innovation-decisions as the followings (p. 372);

*Optional innovation-decisions*: “choices to adopt or reject an innovation that are made by an individual independent of the decisions by other members of a system”.

*Collective innovation-decisions*: “choices to adopt or reject an innovation that are made by consensus among the members of a system”.

*Authority innovation-decisions*: “choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise”.

In general, optional innovation-decisions by individual are more rapidly adopted than collective innovation-decisions by an organization, because the number of persons who take part in making a decision influences negatively the rate of adoption (Rogers, 1995).

Additionally, communication channels, the nature of the social system, and the extent of change agents’ promotion efforts affect an innovation’s rate of adoption.

### **A Social System**

Rogers (1995) defined a social system as “a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal” (p. 23). Individuals, informal groups, organizations, or subsystems may be the units of a social system

(Rogers, 1995). A social system is some place for diffusion to occur. The effect of system norms, opinion leaders and change agents in a social system, types of innovation-decisions, and consequences of innovation are affected by the system's social structure (Rogers, 1995).

There are individuals to provide information and advice about innovations to other members in the social system. Opinion leaders influence members of the social system (Rogers, 1995). Rogers (1995) defined opinion leadership as “the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency” (p. 27). Compared with the followers, opinion leaders are (1) “more exposed to all forms of external communication, and thus are more cosmopolite,” (2) “have somewhat higher social status,” and (3) “are more innovative” (Rogers, 1995, p. 27). In a social system, an opinion leader may support or oppose change.

A change agent is a professional who represents change agencies external to the system (Rogers, 1995). A change agent is “an individual who influences clients’ innovation-decisions in a direction deemed desirable by a change agency” and generally attempts to obtain the adoption of innovations or prevent the adoption (Rogers, 1995). Sometimes, change agents use opinion leaders in a social system as a means of diffusion campaigns (Rogers, 1995).

### **Diffusion and Adoption of Other New Technologies**

*Television, radio, Video Cassette Recorder (VCR), videotex, audiotex, cable, personal computer, digital TV, HDTV, internet, mobile phone, Satellite TV, Personal Digital Assistant (PDA).....* during the past decades, we have met various new

communication technologies. It is no wonder that there are many previous researches about adoption of new technologies. Diffusion of innovation theory is the dominant paradigm for explaining innovation adoption in communication studies. This has been applied to a wide range of new technologies adoption: Audiotext (LaRose and Atkin, 1992; Neuendorf and Atkin, 1998), computer (Danko and MacLachlan, 1983; Dickerson and Gentry, 1983; Dutton, Rogers, and Jun, 1987; Lin, 1998), videotex (Heikkinen and Reese, 1986; Eastlick, 1993), cable (LaRose and Atkin, 1988), internet (Atkin, Jeffres, and Neuendorf, 1998; Du, 1999; Ferguson and Perse, 2000; Papacharissi and Rubin, 2000; La Ferle, Edwards, and Mizuno, 2002), HDTV (Dupagne, 1999), ISDN (Jeffres and Atkin, 1996), electronic bulletin board (James and Wotring, 1995), personal social services (Martinez-Brawley, 1995), computer-mediated political communication systems (Garramone, Harris, and Pizante, 1986), and online shopping (Zellweger, 1997; Jarvenpaa and Tractinsky, 1999; Li, Kuo, and Russell, 1999; Lohse and Spiller, 1999; Swanminathan, Lepkowska-White, and Rao, 1999; Tan, 1999; Wolfenbarger and Gilly, 1999; Vellido, Lisboa, and Meehan, 2000; Miyazaki and Fernandez, 2001; Fenech and O’Cass, 2001; Limayem et al., 2001; Koufaris, et al., 2002).

From television to Internet, various innovations have been researched as to their adoption. A PDA has several new technologies as functions (e.g., Internet, e-mail, mobile phone, wordprocessing/spreadsheet, etc.). Therefore, this study believes that previous adoption studies may be helpful in examining which factors influence adoption of PDA.

### **Internet Adoption**

Internet is the most rapidly growing new mass media. Internet has already become one of the important necessities in daily life. Internet has grown significantly

during the past decade, particularly with respect to its use as a tool for communication, entertainment, and online shopping. The new PDA models allow consumers to access wireless Internet. So, it may be argued that a PDA has a close relation to Internet.

Many researchers have studied the Internet. Papacharissi and Rubin (2000) examined predictors of Internet use in terms of a uses-and-gratifications perspective and how (1) “social and psychological antecedents; contextual age and unwillingness to communicate, (2) perceptions of media attributes; social presence, and (3) internet motives influence behavioral (patterns of internet exposure) and attitudinal (internet affinity and satisfaction) outcomes of internet use” (p. 182). They found some interesting results that the relationship between interpersonal utility and passing time was the highest correlation among Internet motives and “the relationships between internet motives and the social and psychological antecedents support the use of the internet as a functional alternative for internet users for whom other channels were not as available or rewarding” (p. 191). Ferguson and Perse (2000) intended to explore the World Wide Web (WWW) as a functional alternative to television. Their research investigated the similarity of television viewing and internet surfing, and showed that the most significant motive for visiting WWW is entertainment and that, as a way “to pass time” (p. 169), Internet can compete with television. In addition, they proposed that television viewing and the WWW are functionally different and “the Web may not become a functional alternative to television viewing for relaxation” (p. 170). Atkin et al., (1998) explained adoption of internet by several variables: social locators, media use, new media adoption, and communication needs. According to Atkin et al., (1998), among independent variables, social locators (age, education, and income) and technology compatibility were

significantly associated with adoption of internet, while communication needs, activities, and orientations were not related to Internet access.

Du (1999) and Carrie et al. (2002) examined Internet diffusion in China and Japan respectively. Du (1999) purposed to find out which factors affect Internet adoption and Chinese usage patterns. It was found that in China, early adopters of internet were prominently male, young, well-educated, higher-income, and single (Du, 1999). In addition, Du (1999) contended that relative advantage, complexity, innovativeness, Internet content, resources, speed, and ISP service quality affected Internet adoption in China. Carrie et al. (2002) considered cultural difference in Internet diffusion and suggested individualism, uncertainty avoidance, the power distance, and masculinity as factors which contribute to differences in adoption of the Internet and computers.

### **Online Shopping Adoption**

The Internet has grown significantly during the past decade. In particular, online shopping is a rapidly growing area in Internet business. Forrester Research forecasted that online retail trade will be about \$ 217.8 billion by 2007 and account for 8% of total retail revenue. Researches for online shopping or electronic exchange usually have examined the factors that influence adoption of online shopping. Perceived risk (security/privacy) (Donthu and Garcia, 1999; Jarvenpaa et al., 1999; Vellido et al., 2000; Fenech and O’Cass, 2001; Miyazaki and Fernandez, 2001), trust (Donthu and Garcia, 1999; Swaminathan et al., 1999; Jarvenpaa et al., 1999; McKnight and Chervany, 2001), demographics (Donthu and Garcia, 1999; Li et al., 1999), shopping orientation (Li et al., 1999; Swaminathan et al., 1999; Wolfinbarger and Gilly, 1999; Fenech and O’Cass, 2001; Fenech and O’Cass, 2001; Koufaris et al., 2001), innovativeness (Donthu and

Garcia, 1999; Citrin, 2000) and other factors (retailer's reputation, internet usage, channel utilities, etc.) were used as independent variables in order to explore the factors that affect online shopping behavior, attitude, and adoption. A PDA has a function of Internet. It means that consumers can do online shopping through a PDA. Therefore, the previous studies about the adoption of online shopping will be helpful for this present study to select the factors influencing the adoption of PDA.

Demographic has been an important factor in diffusion, adoption, and uses & gratifications studies. Li et al. (1999) posited that consumers who are better educated, have a higher income, and are male will purchase online more frequently than these who are not. In addition, they suggested a proposition that age is not a significant factor. Donthu and Garcia (1999) also posited that "Internet shopper differ from non-shoppers in age, education, income, and gender" (p. 53). Especially, it was expected that age might be a factor that affects internet shopping (Donthu and Garcia, 1999). Both researches found that income is significantly related to online shopping behavior. Interestingly, however, the results of the other factors (age, education, and gender) were different each other. Li et al. (1999) asserted that gender and education were significant variables and age was not significant, while Donthu and Garcia (1999) contended that age was a significant variable, and education and gender were not significant.

Perceived risk is one of the most important concerns for internet shopping. Dowling and Staelin (1994) defined risk as a consumer's perceptions of the uncertainty and adverse consequences of engaging in an activity. Generally, consumer's perceived risks on the Internet are associated with privacy and security of consumer records (Swaminathan et al., 1999; Fenech and O'Cass, 2001; Miyazaki and Fernandez, 2001).

According to Zellweger (1997), perceived unsatisfactory security is one of the obstructions to online purchasing. Miyazaki and Fernandez (2001) asserted that “higher levels of Internet experience may lead to lower risk perceptions regarding online shopping and fewer specific concerns regarding system security and online retailer fraud yet more concerns regarding online privacy” (p. 41) and “perceived risk as least partially mediates the impact of Internet experience on online purchase behavior” (p. 41).

According to Fenech and O’Cass (2001), perceived Web security strongly affects Internet users’ attitude toward Web retailing. Donthu and Garcia (1999) found that nonshoppers show more adversity to risk than internet shoppers. In addition, Vellido et al. (2000) contended that consumer risk affects attitude toward shopping, but not intention toward shopping. However, differently from other studies, Swaminathan et al. (1999) showed that the security of electronic exchanges and privacy issues are not a concern to average consumers when they use the Internet for shopping, because Internet security and payment systems have developed more confidentiality every year.

Consumer shopping orientation is one of the important factors in online shopping behavior studies (Li et al., 1999; Swaminathan et al., 1999; Wolfinbarger and Gilly, 1999; Fenech and O’Cass, 2001; Koufaris et al., 2001). According to Li et al. (1999), there were differences in convenience and experience orientations between Web buyers and non-Web buyers, while there were not any differences in recreational and economic orientations. Swaminathan et al. (1999) found that convenience-oriented consumers are more likely to purchase online and those who value social interactions are less likely to purchase online and use the Internet less frequently for shopping. Donthu and Garcia (1999) also suggested that Internet shoppers are more convenience-oriented than

nonshoppers. Fenech and O’Cass (2001) showed that consumer’s shopping (recreational rather than economic) orientation influences attitude toward Web-retailing.

Citrin et al. (2000) contended that domain-specific innovativeness had a significant positive relation with the adoption of the Internet for shopping. According to Limayem et al. (2000), personal innovativeness has a significant affect on attitude and intention in relation to online shopping. In addition, Donthu and Garcia (1999) found that Internet shoppers were more innovative than nonshoppers.

### **Personal Computers Adoption**

Some consumers think of a PDA as a kind of mini computer. Currently, Pocket PC, created for a smaller notebook, is referred as a different device from a PDA. However, in a few of years, Pocket PC and PDA will be referred to as the same communication device because both of them will have the same functions and applications. This study expects that previous researches about adoption of personal computers provide important implications for examining PDA adoption.

The personal computer was used as an important innovation in previous diffusion studies (Dickerson and Gentry, 1983; Dutton, Rogers, and Jun, 1987; Lin, 1998). Dickerson and Gentry (1983) intended to investigate “the nature of the adopter of one particular technological innovation, the home computer” (p. 227) and suggested three predictors to provide profiles of innovation adopters: demographic characteristics, consumer creativity, and previous experiences. In addition, Dickerson and Gentry (1983) showed that adopters were more likely to be home owners, better educated, older, and higher income than non-adopters. Additionally, a consumer’s creativity and previous experiences were significantly related to adoption of the home computer. Dutton, Rogers,

and Jun (1987) also researched adoption of personal computer and patterns of use. Their study took four categories of variables: (1) “the independent factors shaping patterns of personal computing, the intervening variables of (2) adoption and (3) use, and (4) impacts” (p. 220) and drew the eight general conclusions from meta-analysis (p. 243-245):

- (1) Years of formal education is strong in explaining the adoption and use of home computing.
- (2) One of the important uses of home computers is to learn how to use a computer, in addition to accomplishing specific tasks such as word processing or playing video games.
- (3) Early research on home computing underemphasized the use for work at home, and overemphasized the computer’s use for education and entertainment.
- (4) The potential social impacts of home computing are illustrated by contemporary shifts in time use in adopting households.
- (5) The role of contextual factors in shaping the uses and impacts of personal computing needs to be examined more fully.
- (6) Different types of computer users should be more fully differentiated.
- (7) The negative impacts of home computing – such as computer addiction, less sleep, social isolation, and family conflicts – found in past research need further investigation.
- (8) Future research is needed concerning home computing as one part of communications technologies in the home.

Lin (1998) explored the adoption of the personal computer as an interactive multimedia entertainment and information provider and posited that resources, innovativeness need, complexity, advantages, communication technology ownership, media use level, and demographics would affect adoption of personal computer. In addition, Lin (1998) found that education, ownership of communication technology, the perceived advantage, resources, and need for innovativeness are significant predictors.

### **Information Systems (Audiotex, Videotex, and Electronic Bulletin Board) Adoption**

Information systems such as audiotex, videotex, electronic bulletin board, and so on, were perceived as innovations in the late 80’s and early 90’s. At that time, many

researchers examined information systems diffusion and adoption (Heikkinen and Reese, 1986; LaRose and Atkin, 1992; Eastlick, 1993; James and Wotring, 1995; Jeffres and Atkin, 1996; Neuendorf, Atkin, and Jeffres, 1998).

LaRose and Atkin (1992) posited that early adoption is typical of consumers who are (1) younger, better educated, and male and (2) heavier users of functionally similar technologies. That research found that household size, use of cellular phones, videotext, 800 numbers, automatic teller machines, speaker phones and auto-dialers were the most powerful predictors of adoption of audiotext. In addition, answering machine use, female, conference call use, ethnicity, and education level were positive predictors, while electronic mail use, personal use, and VCR ownership were negative predictors (LaRose and Atkin, 1992) and interestingly, results were found that VCR's compatibility (the functional similarity with audiotext) was negatively related to adoption of audiotext and other technologies, which were not functionally similar with audiotext, were positively associated with adoption of audiotext (LaRose and Atkin, 1992). Neuendorf et al. (1998) examined adoption of two audio information services: audiotext (including 1-900 service) and fax. They posited the following research question: "what are the relative influences of social indicators (including demographics), media use, communication needs, and, particularly, QOL (Quality of Life) assessments on people's use of audio information services and fax" (p. 86). In result, media use were more predictive of adoption for audio information service that social indicator and communication needs QOL might become the predictors of adoption (Neuendorf et al., 1998).

Heikkinen and Reese (1986) researched newspaper readers' adoption of videotext with individual characteristics (information need and channel orientation).

Eastlick (1993) intended to investigate factors which affect the adoption of videotex shopping. Eastlick (1993) posited that perceptions of the properties of a videotex shopping system and the innovation properties (relative advantage, compatibility, trialability, and complexity) will be better predictors than any other variables. Eastlick (1993) asserted that “perceptions of the advantages of videotex shopping and its consistency with shopping needs and experiences were important factors in determining either an adoption or nonadoption decision.” (p. 73).

James and Wotring (1995) investigated and characterized the users and uses of electronic bulletin board messages in terms of adopter characteristics and social impacts. That study found that education, income, gender, and occupation were related to adoption of electronic bulletin board, but age was not. In addition, James and Wotring (1995) showed that electronic bulletin board would not affect radio listening, large group communication, and small group communication.

### **Other New Technologies Adoption**

Dupagne (1999) investigated the characteristics of potential High-Definition Television (HDTV) adopters. Additionally, this researcher examined how demographics, mass media use, ownership of home entertainment products, and importance of television attributes affect HDTV awareness, interest, and purchase intention (Dupagne, 1999). According to Dupagne (1999), demographics, mass media use, and the number of home entertainment products were partially significant related to HDTV awareness and interest, and only the perceived importance of television attributes had a significant relation with purchase intention.

Garramone, Harris, and Pizante (1986) examined predictors of motivation to use Computer-Mediated Political Communication Systems (CMPCS). Interestingly, among several variables (demographics, needs, traditional political participation, satisfactions obtained from traditional political participation, and satisfactions anticipated from CMPCS use), only needs and satisfactions expected from CMPCS use were significant predictors of motivation to use CMPCS (Garramone et al., 1986).

Factors influencing the adoption of multimedia cable technology were examined by Lin and Jeffres (1998). Lin and Jeffres (1998) contended that existing media use patterns and media content satisfaction might be helpful in establishing the potential dynamics of functional substitutions between an existing and emerging medium.

Parthasarathy and Bhattacharjee (1998) examined post-adoption behavior in the context of online services. Their study focused on investigating discontinuance in the online services industry by variables (communication channels, utilization level, perceived innovation attributes, network externalities, and reasons for discontinuance).

Okolica and Stewart (1996) examined factors affecting the use of voice mail. Perceived usefulness, individual innovativeness, and training had a positive relation with use of voice messaging (Okolica and Stewart, 1996).

## CHAPTER 3 RESEARCH MODEL

This chapter will present the hypothesized model. This model is based on the innovation-decision process. Additionally, in the basis of previous researches, this current study selected several variables to explore the adoption of PDA. This chapter will explain each of variables. In the last part, this current study will show the hypothesized model. In the next chapter, the relations among variables will be suggested.

### **Independent Variables**

#### **Perceived Characteristics of the Innovation**

In many researches, perceived characteristics of the innovation explained individuals' perceptions about innovations as important predictors of adoption behavior (Agarwal and Prasad, 1997). According to Rogers (1995), the making-decision unit forms attitude toward the innovation at the persuasion stage. After making-decision unit knows about the innovation, it can begin to form an attitude toward the innovation. Rogers (1995) contended that at the persuasion stage, perceived characteristics of an innovation play in an important role to form an attitude. Perceived characteristics of the innovation consist of (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. All attributes except complexity are positively related to adoption of innovations (Rogers, 1995). Ostlund (1974) found that perceived characteristics of innovation are significant predictors of new product purchase. Eastlick (1993), in videotex adoption study, expected that relative advantage, compatibility, trialability, and complexity would be better predictors of adoption of videotex than other characteristics

and found that relative advantage and compatibility were better properties. Du (1999) proposed that relative advantage, compatibility, and complexity were factors influencing Internet adoption in China. Sund et al., (2001) found that relative advantage, complexity, and compatibility are relevant to adoption of ERP systems. According to Lin (1998), relative advantage was a significant predictor of adoption, while complexity was not significantly associated with adoption of personal computers.

Most researches, which had perceived characteristics of an innovation as independent variables, exclude trialability and observability. In addition, in most researches, these two variables didn't have a significant effect. On the other hand, several studies found that trialability is a significant predictor for adoption of innovations (Moore and Benbasat, 1991; Agarwal and Prasad, 1997).

Based on previous assertions, it is clear that perceived characteristics of innovations play an important role in predicting innovation adoption. This present study will leave relative advantage, compatibility, complexity, and trialability as independent variables and exclude observability in this study.

### **Ownership of New Technology Products**

Rogers (1995) contended that an individual's experience with one innovation influences individual's adoption of the next innovation. In addition, Rogers (1995) suggested one concept: "technology cluster" (p. 15). A technology cluster is defined as "one or more distinguishable elements of technology that are perceived as being interrelated" (Rogers, 1995, p. 15). Rogers (1995) asserted that any innovation doesn't have a clear-cut boundary with other innovation and potential adopters often perceive one innovation as closely related to another new innovation.

In terms of the notion of technology cluster, previous several studies examined the relation between adoption of innovation and other technology experience (Dickerson and Gentry, 1983; Jeffres and David, 1996; Lin, 1998; Dupagne, 1999). Ettema (1984) found that the adoption of other innovations affected the adoption of text services. On the basis of Roger's concept, Lin (1998) contended that "communication media sharing certain functional similarities may create synergies insofar as adoption rates are concerned – assuming that other circumstantial factors such as pricing are held constant" (p. 99) and found that communication technology ownership (e.g., satellite dish, VCR, video camera, compact disc player, laser disc player, video game player, electronic personal organizer, electronic pager, answering machine, cellular telephone, fax machine, word processor, cable TV subscription, premium cable TV subscription, DBS subscription, and voice mail subscription) is an important predictor of the personal computer adoption rate. According to Dupagne (1999), adoption of HDTV is positively related to the number of home entertainment products. Dickerson and Gentry (1983) found that "adopters of home computers have had more experience with a variety of technical products and services than non-owners" (p. 234). Jeffres and David (1996) proposed that media use pattern is a significant predictor of the degree to use the new technologies. Danko and MacLachlan (1983) found that the early adopters of personal computers owned other high technology products (e.g. microwave oven, tape-deck equipment, and video games).

On the basis of previous adoption studies, this current study expects that ownership of technology products can be one of predictors for adoption of PDA.

**Personal Innovativeness**

According to diffusion theory, adoption of innovations is a function of personal innovativeness, or willingness to try the innovations (Jeffres and Atkin, 1996). Many studies employed personal innovativeness as a predictor in order to explain the adoption of innovations (Venkatraman, 1991; Manning et al., 1995; Lin 1998; Lin and Jeffres, 1998; Donthu and Garcia, 1999; Du, 1999; Citrin et al., 2000; Im et al., 2003). Rogers (1995) defined innovativeness as “the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system” (p. 37) Additionally, Rogers (1995) asserted that innovativeness affects the rate of adoption. Lin (1998) posited that “need for innovativeness” (p. 97) is a positive factor in showing an interest in and involvement with innovations. Pope et al. (1999) proposed that personal innovativeness is positively associated with purchase intention for sports products via the Internet. Donthu and Garcia (1999) also suggested that Internet shoppers have more innovativeness than nonshoppers. Im et al. (2003) found that new product adoption behavior is positively affected by innate innovativeness and personal characteristics don’t influence innovative potentiality. Citrin et al. (2000) classified consumer innovativeness into two types: “open-processing innovativeness” and “domain-specific innovativeness” (p. 294). Open-processing innovativeness focuses on a cognitive style and domain-specific innovativeness focuses on product category or domain specific (Citrin et al., 2000). Citrin et al. (2000) also found that open-processing innovativeness doesn’t have a significant relation with the adoption of Internet shopping, while domain-specific innovativeness has a positive relation with the adoption of Internet shopping. Venkatraman (1991) also sorted innovators into two types: “cognitive innovators” and

“sensory innovators” (p. 52). According to Venkatraman (1991), cognitive innovators are defined as “people who have a strong preference for new mental experiences” (p. 52) and sensory innovators are defined as “people who have a strong preference for both new cognitive and sensory experiences” (p. 52). In addition, Venkatraman (1991) found that “the interaction between innovativeness tendencies and product type determines the demographic profile of the adopter within each segment of cognitive and sensory innovators” (p. 64). Manning et al. (1995) showed two scales of consumer innovativeness: “Consumer Independent Judgment Making (CIJM)”, which is defined as “the degree to which an individual makes innovation decisions independently of the communicated experience of others” (p. 329) and “Consumer Novelty Seeking (CNS)”, which is defined as “the desire to seek out new product information” (p. 329) and examined measurements of the two scales and the relationship between them and the adoption process. Findings were that CIJM was significantly related to only the later trial stage and CNS was positively associated with the initial stages of the adoption process (Manning et al., 1995).

Based on the previous studies, personal innovativeness may be a significant determinant to predict the adoption of PDA.

### **Intervening Variables**

#### **Attitude toward PDA.**

The persuasion stage is the step involved in forming favorable or unfavorable attitude toward the innovation. Rogers (1995) suggested that “the main outcome of the persuasion stage in the innovation-decision process is either a favorable or unfavorable attitude toward the innovation” (p. 169). At this stage, individuals consider mentally

various situations, and then develop an attitude toward the innovation. Finally, they form a favorable or unfavorable attitude. Therefore, attitude toward PDA will be examined in this study.

### **Perceived Uncertainty**

Rogers (1995) defined “uncertainty” as “the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probability of these alternatives” (p. 6). Rogers (1995) also asserted that during innovation-decision process, the making-decision unit tries to reduce uncertainty about the expected consequences of an innovation and information is a significant means of reducing uncertainty. Especially, at the persuasion and decision stage, an individual seek “innovation-evaluation information” (p. 168) to reduce uncertainty. Eastlick (1996) defined perceived uncertainty as a variety of risks associated with adopting an innovation. Consumer behavior is motivated to reduce risk and reduction of uncertainty is related to information acquisition, transmission, and processing (Taylor, 1974). Grønhaug (1972) also contended that consumer behavior is related to a problem-solving process. Dowling and Staelin (1994) said that “the concept of perceived risk most often used by consumer researchers defines risk in terms of the consumer’s perceptions of the uncertainty and adverse consequences of buying a product or service” (p. 119). Cox and Rich (1964) referred perceived risk as “the nature and amount of risk perceived by a consumer in contemplating a particular purchase intention” (p. 33). Miller and Friesen (1982) operationalized uncertainty into the components of hostility, heterogeneity, and dynamism. Sheth and Parvatiyar (1995) contended that the uncertainty is associated with perceived risk and consumers intend to develop various ways to reduce perceived risk.

Eastlick (1996) defined perceived uncertainty as a variety of risks associated with adopting an innovation. On the other hand, Knight (1965) defined the concepts of risk and uncertainty separately. Knight (1965) contended that when it is lack of knowledge of a precise probability, uncertainty exists and risk exists in cases where there is a known probability. Usually, however, researchers have accepted the two concepts to be used synonymously (Mitchell, 1998). On the basis of previous suggestions, the present study will conceptualize perceived uncertainty as perceived risk, so this study assumes that “risk” will be exchangeable with “uncertainty.”

Garner (1996) suggested six types of risks: social, financial, physical, performance, time, and psychological. Dholakia (1997) contended that the six dimensions of perceived risk are helpful in explaining importance for a product classes. Ho and Ng (1994) explained customers’ risk perception of electronic payment systems with five risks (physical, performance, psychological, financial and time risks). Ko (2001) found that perceived risk is related to online auctions. The perceived risk was used as a variable in several studies for online shopping (Donthu and Garcia, 1999; Jarvenpaa et al., 1999; Swaminathan et al., 1999; Fenech and O’Cass, 2001). Sometimes risk or uncertainty is viewed as an expectation of loss (Stone and Winter, 1987). Mitchell and Greatorex (1993) addressed four types of loss: financial loss, time loss, physical loss, and psychosocial loss. Finally, the reduction of perceived uncertainty is one of the consequences in the persuasion stage.

### **Dependent Variable**

#### **Purchase Intention**

The next stage of the persuasion stage is the decision stage. According to Rogers (1995), the decision stage occurs when “an individual (or other decision-making unit) engages in activities that lead to a choice to adopt or reject an innovation” (p. 171). He defined “adoption” as “a decision to make full use of an innovation as the best course of action available” (p. 171). In this study, adoption of PDA will be operationalized as purchase intention for PDA.

### **Additional Variable**

#### **Functions of PDA**

As a “convergence” communication device, a PDA has several functions: PIMS, internet/e-mail, global positioning system, wordprocessing/ spreadsheet, digital camera, video games, MP3/movie file player, mobile phone, and so on. This study expects that the perceived importance of each function will be related to attitude toward PDA. Therefore, for exploratory attempt, this present study will examine which functions will be related to attitude and purchase intention.

### **Hypothesized Model**

This study presents the following hypothesized model with variables to be selected for this current study (see Figure 3-1). The relations among the variables will be explained in the next chapter.

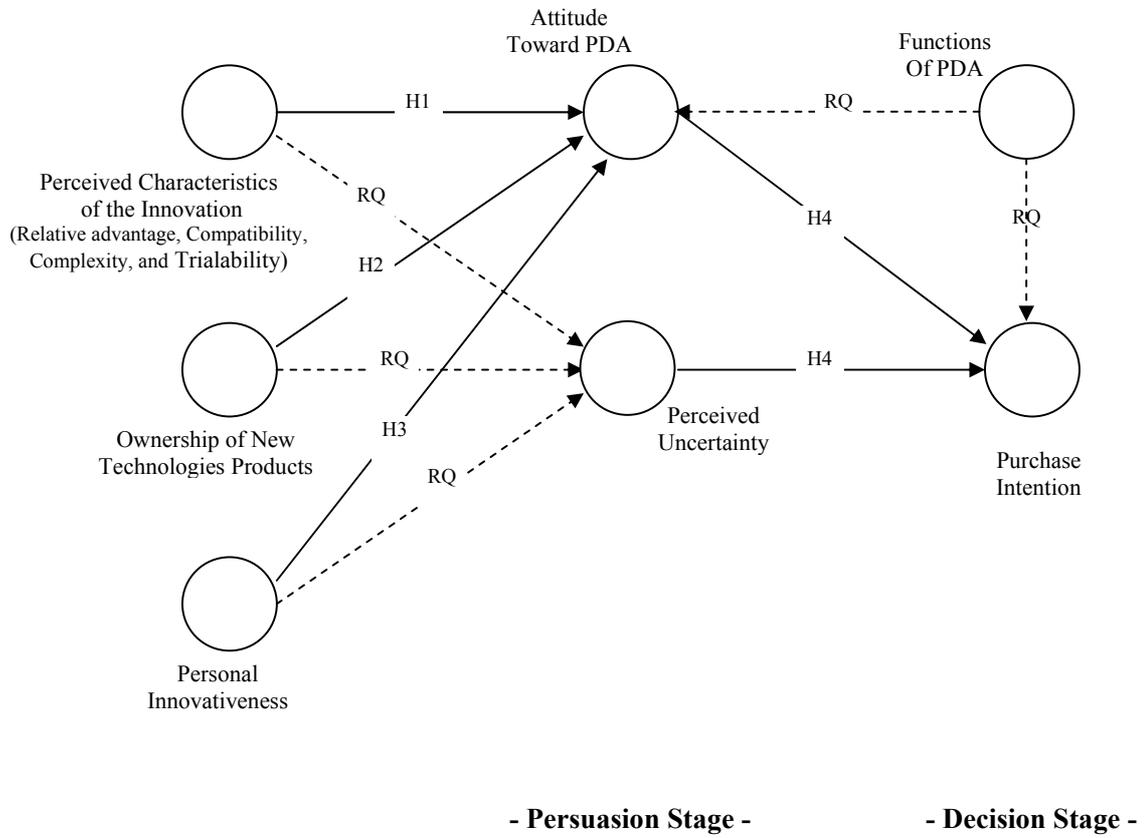


Figure 3.1: Hypothesized Model

## CHAPTER 4 HYPOTHESES AND RESEARCH QUESTIONS

This research intends to examine the relative influence of perceived characteristics of innovation, personal innovativeness, attributes of PDA in exploring attitude toward PDA, perceived uncertainty, and purchase intention, and the relationships among the variables, based on a model of the Innovation-Decision Process of Diffusion theory. In order to investigate relations among variables, hypotheses and research questions were created.

### **Hypotheses**

The first hypotheses deals with the persuasion stage of the innovation-decision process of diffusion theory. The second part is derived from the decision stage.

#### **The Persuasion Stage**

In the persuasion stage, an individual (or making decision unit) forms favorable or unfavorable attitude toward innovations and attempts to reduce uncertainty about expected consequences of an innovation and get information, which is a significant means of reducing uncertainty (Rogers, 1995). This study posits that perceived characteristics of innovations, ownership of new technology products, and personal innovativeness influence attitude toward PDA at the persuasion stage. With respect to perceived uncertainty, this study created a research question about the relationship between variables and perceived uncertainty.

**Relation between perceived characteristics of innovations and attitude toward PDA**

Hypothesis 1 expresses the relation between perceived characteristics of innovations and attitude toward PDA. Rogers (1995) asserted that perceived attributes of innovations (relative advantage, complexity, compatibility, trialability, and observability) play an important role in the persuasion stage and only complexity influences negatively the adoption of innovations. Du (1999) showed that relative advantage, compatibility, and complexity affected significantly the adoption of the Internet in China. Lin (1998) found that relative advantage was a significant predictor of adoption of personal computer. Ostlund (1974) showed that perceived innovation attributes were strongly correlated to new product purchase. In addition, according to Eastlick (1993), relative advantage and compatibility were positively related to videotex adoption. Holak (1988) found that product trial was positively correlated to purchase intention. Sund et al., (2001) also contended that three innovation attributes (relative advantage, complexity, and compatibility) are related to the adoption of ERP systems. According to Parthasarathy and Bhattacharjee (1998), relative advantage (usefulness) and compatibility was significant factors of post-adoption behavior, but complexity was not significant.

Based on previous studies, the following hypotheses are designed.

*H1.1: Relative advantage will be positively related to attitude toward PDA*

*H1.2: Compatibility will be positively related to attitude toward PDA*

*H1.3: Complexity will be negatively related to attitude toward PDA*

*H1.4: Trialability will be positively related to attitude toward PDA*

**Relation between ownership of new technology products and attitude toward PDA**

Hypothesis 2 is designed to investigate the relationship between ownership of new technology products and attitude toward PDA.

Atkin (1993) suggested the notion of “functional similarity/need compatibility explanation” (p. 52) in his study. It means that the adoption of innovations is associated with the adoption of functionally similar technology (Lin and Jeffres, 1998). Perse and Dunn (1998) asserted that in terms of uses and gratifications perspective, perceptions about the different communication channels have an important meaning for two reasons: (1) “people turn to different communication channels, because they believe that they will derive something from that use,” and (2) “few communication channels are uniquely able to fill communication needs. Most are functional alternates to other channels, or able to fill similar communication needs” (p. 436). Atkin (1993) found that cable subscribership is related to functionally similar media and cable subscribers tended to adopt VCRs, camcorders, and cordless phones more than nonsubscribers. In addition, he found that pay viewers were more likely to adopt cellular phone, computers, walkman, and video games. Perse and Courtright (1993) contended that the adoption of new technologies is related to the adoption of functionally similar product. Danko and MacLachlan (1983) found that the early adopters of personal computers owned other high technology products. According to Reagan et al. (1995), people have a tendency to select technologies to fit a function and several technologies can provide a similar function to other technologies. They supported the concept of “functional similarity” and found that functional similarity seems to vary depending on the innovations. Dickerson and Gentry (1983) posited that “adopters of home computers will have had more experience than

non-adopters with other technical consumer products” (p. 228). Their study found that 17 of 19 technical products and services were more likely to be used by home computer adopters. Lin (1998) focused on investigating the relation between the adoption of personal computer and communication technology ownership and found that the relation was significant. Dupagne (1999) examined how the number of home entertainment products influences HDTV awareness, interest, and purchase intention. LaRose and Atkin (1992) found that ownership of several technology products is a positive or negative predictor. Atkin et al. (1998) asserted that the adoption of new product is associated with the adoption of other innovations. Neuendorf et al. (1998) investigated the adoption of an audio information service and fax in terms of two kinds of functionally similar media: entertainment media (e.g., television, movies) and utilitarian media (e.g., personal computers).

On the basis of these previous researches, ownership of other technologies is expected as an important predictor of PDA adoption. In order to investigate ownership of new technologies, seven products were selected: (1) mobile phone, (2) video game player, (3) DVD player, (4) digital camera, (5) digital Cable/satellite TV, (6) broadband, and (7) Personal Video Recorder.

*H2: The number of ownership of new technologies (Mobile Phone, Video game player, DVD player, Digital camera, Digital Cable/Satellite TV, Broadband, and Personal Video Recorder) will be positively related to attitude toward PDA.*

### **Relation between personal innovativeness and attitude toward PDA**

Hypothesis 3 is designed to examine how personal innovativeness influences attitude toward PDA. Citrin et al. (2000) investigated the relation between two types of innovativeness (open-processing innovativeness and domain-specific innovativeness) and

adoption of Internet shopping. Manning et al. (1995) conceptualized innovativeness as “consumer independent judgment making” and “consumer novelty seeking” (p. 329) and examined how the two types of innovativeness affect adoption at each stage of the adoption process. Im et al. (2003) explored the relation between innate consumer innovativeness and new product adoption behavior. Venkatraman (1991) developed different innovativeness segments (cognitive innovativeness and sensory innovativeness) and explored their influence on the adoption of an innovation. Donthu and Garcia (1999) also examined the relation between innovativeness and adoption of Internet shopping. Du (1999) found that innovativeness was a significant predictor of Internet adoption. Lin and Jeffres (1998) focused on the relation between innovativeness traits and the adoption of multimedia cable technology. Limayem et al. (2000) posited that personal innovativeness affects directly and indirectly both attitude and intention of online shopping. In addition, Pope et al. (1999) hypothesized that individual’s innovativeness would have a positive relation with intention to purchase sport product through the Internet.

Considering previous studies, the following hypothesis below were formulated for this study

*H3: Personal innovativeness will be positively related to attitude toward PDA.*

### **The Decision Stage**

At the decision stage, an individual takes part in activities to choose adoption or rejection of an innovation (Rogers, 1995). Rogers (1995) asserted that in this stage, attitude toward PDA and perceived uncertainty affect purchase intention.

### **Relation between attitude toward PDA and perceived uncertainty, and purchase intention**

Hypothesis 4 is derived from the decision stage of the innovation-decision process of diffusion theory. At the decision stage, an individual decides on adoption or rejection of an innovation. Rogers (1995) asserted that attitude toward an innovation does not lead to adoption or rejection under many other circumstances, but there is a positive relation between attitude and behavior. Brown and Stayman (1992) examined antecedents and consequences of attitude toward the ad with a meta-analysis of 47 researches about attitude toward the ad and focused on the relations between ad attitude, brand attitude, and purchase intention. Ko (2002) found that attitude toward the brand positively affect purchase intention. Lutz et al. (1983) contended that attitude toward the ad is positively related to brand attitude and purchase intention. Limayem et al. (2000) also found that an individual's attitude had a strong correlation with intent toward online shopping. According to the Theory of Reasoned Action (Fishbein and Ajzen, 1975) and the Theory of Planned Behavior (Ajzen, 1985), beliefs affect person's attitudes and attitudes, in turn, influence behavioral intention, which is a good forecaster of actual behavior. Therefore, it is expected that attitude is one of the factors influencing purchase intention of PDA.

*H4.1: Attitude toward PDA will be positively related to purchase intention.*

Rogers (1995) contended that an individual seeks information to reduce perceived uncertainty for the innovation and this may affect his/her adoption/rejection. Reduction of perceived risk positively affects consumers' shopping activities (Dowling and Staelin, 1994). Cox and Rich (1964) contended that perceived risk by the consumer is a function of the amount at stake in the purchase intention and perceived risk is one determinant of telephone shopping. Mitchell (1998) found that consumer risk perceptions had an important role in grocery retailing. Perceived risk was applied to

examine online purchase of sport products (Pope, 1999). Perceived risk affects overall evaluation of the deal and purchase intention (Wood and Scheer, 1996). In addition, Ko (2001) found that perceived risks influence the adoption of online auction participation.

On the basis of other researches, the following hypothesis is provided:

*H4.2: Perceived uncertainty will be negatively related to purchase intention.*

### **Research Questions**

This study suggests three research questions about the adoption of PDA:

*RQ1: Which factors influence attitude toward Personal Digital Assistant (PDA) and perceived uncertainty at the persuasion stage of the Innovation-Decision process and which variables have the relatively strong or weak influence on attitude and perceived uncertainty?*

The first research question is designed to investigate the relationships between the independent variables (relative advantage, compatibility, complexity, trialability, ownership of new technologies, and personal innovativeness) and perceived uncertainty. In addition, this study will examine whether there is a significant difference among the significant variables.

*RQ2: Which factors will be useful in discriminating between two purchase intention groups (high or low)?*

The second research question addresses which variables can be used as significant factors to discriminant between a high purchase intention group and a low purchase intention group.

### **Relation between the Functions of PDA and Purchase Intention**

According to previous studies, from the perspective of uses and gratifications, one innovation can have several functions to satisfy motivations and needs. December (1996) contended that the Internet is used mainly for communication, interaction, and

information. According to the 9th WWW User Survey conducted by Georgia Tech (GVU's 9th WWW user survey, 1998), entertainment, education, time wasting and personal information are main purposes for the youngest user to use the web. Hunter (1996) suggested that the Internet involves five categories of needs: cognitive needs, affective needs, personal integrative needs, social integrative needs, and escapist needs. Rubin (1981) showed nine motivations to view television: to pass time, for companionship, arousal, content, relaxation, information, escape, entertainment, and social interaction. According to Sherry et al. (2001), challenge, arousal, and diversion were the most frequently reported reason for using video games.

In HDTV adoption research, Dupagne (1999) found that HDTV purchase intention was related only to the perceived importance of HDTV attributes. Even though a PDA has many attributes, few models have these functions currently and most of them will be added in the near future. So, this present study expects to know how respondents perceive each function of PDA and how each function is related to attitude toward PDA. Finally, the third research question is the following:

*RQ3: which functions of PDA are related to attitude toward PDA and purchase intention?*

## CHAPTER 5 RESEARCH METHODOLOGY

Babbie (2001) proposed that “survey research is probably the best method available to the social researcher who is interested in collecting original data for describing a population too large to observe directly and surveys are excellent vehicles for measuring attitudes and orientations in a large population” (p. 238). Most adoption researches have used a survey as a research technique. In addition, previous studies provide a number of reliable scales for measuring variables regarding the adoption of the innovation. So, this current study expected that a survey would be adequate for exploring the adoption of PDA and this study used a survey.

### **Sample**

The sample used for the present study was 218 students from a large southeastern university. This study recruited respondents from several classes at the university. The researcher visited these classes and administered a survey. In other words, this study used a convenience sampling. The survey was conducted from March 18 to April 17, 2003; 191 samples were valid, and 27 samples were invalid. Among the subjects, 62.3 percent were female and 37.7 percent were male. Most respondents were undergraduate students (76.4%).

### **Measurements**

The survey for this study provided all subjects basic information about a PDA with a picture (see Figure 5-1) and the following information:



Figure 5-1: Personal Digital Assistant

Information:

- This is the picture of Personal Digital Assistant (PDA).
- The newest model can provide you several functions:  
It enables you to access Internet/E-mail and Global Positioning System (GPS) through satellite. As a communication device, it has a mobile phone. It also allows entertainment: You can play MP3, movie files and video games. In addition, it has functions of digital camera, digital organizer, and wordprocessing/Spreadsheet.

After the subjects read the information, they were asked to answer questionnaires.

First, respondents were asked to address their awareness, expected cost, and ownership of PDA. Some of the questions were: (1) “Have you ever heard of a Personal Digital Assistant (PDA)?” (2) “How much do you think the newest PDA would cost?” (3) “Do you own a PDA?”

Second, subjects were asked to express their levels of agreement with 12 statements, in order to measure perceived characteristics of PDA.

**Relative advantage.** Parthasarathy and Bhattacharjee (1998) conceptualized relative advantage as “usefulness” (p. 336). That study proposed that earlier adopters think of online services as being more useful than later adopters do. Okolica and Stewart (1996) also employed perceived usefulness to examine the extent of use of voice messaging. The

present study adapted a usefulness measuring scale from Parthasarathy and Bhattacharjee (1998). “Usefulness” was measured using a seven-point scale ranging from strongly agree (7) to strongly disagree (1). This part of questionnaire consisted of three items: (1) “I feel that a PDA will save me time/effort over other means of performing the same tasks,” (2) “I feel that a PDA will enable me to perform many tasks better than through other means,” and (3) “I feel that a PDA will provide a greater value than other ways of performing the same task”.

**Compatibility.** A compatibility measuring scale was also adapted from Parthasarathy and Bhattacharjee (1998) and used a seven-point scale. This scale had three items: (1) “I feel that a PDA will be easy for me to adjust to,” (2) “I feel that a PDA will fit my lifestyle very well,” and (3) “I feel that a PDA will fit the way I perform my daily tasks well.”

**Complexity.** Parthasarathy and Bhattacharjee (1998) operationalized complexity as “ease of use” (p. 337). Ease of use has an inverse meaning to complexity. For measurement of complexity this study also used Parthasarathy and Bhattacharjee (1998) scale. This scale ranges from strongly agree (7) to strongly disagree (1) and involves questions like the followings: (1) “I feel that a PDA will be hard to learn,” (2) “I feel that a PDA will be quite complicated to master,” (3) “I feel that a PDA will be difficult to use,” and (4) “I feel that a PDA will have a complex, hard-to-learn system”.

**Trialability.** Agarwal and Prasad (1997) measured trialability as “the extent to which potential adopters perceive that they have an opportunity to experiment with the innovation prior to committing to its usage” (p. 562). Several previous researches indicated the relation between only the first three attributes (relative advantage,

compatibility, and complexity) and their dependent variables (Eastlick, 1993; Lin, 1998; Parthasarathy and Bhattacharjee, 1998; Du, 1999). However, some studies employed trialability as a factor to measure the perceptions of adopting innovations (Moore and Benbasat, 1991; Agarwal and Prasad, 1997). The present study uses trialability as a predictor that affects attitude toward PDA and perceived risk. In this study, previous study (Agarwal and Prasad, 1997) scale was adapted. The following two questions were used: (1) “I might try out a PDA long enough to see what I could use it for,” and (2) “Before deciding to use the PDA, I would like to be able to try one out.”

Third, in order to investigate ownership of new technology products, subjects were asked to address their ownership of seven new technologies. In previous studies, experiences with other technologies played an important role in exploring new technology adoption (Dickerson and Gentry, 1983; Jeffres and David, 1996; Lin, 1998; Dupagne, 1999). In particular, Dupagne (1999) examined the relation between the number of home entertainment and adoption of HDTV. So, this present study adapted the Dupagne questionnaire (1999) to measure the number of new technology products: “Do you personally own the following product/service? (1) Mobile Phone, (2) Video game player (Xbox, Playstation 2, etc.), (3) DVD, (4) Digital Camera, (5) Digital Cable/Satellite TV, (6) Broadband (High-Speed Internet), (7) Digital Video Recorder (TiVo or Replay TV).” These seven items were coded as dummy variables (0 = no, 1 = yes). Results were added together. In other words, if a respondent owns all products/services, he or she gets “7” point. The total number of devices owned indicates the degree of ownership of new technology products.

Fourth, personal innovativeness was examined. Several scales for measurement of innovativeness were used in a number of studies (Hurt et al, 1977; Oliver and William, 1985; Venkatraman, 1991; Manning et al., 1995; Lin and Jeffres, 1998; Du, 1999; Donthu and Garcia, 1999; Citrin et al., 2000; Limayem et al., 2000; Im et al., 2003). This present study adapted a scale from Oliver and William (1985). This scale had three items: (1) "I like to buy new and different things," (2) "I am usually among the first to try new products," and (3) "I don't like to take chances". A seven-point scale ranging from strongly agree (7) to strongly disagree (1) was used.

Fifth, in order to examine RQ3, this study asked the respondents the following questions: "How important is each of the following PDA functions to you? (1) Mobile Phone, (2) Internet/E-mail, (3) Video games, (4) MP 3 and movie file player, (5) Wordprocessing/Spreadsheet, (6) Digital camera, (7) Global Positioning System." This item has a seven-point scale ranging from "not important at all" (1) to "extremely important" (7).

Sixth, perceived risks were measured. In this study, perceived uncertainty is interchangeable with perceived risk. There are numerous scales to measure perceived risk. Among them, this present study used Garner (1986) scale in order to measure the perceived risk. This scale can measure six kinds of risks. The six dimensions of perceived risk can explain a significant portion of the overall risk (Stone and Grøenhaug, 1993; Dholakia, 1997). This study removed the health risk and psychological risk items because they were expected to be unrelated to adoption of PDA. Respondents were asked to indicate their answer with the following four statements: (1) "The product might fail to perform to my satisfaction (performance risk)," (2) "My friends or relatives will judge

my purchase (social risk),” (3) “I might lose my money (financial risk),” and (4) “I might waste my time or effort getting the product repaired or replaced (time risk).” Each statement used a seven-point scale (from strongly agree (7) to strongly disagree (1)).

Seventh, subjects were asked to express their agreement about attitude toward PDA. Attitude toward PDA was measured with a three-item scale from Sujan and Bettman (1989). Originally, this scale was used to measure brand evaluation. Three items (positive/negative, good/bad, and favorable/unfavorable) used a seven-point scale.

Eighth, as the dependent variable, subjects were asked to address their purchase intention. In order to investigate purchase intention, a three-item index was adapted from a previous study (MacKenzie et al., 1986). A seven-point scale was used ranging from 7 (strongly agree) to 1 (strongly disagree). Respondents stated their agreement with three statements about purchase intention. This scale included: likely/unlikely, probable/improbable, and possible/impossible.

Finally, subjects were asked to write down their demographic information.

Table 5-1 presents detailed information on the types of scale adapted and Table 5-2 shows all questionnaires used in this current study.

Table 5-1: Measured variables

<b>Variables</b>	<b>Adapted measure and source</b>	<b>Scale Type</b>
Relative advantage	Adapted from Parthasarathy and Bhattacharjee (1998)	Seven-point scale: strongly disagree (1) to strongly agree (7)
Compatibility	Adapted from Parthasarathy and Bhattacharjee (1998)	Seven-point scale: strongly disagree (1) to strongly agree (7)
Complexity	Adapted from Parthasarathy and Bhattacharjee (1998)	Seven-point scale: strongly disagree (1) to strongly agree (7)
Trialability	Adapted from Agarwal and Prasad (1997)	Seven-point scale: strongly disagree (1) to strongly agree (7)

Table 5-1. Continued

<b>Variables</b>	<b>Adapted measure and source</b>	<b>Scale Type</b>
Ownership of new technology products	Adapted from Dupagne (1999)	Nominal Yes: 1, No: 0
Personal innovativeness	Adapted from Oliver and William (1985)	Seven-point scale: strongly disagree (1) to strongly agree (7)
Perceived uncertainty	Adapted from Garnet (1986)	Seven-point scale: strongly disagree (1) to strongly agree (7)
Attitude toward PDA	Adapted from Sujan and Bettman (1989)	Seven-point scale
Purchase intention	Adapted from MacKenzie et al. (1986)	Seven-point scale

Table 5-2: Observed variables

<b>Variables</b>	<b>Questionnaires</b>
<b>Awareness</b>	Have you ever heard of a Personal Digital Assistant (PDA)?
<b>Ownership of PDA</b>	Do you own a PDA?
<b>Expected cost</b>	How much do think the newest PDA would cost?
<b>Relative advantage</b>	I feel that a PDA will save me time/effort over other means of performing the same tasks. I feel that a PDA will enable me to perform many tasks better than through other means. I feel that a PDA will provide a greater value than other ways of performing the same task.
<b>Compatibility</b>	I feel that a PDA will be easy for me to adjust to. I feel that a PDA will fit my lifestyle very well. I feel that a PDA will fit the way I perform my daily tasks well.
<b>Complexity</b>	I feel that a PDA will be hard to learn. I feel that a PDA will be quite complicated to master. I feel that a PDA will be difficult to use. I feel that a PDA will have a complex, hard-to-learn system.
<b>Trialability</b>	I might try out a PDA long enough to see what I could use it for. Before deciding to use the PDA, I would like to be able to try one out.
<b>Ownership of new technology products</b>	Do you <u>personally</u> own the following product/service and how familiar are you with each of them? (1) Mobile Phone, (2) Video game player (Xbox, Playstation 2, etc.), (3) DVD, (4) Digital Camera, (5) Digital Cable/Satellite TV, (6) Broadband (High-Speed Internet), (7) Digital Video Recorder (TiVo or Replay TV)*
<b>Personal innovativeness</b>	I like to buy new and different things. I am usually among the first to try new products. I <u>don't like</u> to take chances.(reverse scale)
<b>Perceived importance of functions</b>	How important is each of the following PDA functions to you? (1) Mobile Phone, (2) Internet/E-mail, (3) Video games, (4) MP 3 and movie file player, (5) Wordprocessing/Spreadsheet, (6) Digital camera, (7) Global Positioning System

Table 5-2. Continued

Variables	Questionnaires
<b>Perceived uncertainty</b>	The PDA might fail to perform to my satisfaction. My friends or relatives will judge my purchase.* I might waste my money. I might waste my time or effort getting the product repaired or replaced.
<b>Attitude toward PDA</b>	Unfavorable/Favorable Bad/Good Negative/Positive
<b>Purchase intention</b>	Unlikely/Likely Improbable/Probable Impossible/Possible

\* Variables which were deleted to improve reliability.

### Statistical Analysis

This present study used the following statistical methods: multiple regression analysis, stepwise regression analysis, t-test, and discriminant analysis.

All hypotheses were developed to examine the relation among variables. According to Garson (2003), the ratio of the relative predictive power of the independent variables is indicated by the standardized b coefficients and the ratio of the beta coefficients. So, multiple regression analysis was employed to test all hypotheses.

In order to make an equation model with only significant variables, this study used stepwise regression analysis. Stepwise regression is one of the ways to compute Ordinary Least Squares (OLS) (Garson, 2003). In stage one, the independent best correlated with the dependent is included in the equation. In the second stage, the remaining independent with the highest partial correlation with the dependent, controlling for the first independent, is entered (Garson, 2003). This process is repeated until  $R^2$  is not significantly increased by the addition of a remaining independent or all variables are

added (Garson, 2003). Therefore, stepwise regression can help identify which factor has a relatively strong effect or weak effect.

The first research question was suggested to investigate the relationship among predictors (perceived characteristics of innovations, ownership of new technology products, and personal innovativeness) and attitude and perceived uncertainty toward PDA. In order to examine the relation, multiple regression and stepwise regression were performed (Eastlick, 1996).

The second research question suggested which factors are useful for discriminating two purchase intention groups (high/low). This study categorized two groups: “high” purchase intention and “low” purchase intention. Respondents, who score higher than mean scores on purchase intention, were identified as the “high” purchase intention group and respondents, who got a lower score than the mean of purchase intention, were identified as the “low” purchase intention group. Eastlick (1996) used multiple discriminant analysis to investigate whether factors of attitude toward interactive teleshopping differentiate subjects on intent to adoption. According to Parthasarathy and Bhattacharjee (1998), when independent variables are continuous and dependent variables are categorical, multiple discriminant analysis is an appropriate statistical method. Since there are only two groups by the dependent variable in this study, instead of multiple discriminant analysis, discriminant analysis was performed.

Finally, the third research question addressed which functions of PDA are related to attitude toward PDA and purchase intention. In order to investigate the relation between each function of PDA and attitude toward PDA, and the relation between each

function and purchase intention, Pearson correlation analysis was adapted for this research question.

Statistical methods employed in this study are shown in Table 5-3.

Table 5-3: Statistical methods

Hypotheses & Research Questions	Statistical Methods
H1.1: Relative advantage will be positively related to attitude toward PDA. H1.2: Compatibility will be positively related to attitude toward PDA. H1.3: Complexity will be negatively related attitude toward PDA. H1.4: Trialability will be positively related to attitude toward PDA. H2: The number of ownership of new technologies will be positively related to attitude toward PDA. H3: Personal innovativeness will be positively related to attitude toward PDA.	Multiple Regression Stepwise Regression
H4.1: Attitude toward PDA will be positively related to purchase intention. H4.2: Perceived uncertainty will be negatively related to purchase intention.	Multiple Regression Stepwise Regression
RQ1: Which factors influence attitude and perceived uncertainty toward PDA at the persuasion stage of the Innovation-Decision process?	Multiple Regression Stepwise Regression
RQ2: Which factors will be useful in discriminating two purchase intention group (High/Low)?	Discriminant Analysis
RQ3: Which functions of PDA are related to attitude toward PDA?	Pearson Correlation

## CHAPTER 6 RESULTS

This chapter comprises two parts. The first part discusses the descriptive statistics about the study subjects. The second part presents the results of several statistics methods that were used to examine hypotheses and research questions. Finally, final parsimonious model will be presented in the third part.

### **Descriptive Statistics**

#### **Sample Characteristics**

This study recruited a total of 218 respondents (see Table 6-1). Most respondents for this survey were students from a large southeastern university. Completed questionnaires were received from 191 of 218 respondents. 27 questionnaires were excluded because some questionnaires were uncompleted and some respondents own a PDA. Among the respondents, 119 were female (62.3%) and 72 were male (37.7%). In terms of education demographics analysis of the sample, only three respondents were first-year college students (1.6%), six respondents were second-year college students (3.1%), 55 respondents were third-year college students (28.8%), 82 respondents were fourth-year college students (42.9%), 43 respondents were graduate students (22.5%), and two respondent were others (1.0%). Respondents' age ranged from 18 to 61. The mean age was 22.62 years and the median age was 21 years. 167 respondents (87.4%) were 18-24 age group, 21 respondents (11.0%) were 25-34 age group, and three respondents (1.6%) were over the age of 35.

In order to examine respondents' awareness of PDA, respondents were asked the following question: "Have you ever heard of a Personal Digital Assistant (PDA)?" 175 respondents (91.6%) answered "yes" and 16 respondents (8.4%) answered "no." Among respondents who were not aware of a PDA, nine respondents were female and seven respondents were male. On the basis of this data, it is clear that the PDA already passed the knowledge stage.

In addition, respondents were asked about their ownership of PDA. 22 respondents (10.1%) owned a PDA and 191 respondents (89.9%) didn't own one. Respondents who currently own a PDA were excluded from this research because this study investigates the relationship between purchase intention and predictors.

With respect to expected cost, the survey for this research included the following question: "how much do you think the newest PDA would cost?" Many respondents (19.3%) answered that they think the newest PDA would cost in a range from \$301 to \$400; 18.5 percent of respondents answered that it would cost between \$401 and \$500; seven respondents answered that it would cost more than \$1,000.

Table 6-1: Sample Characteristics

<b>Items</b>	<b>Number</b>	<b>% (cumulative)</b>
<b>Total</b>	218	
Invalid data	27	12.4%
Valid data	191	87.6%
<b>Adopter</b>		
Adopter	22	10.1%
Non-Adopter	191	89.9%
<b>Awareness</b>		
Awareness	175	91.6%
Non-awareness	16	8.4%

Table 6-1. Continued

<b>Items</b>	<b>Number</b>	<b>% (cumulative)</b>
<b><u>Price</u></b>		
Under \$100	16	8.4% (8.4%)
\$101 - \$200	35	18.3% (26.7%)
\$201 - \$300	24	12.6% (39.3%)
\$301 - \$400	37	19.3% (58.6%)
\$401 - \$500	40	18.5% (77.0 %)
\$501 - \$600	7	3.6% (80.6 %)
\$601 - \$700	15	7.8% (88.5 %)
\$701 - \$800	7	3.7% (92.1 %)
\$801 - \$900	2	1.0% (93.2 %)
\$901 - \$1000	6	3.1% (96.3 %)
More than \$1000	7	3.5% (100 %)
Mean	\$444.88	
Median	\$400.00	
<b><u>Gender</u></b>		
Male.	72	37.7%
Female	119	62.3%
<b><u>Age</u></b>		
Range	18-61	
Mean	22.62	
Median	21	
18 – 24	167	87.4% (87.4%)
25 – 34	21	11.0% (98.4%)
More than 35	3	1.6% (100%)
<b><u>Education</u></b>		
1 <sup>st</sup> year college student	3	1.6% (1.6%)
2 <sup>nd</sup> year college student	6	3.1% (4.7%)
3 <sup>rd</sup> year college student	55	28.8% (33.5%)
4 <sup>th</sup> year college student	82	42.9% (76.4%)
Graduate Students	43	22.5% (98.9%)
Others	2	1.0% (100%)

### Normality of Items

Generally, if calculated values of skewness and kurtosis don't exceed  $\pm 2.58$  at .01 probability level, the null hypothesis about the normality of the distribution is rejected (Hair et al., 1998). Table 6-2 shows the descriptive statistics of each observed item and variable in terms of mean, standard deviation, skewness, and kurtosis. As seen from the

table, most observed values of skewness and kurtosis didn't exceed  $\pm 2.58$ , so the null hypothesis about the normality was rejected. However, both skewness and kurtosis of observed value about ownership of Digital Video Recorder (DVR) were over 2.58. The reason for this may be that only two respondents own a DVR. Therefore, the item about ownership of DVR was deleted in this study. Observed value about ownership of new technologies was calculated excluding ownership of a DVR.

### Reliability

Cronbach's alpha ranges from 0.0 to 1.0. Generally, an alpha coefficient of .70 or greater indicates that a scale is appropriate for use in research. A scale with an alpha coefficient over .60, however, can be used for a research (Garson, 2003). Table 6-2 presents that Cronbach's alpha of all scales exceeded .60. This means that all scales can be used statistically in this research. In the case of perceived risks scale, a Cronbach alpha of four original items didn't exceed .60, but if the 2<sup>nd</sup> questionnaire ("My friends or relatives will judge my purchase.") is deleted, the Cronbach alpha becomes over .60 ( $\alpha=.6706$ ). For valid reliability, this study eliminated 2<sup>nd</sup> item of the perceived risks scale.

Table 6-2: Descriptive profile of each variable

	Mean	SD	Skewness	Kurtosis
<b>Relative Advantage</b>				
A PDA will save me time/effort over other means of performing the same tasks.	4.325	1.314	-.169	.002
A PDA will enable me to perform many tasks better than through other means.	4.126	1.348	-.192	-.221
A PDA will provide a greater value than other ways of performing the same task.	3.966	1.330	.104	.189
<b>Cronbach Alpha</b>		<b>.8599</b>		
<b>Compatibility</b>				
A PDA will be easy for me to adjust to.	4.322	1.584	-.118	-.688
A PDA will fit my lifestyle very well.	4.141	1.442	-.069	-.304

Table 6-2. Continued

	Mean	SD	Skewness	Kurtosis
A PDA will fit the way I perform my daily tasks well.	4.126	1.471	-.139	-.307
<i>Cronbach Alpha</i>		<i>.8352</i>		
<b>Complexity</b>				
A PDA will be hard to learn.	3.319	1.657	.441	-.546
A PDA will be quite complicated to master.	3.361	1.683	.434	-.653
A PDA will be difficult to use.	3.162	1.580	.458	-.625
A PDA will have a complex, hard-to-learn system.	3.136	1.570	.489	-.519
<i>Cronbach Alpha</i>		<i>.9508</i>		
<b>Trialability</b>				
A PDA will I might try out a PDA long enough to see what I could use it for.	4.924	1.613	-.622	-.066
A PDA will Before deciding to use the PDA, I would like to be able to try one out.	5.510	1.450	-1.036	.968
<i>Cronbach Alpha</i>		<i>.6025</i>		
<b>Ownership of new technology</b>				
Mobile Phone	.804	.397	-1.541	.392
Video game player (Xbox, Playstation, etc.)	.332	.466	.717	-1.470
DVD	.717	.446	-.972	-1.032
Digital Camera	.306	.458	.847	-1.273
Digital Cable/Satellite TV	.398	.485	.420	-1.819
Broadband (High-Speed Internet)	.673	.467	-.742	-1.446
Digital Video Recorder (TiVo or Replay TV)	.094	.293	<b>2.800</b>	<b>5.900</b>
<b>Familiarity with new technology</b>				
Mobile Phone	6.270	1.198	-1.827	<b>3.098</b>
Video game player (Xbox, Playstation, etc.)	4.869	1.956	-.570	-.828
DVD	5.929	1.372	-1.530	2.314
Digital Camera	4.856	1.713	-.538	-.476
Digital Cable/Satellite TV	4.759	1.838	-.498	-.736
Broadband (High-Speed Internet)	5.772	1.547	-1.437	1.575
Digital Video Recorder (TiVo or Replay TV)	3.029	1.995	.610	-.723
<i>Cronbach Alpha</i>		<i>.7405</i>		

Table 6-2. Continued

	Mean	SD	Skewness	Kurtosis
<b>Personal Innovativeness</b>				
I like to buy new and different things.	5.293	1.454	-.606	-.105
I am usually among the first to try new products.	3.749	1.539	.088	-.627
I don't like to take chances.	4.885	1.548	-.373	-.562
<i>Cronbach Alpha</i>		.7779		
<b>Importance of PDA functions</b>				
Mobile Phone	5.157	1.994	-.839	-.550
Internet/E-mail	5.942	1.295	-1.422	2.220
Video games	2.670	1.570	.733	-.207
MP 3 and movie file player	4.016	1.761	-.124	-.967
Wordprocessing/Spreadsheet	5.162	1.606	-.807	-.080
Digital camera	4.340	1.749	-.270	-.892
Global Positioning System	3.497	1.954	.122	-1.206
<b>Perceived Risks</b>				
The PDA might fail to perform to my satisfaction.	4.026	1.308	-.220	-.199
My friends or relatives will judge my purchase.	2.812	1.578	.404	-.890
I might waste my money.	4.356	1.602	-.256	-.744
I might waste my time or effort getting the product repaired or replaced.	4.042	1.486	-.082	-.425
<i>Cronbach Alpha</i>		.5310 (.6706 if 2nd item deleted)		
<b>Attitude</b>				
Unfavorable/Favorable	4.733	1.264	-.386	.263
Bad/Good	4.777	1.222	-.423	.271
Negative/Positive	4.712	1.267	-.368	.274
<i>Cronbach Alpha</i>		.9472		
<b>Purchase Intention</b>				
Unlikely/Likely	4.073	1.687	-.163	-.955
Probable / Improbable	4.099	1.551	-.245	-.608
Possible / Impossible	4.743	1.473	-.396	-.137
<i>Cronbach Alpha</i>		.9091		

### Ownership and Familiarity of New Technologies

In terms of ownership of new technologies (Table 6-3), a mobile phone is owned by the largest respondents, among the new technologies measured in this study. 153 respondents personally own a mobile phone. Secondly, 135 respondents have a DVD player. A digital camera is owned by only 57 respondents (29.8%). A Digital Video Recorder (DVR), which was deleted from the results of analysis because of normality, is owned by just two respondents.

Table 6-3: Ownership of new technologies

	Mobile Phone	Video Game	DVD	Digital Camera	Digital Cable	Broadband	DVR
Owner	153	61	135	57	74	127	2
No owner	37	125	52	131	113	61	189
% owner	80.5%	32.6%	72.2%	30.3%	39.6%	67.6%	1.1%

With respect to familiarity with new technologies, regardless of ownership, respondents feel familiar with new technologies except that of a DVR. Table 6-2 presents that all means relative to familiarity with new technologies are more than 4.8. Because “4” means “neutral” and “7” means “very familiar,” it can be verified that a mobile phone, a video game console, a DVD player, a digital camera, digital cable/satellite TV, and broadband are communication devices with which respondents feel familiar.

### The Results of Hypotheses and Research Questions

Some hypotheses were supported and other hypotheses were not supported. Table 6-4 presents the results of hypotheses and research questions.

Table 6-4: Results of Hypotheses and Research Questions

Hypotheses	Results
H1.1: Relative advantage will be positively related to attitude toward PDA.	<b>Supported</b>
H1.2: Compatibility will be positively related to attitude toward PDA.	<b>Supported</b>
H1.3: Complexity will be negatively related attitude toward PDA.	Not supported
H1.4: Trialability will be positively related to attitude toward PDA.	<b>Supported</b>
H2: The number of ownership of new technologies will be positively related to attitude toward PDA.	Not supported
H3: Personal innovativeness will be positively related to attitude toward PDA.	<b>Supported</b>
H4.1: Attitude toward PDA will be positively related to purchase intention.	<b>Supported</b>
H4.2: Perceived uncertainty will be negatively related to purchase intention.	Not supported

Research Questions	Results
RQ1: Which factors influence attitude and perceived uncertainty toward PDA at the persuasion stage of the Innovation-Decision process and is there the relative influence among variables?	- Attitude: <i>compatibility &gt; personal innovativeness &gt; trialability &gt; relative advantage</i> - Perceived uncertainty: <i>relative advantage &gt; complexity</i>
RQ2: Which factors will be useful in discriminating two purchase intention group (High/Low)?	<i>attitude, relative advantage, compatibility, trialability, and personal innovativeness</i>
RQ3: Which functions of PDA are related to attitude toward PDA and purchase intention?	- Attitude: <i>mobile phone, video games, digital camera, and global positioning system</i> - Purchase intention: <i>MP3 player, digital camera, and global positioning system</i>

### Factors Influencing Attitude toward Personal Digital Assistant (PDA)

The first research question and six hypotheses were developed to investigate the relationship between independent variables (relative advantage, compatibility, complexity, trialability, ownership of new technologies, and personal innovativeness) and attitude toward PDA. Multiple regression and stepwise regression were performed. Stepwise regression is one of the ways to compute Ordinary Least Squares (OLS) (Garson, 2003).

The results of multiple regression analysis of attitude toward PDA on relative advantage, compatibility, complexity, trialability, ownership of new technology, and

personal innovativeness were presented in Table 6-5, with tolerance and Variance-Inflation Factor (VIF) provided as supporting information. Multicollinearity means the linear relation of independent variables, so high multicollinearity may make assessment of the unique role of independent variable difficult. In order to measure multicollinearity, tolerance or VIF is used (Garson, 2003). According to Garson (2003), generally, if tolerance is less than .20, a multicollinearity problem is indicated. In other words, the closer to 0 tolerance is, the higher multicollinearity is. In case of VIF, which is the reciprocal of tolerance, a value above 5 indicates a problem with multicollinearity. SPSS suggests another method, called condition indices, to assess if there is too much multicollinearity in the model (Garson, 2003). If a condition index is over 30, there is a serious collinearity problem. A condition index over 15 suggests possible collinearity problems (Garson, 2003). Table 6-5 shows that all independent variables tolerance levels fall between .590 and .878 and VIF scores range from 1.138 to 1.694. In case of a condition index (see Table 6-6), there is no factor that exceeds 30. On the basis of this data, multicollinearity was not found in this analysis.

The results of multiple regression analysis in Table 6-5 present that this regression equation is significant ( $F=20.553$ ,  $p < .001$ ). For this equation, 40.1 percent of the variance is statistically explained by the independent variables. Among the independent variables, relative advantage ( $\beta = .153$ ), compatibility ( $\beta = .364$ ), trialability ( $\beta = .147$ ), and personal innovativeness ( $\beta = .217$ ) were significantly ( $p < .05$ ) and positively related to attitude toward PDA. Complexity and ownership of new technologies had no significant impact on attitude toward PDA.

Based on the results of multiple regression analysis, hypotheses were examined.

H1.1, H1.2, H1.3, and H1.4 stated that perceived attributes of PDA are significantly related to attitude toward PDA. The results of regression revealed that relative advantage, compatibility, and trialability had a significant positive relationship with attitude.

Therefore, H1.1, H1.2, and H1.4 are supported, while H1.3 is not supported (see Table 6-4).

H2 and H3 predicted that ownership of new technologies and personal innovativeness would be positively related to attitude toward PDA, respectively. The results from multiple regression analysis supported H3 with a significant positive relation, but H2 was not supported (see Table 6-5).

Table 6-5: Multiple regression analysis of attitude toward PDA on relative advantage, compatibility, complexity, trialability, ownership of new technology, and personal innovativeness.

Dependent variable: Attitude toward PDA

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Tolerance	VIF
	B	SD	Beta				
Relative Advantage	.154	.069	.153	2.232	<b>.027</b>	.694	1.440
Compatibility	.331	.068	.364	4.897	<b>.000</b>	.590	1.694
Complexity	-.011	.036	-.019	-.313	.755	.878	1.138
Trialability	.201	.088	.147	2.293	<b>.023</b>	.795	1.258
Ownership of new technologies	-.041	.147	-.017	-.280	.780	.838	1.193
Innovativeness	.204	.060	.217	3.386	<b>.001</b>	.794	1.259

R: .633  
R<sup>2</sup>: .401  
Adjusted R<sup>2</sup>: .382  
F-ratio: 20.553 (p< .001)

Table 6-6: Collinearity diagnostics of multiple regression analysis of attitude and perceived uncertainty toward PDA on relative advantage, compatibility, complexity, trialability, ownership of new technology, and personal innovativeness

Dimension	Eigenvalue	Condition Index
1	6.506	1.000
2	.197	5.753
3	.144	6.726
4	.05524	10.852
5	.04237	12.391
6	.03436	13.760
7	.02175	17.295

Stepwise regression was performed to examine a model with variables (relative advantage, compatibility, trialability, and personal innovativeness) that contributed significantly to attitude toward PDA from the previous multiple regression and to investigate their relative influence on attitude. Table 6-7 presents the results of stepwise regression. They showed unique and substantial contribution in this study. The model obtained from this stepwise regression procedure has four variables that statistically significantly explained 40.1 percent of the variance in attitude toward PDA.

Compatibility had the strongest influence in this equation, while relative advantage, trialability, and personal innovativeness had weak influence on attitude toward PDA.

Since all tolerance values are not below .20 and all VIF are not above 5, there may be no serious multicollinearity problem in this model.

Table 6-7: Stepwise multiple regression of attitude toward PDA on relative advantage, compatibility, trialability, and personal innovativeness

<b>Model 1</b>										
Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
	.565	.319	.315	.319	88.492					
Compatibility						.514	.565	10.76	1.00	1.00
<b>Model 2</b>										
Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
	.600	.360	.354	.042	12.213					

Table 6-7. Continued

Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
Compatibility						.446	.490	7.875	.880	1.136
Innovativeness						.204	.058	3.495	.880	1.136
<b>Model 3</b>										
Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
	.620	.384	.374	.024	7.232					
Compatibility						.402	.441	6.929	.811	1.233
Innovativeness						.200	.213	3.483	.880	1.137
Trialability						.222	.162	2.689	.906	1.104
<b>Model 4</b>										
Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
	.633	.401	.388	.016	5.103					
Compatibility						.337	.370	5.260	.650	1.540
Innovativeness						.199	.212	3.496	.880	1.137
Trialability						.190	.138	2.287	.879	1.138
Relative advantage						.153	.152	2.259	.710	1.408
* all $p < .05$										

### Factors Influencing Perceived Uncertainty toward Personal Digital Assistant (PDA)

In order to examine the relationship between perceived uncertainty and the independent variables (relative advantage, compatibility, complexity, trialability, ownership of new technologies, and personal innovativeness), multiple regression and stepwise regression were used. Table 6-8 shows the results of multiple regression analysis of perceived uncertainty toward PDA on the independent variables. Results revealed that this equation is significant ( $F=5.633$ ,  $p < .001$ ), but only 15.5 percent of the variation in perceived uncertainty toward PDA is explained. Contrary to the previous equation for attitude, there are only two variables which are significantly ( $p < .05$ ) related to perceived uncertainty toward PDA: relative advantage ( $\beta = -.317$ ) and complexity ( $\beta = .153$ ). Relative advantage is negatively related to perceived uncertainty and complexity

is positively related to perceived uncertainty. Because tolerance values ranged from .590 to .878 and VIF values ranged from 1.138 to 1.694, no serious multicollinearity problem was found. In addition, a condition index didn't exceed 30 (see table 6-5).

Table 6-8: Multiple regression analysis of perceived uncertainty toward PDA on relative advantage, compatibility, complexity, trialability, ownership of new technology, and personal innovativeness

Dependent variable: Perceived uncertainty toward PDA

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Tolerance	VIF
	B	SD	Beta				
Relative Advantage	-.308	.079	-.317	-3.903	<b>.000</b>	.694	1.440
Compatibility	-.047	.077	-.053	-.602	.548	.590	1.694
Complexity	.08669	.041	.153	2.122	<b>.035</b>	.878	1.138
Trialability	.116	.100	.088	1.155	.250	.795	1.258
Ownership of new technologies	.07093	.169	.031	.420	.675	.838	1.193
Innovativeness	-.058	.069	-.064	-.841	.402	.794	1.259

R: .394  
R<sup>2</sup>: .155  
Adjusted R<sup>2</sup>: .128  
F-ratio: 5.633 (p< .001)

Stepwise regression was performed to examine a model with variables (relative advantage and complexity) that significantly contributed to perceived uncertainty toward PDA from the previous multiple regression and to investigate the relative influence of two variables (see Table 6-9). The obtained model from stepwise regression explains 14.3 percent of the variation in perceived uncertainty. Relative advantage had the strongest influence on perceived uncertainty. In addition, there was no serious multicollinearity problem in this model.

Table 6-9: Stepwise multiple regression of perceived uncertainty toward PDA on relative advantage and complexity

<b>Model 1</b>										
Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
	.330	.109	.104	.109	23.113					
Relative Advantage						-.32	-.330	-4.808	1.00	1.00
<b>Model 2</b>										
Variables	R	R2	Adj. R2	R2 change	F change	B	Beta	t	Tolerance	VIF
	.378	.143	.134	.034	7.486					
Relative Advantage						-.32	-.330	-4.887	1.00	1.00
Complexity						.104	.185	2.736	1.00	1.00
* all p < .05										

### **Relationship between the Intervening Variables (Attitude and Perceived Uncertainty toward PDA) and Purchase Intention**

The set of fourth hypotheses addressed whether there are significant relationships between intervening variables (attitude and perceived uncertainty) and purchase intention. Multiple regression was also employed to measure the relationship. The prediction equation for purchase intention explains 43.0 percent of the variance in purchase intention (see Table 6-10). Purchase intention is significantly predicted by only attitude toward PDA.

H4.1 and H4.2 predicted that attitude toward PDA would be positively related to purchase intention and perceived uncertainty would be negatively related to purchase intention. The results of multiple regression analysis show that attitude has a significant effect for predicting purchase intention, while perceived uncertainty is not a significant predictor. So, H4.1 was supported, H4.2 was not supported (see Table 6-4).

Table 6-10: Multiple regression analysis of purchase intention on attitude and perceived uncertainty toward PDA

Dependent variable: Purchase intention

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Variables	VIF
	B	SD	Beta				
Attitude	.774	.071	.634	10.941	.000	.904	1.106
Perceived risks	-.0790	.073	-.062	-1.076	.283	.904	1.106

R: .655  
R<sup>2</sup>: .430  
Adjusted R<sup>2</sup>: .424  
F-ratio: 70.886 (significant: .000)

Stepwise regression results are presented in Table 6-11, with only attitude as an independent variable. This regression model predicting purchase intention results in 42.6 percent of variance explained.

Table 6-11: Regression of purchase intention on attitude toward PDA

Model 1										
Variables	R	R <sup>2</sup>	Adj. R <sup>2</sup>	R <sup>2</sup> change	F change	B	Beta	t	Tolerance	VIF
	.653	.426	.423	.426	140.457					
Attitude						.797	.653	11.85	1.00	1.00

\* all p < .05

### Factors Discriminating Two Purchasing Intention Group (High/Low)

The second research question addressed which factors are useful in discriminating among purchase intention groups. In order to examine this research question, discriminant analysis was employed. All variables (relative advantage, compatibility, complexity, trialability, ownership of new technologies, personal innovativeness, perceived uncertainty, and attitude toward PDA) served as the independent variables, and

two purchase intention groups (high and low) were used as the dependent variables in discriminant analysis. Questionnaires about purchase intention were composed of three items, which adapt a seven-point scale. In other words, a score of 21 indicates the highest purchase intention and a score of 3 presents the lowest purchase intention. The mean of purchase intention scores was 12.9, so this study classified respondents whose scores were over 12.9, into the high purchase intention group ( $n = 88$ ), and respondents whose scores were under 12.9, into the low purchase intention group ( $n = 103$ ).

Table 6-12 reveals the result of Wilks's lambda of each variable in discriminant analysis. The larger the Wilks's lambda, the less important the independent variables to the discriminant analysis (Garson, 2003). Wilks's lambdas of relative advantage, compatibility, trialability, innovativeness, and attitude are significant by the F test. This study dropped complexity, ownership of new technologies, and perceived uncertainty because they were not significant.

Homogeneity of covariance matrices between groups is the assumption of discriminant analysis. This assumption is measured by Box's M test. On the basis of Box's M test, a null hypothesis of equal population covariance matrices was rejected (see Table 6-12). This study has only one discriminant function because there are only two categories in the dependent variable. The eigenvalue of discriminant function is statistically significant ( $p < .001$ ).

Table 6-11 also presents canonical discriminant function coefficients. Standard canonical discriminant function coefficients indicate the relative importance of the independent variables in explaining the dependent variable (Garson, 2003). Attitude is the strongest discriminating factor among the independent variables. Compared to

attitude, the importance of other variables is very weak. In terms of the correlations of each variable with discriminant function, attitude has the strongest correlation with discriminant function.

Table 6-12: Discriminant analysis between high-purchase intention group and low-purchase intention group

<b>Tests of equality of group means</b>					
	Means		Wilks' Lambda	F	Sig.
	Low intention	High intention			
Relative advantage	11.7136	13.2386	.953	9.255	<b>.003</b>
Compatibility	11.1893	14.2273	.849	33.704	<b>.000</b>
Complexity	13.3689	12.5227	.995	.925	.337
Trialability	9.9709	10.9773	.962	7.380	<b>.007</b>
Ownership of new technology	3.2233	3.4432	.995	1.017	.314
Innovativeness	13.0680	14.9318	.939	12.218	<b>.001</b>
Perceived uncertainty	12.9029	11.8636	.977	4.449	.036
Attitude	12.3204	16.4545	.662	96.396	<b>.000</b>

<b>Box's M test</b>				
Box's M	F			
	Approx.	df1	df2	sig.
75.926	2.014	36	114249.6	<b>.000</b>

<b>Eigenvalues</b>				
Function	eigenvalue	% of variance	Cumulative %	Canonical correlation
1	.536	100.0	100.0	.591

<b>Wilks' Lambda</b>				
Function	Wilks' Lambda	Chi-square	df	Sig.
1	.651	79.454	8	<b>.000</b>

<b>Canonical discriminant function coefficients</b>			
	Standardized Canonical Discriminant Function Coefficients	Unstandardized Canonical Discriminant Function Coefficients	Structure Matrix
	Relative advantage	-.161	
Compatibility	.244	.068	.577
Complexity	.036	.006	-.096
Trialability	.007	.003	.270

Table 6-12. Continued

	Standardized Canonical Discriminant Function Coefficients	Unstandardized Canonical Discriminant Function Coefficients	Structure Matrix
Ownership of new technology	-.057	-.038	.100
Innovativeness	.040	.011	.347
Perceived risks	.047	.014	-.209
Attitude	<b>.935</b>	<b>.322</b>	<b>.975</b>

Classification results of discriminant analysis are presented in Table 6-13. 75.9 percent of original grouped cases are correctly classified by discriminant function.

In order to measure the significance of hit rate, t-ratio test was employed.  $t_0$  was calculated by the equation, and it was 5.40. Therefore, the hit rate is statistically significant ( $p < .01$ ).

Table 6-13: Classification results of discriminant analysis

Purchase Intention		Predicted Group Membership		Total
		Low	High	
Count	Low	74	29	103
	High	17	71	88
%	Low	71.8	28.2	100.0
	High	19.3	80.7	100.0

### Relation between Functions of PDA and Attitude and Purchase Intention

The third research question was developed to explore the relationships among each function of PDA, attitude, and purchase intention. Pearson correlation was performed. Questions about the perceived importance of functions of PDA used a seven-point scale, with “7” meaning that respondents consider that function extremely important. Respondents answered that Internet/Email (mean=5.517) and mobile phone (mean=5.942) are important functions in PDA, while Global Positioning System (GPS)

(mean=3.497) and video games (mean=2.670) were not perceived as important functions (see Table 6-14).

Table 6-14: Descriptive profile of perceived importance of functions of PDA

	Mean	Median	SD	Skewness	Kurtosis
Mobile Phone	5.517	6.00	1.994	-.839	-.550
Internet/Email	5.942	6.00	1.294	-1.422	2.220
Video games	2.670	2.00	1.569	.733	-.207
MP3 player	4.016	4.00	1.761	-.124	-.967
Wordprocessing	5.162	6.00	1.616	-.807	-.080
Digital Camera	4.340	4.00	1.749	-.270	-.892
GPS	3.497	4.00	1.954	.122	-1.206

The correlation matrix is presented in Table 6-15. In terms of relationship between each function of PDA and attitude toward PDA, mobile phone, video games, digital camera, and global positioning system are significantly correlated to attitude. Interestingly, Internet/Email, which is perceived as a relatively important function, didn't have a significant relation with attitude, and video games, which was perceived to be the least important function, is significantly and positively related to attitude toward PDA. With respect to the relationship between each function and purchase intention, MP3 player, digital camera, and global positioning system are significantly correlated to purchase intention, while mobile phone, Internet/Email, video games, and wordprocessing/spreadsheet are not significantly related to purchase intention. As in the result of the relationship to attitude, Internet/Email was not significantly related to purchase intention.

Table 6-15: Pearson correlation between perceived importance of PDA functions and attitude and purchase intention

Variables	Func1	Func2	Func3	Func4	Func5	Func6	Func7	Attitude	Purchase intention
Function1: Mobile Phone	1.000								
Function 2: Internet/Email	.354**	1.000							
Function 3: Video games	.064	.022	1.000						
Function 4: MP3 player	.029	.067	.451**	1.000					
Function 5: Wordprocessing	.179*	.394**	-.002	.131	1.000				
Function 6: Digital Camera	.329**	.141	.179*	.359**	.065	1.000			
Function 7: GPS	-.036	-.072	.289**	.276**	-.113	.357**	1.000		
Attitude	.187**	.071	.180*	.096	.030	.246**	.178*	1.000	
Purchase intention	.120	-.001	.123	.180*	.059	.343**	.260*	.653**	1.000

\*:  $p < .05$ , \*\*:  $p < .01$

This study classified the dimensions of functions with factor analysis. With eigenvalues of 1.00 or higher as the criteria, two factors were yielded by explaining 52.721 percent of the variance (see Table 6-16). Factor 1 consists of video games, MP3 player, digital camera, and global positioning system. Factor 2 is composed of mobile phone, Internet/Email, and wordprocessing/spreadsheet. Factor 1 has more entertainment aspects than factor 2. On the other hand, factor 2 has more information aspects than factor 1. So, this study refers factor 1 as an entertainment factor and factor 2 as an information factor. In addition, entertainment has more significant functions than information, in terms of the relationship with attitude and purchase intention, even though respondents thought that functions related to entertainment are less important than those related to information.

Table 6-16: Factor analysis of perceived importance of PDA functions

Items	Mean	SD	Factor 1	Factor 2
<b>Importance of PDA functions</b>				
Mobile Phone	5.157	1.994	.127	<b>.681</b>
Internet/E-mail	5.942	1.295	-.007	<b>.797</b>
Wordprocessing/Spreadsheet	5.162	1.606	-.044	<b>.690</b>

Table 6-16. Continued

Items	Mean	SD	Factor 1	Factor 2
<b>Importance of PDA functions</b>				
Video games	2.670	1.570	<b>.692</b>	-.023
MP 3 and movie file player	4.016	1.761	<b>.745</b>	.108
Digital camera	4.340	1.749	<b>.648</b>	.314
Global Positioning System	3.497	1.954	<b>.700</b>	-.204

Table 6-17. Continued

Items	Mean	SD	Factor 1	Factor 2
<b>Eigenvalue</b>			<b>1.962</b>	<b>1.728</b>
<b>Percent of variance explained</b>			<b>28.034%</b>	<b>24.687%</b>
<b>Cumulative percent</b>			<b>28.034%</b>	<b>52.721%</b>
<b>Cronbach Alpha</b>			<b>.6490</b>	<b>.5391</b>

### Demographic Characteristic of Purchase Intention Group

Differences in demographic characteristics between the high purchase intention group and the low intention group were investigated to reveal if there were distinct characteristics for each group. *t*-test results are shown in Table 6-17. Results indicated that there was little demographic difference between the high purchase group and the low purchase intention group. In the case of age, *t*-value was  $-.846$  ( $p > .05$ ) and the *t*-value of gender was  $-.948$  ( $p > .05$ ).

Table 6-17: *t*-test Results Comparing between Purchase Intention Group

Demographics	Low purchase intention group		High purchase intention group		t-Value
	Mean	SD	Mean	SD	
Age	22.388	4.6510	22.909	3.7035	$-.846$ ( $p = .399$ )
Gender	1.592	.4938	1.659	.4767	$-.948$ ( $p = .345$ )

Gender: Male = 1; Female = 2.

Purchase intention: Low = 0; High = 1.

### Final Parsimonious Model

This study examined the relationships among variables. Relative advantage, compatibility, trialability, and personal innovativeness were the significant factors that affected attitude toward PDA. In addition, attitude was the significant predictor as to purchase intention. Based on these results, this current study created a final parsimonious model like the following:

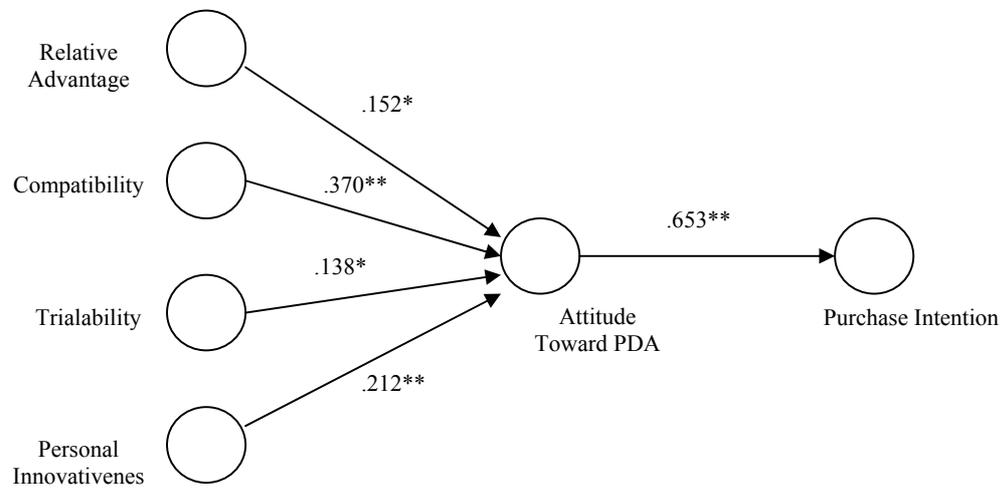


Figure 6-1: Final Parsimonious Model

## CHAPTER 7 DISCUSSION

This chapter consists of four parts. The first part will present a brief review of the theoretical model of this current study. The second part will summarize the findings from the statistics analysis and the results of hypotheses and research questions. The third part will discuss the implications of this study. In the fourth part, limitations of this study will be presented. Finally, conclusion will be addressed in the last part.

### **Review of the Present Study**

This current study had a goal. This study wanted to examine the impact and the relative influence of perceived characteristics of innovation, ownership of new technologies, personal innovativeness, and functions of PDA in exploring attitude, perceived uncertainty, and adoption of PDA. Toward this goal, diffusion theory was used as the conceptual framework and theoretical paradigm for understanding the adoption of PDA. Rogers (1995) argued that during the process of the adoption of new technology, an individual (or other decision-making unit), who passed the knowledge stage of an innovation, forms his/her attitude toward the innovation, decides to adopt or reject, implements, uses the new idea, and confirms his/her decision. Following from this focus, this present study focused on two stages (persuasion stage and decision stage) of the Innovation-Decision Process of Diffusion theory to examine which variables affect attitude and perceived uncertainty toward PDA, and whether PDA adoption can be explained by variables.

According to Rogers (1995), an individual forms a favorable or unfavorable attitude toward the innovation and seeks information to decrease a perceived uncertainty about the innovation at the persuasion stage, and decides to adopt or reject the innovation at the decision stage. This study applied Rogers's theory to predict and examine the factors influencing adoption of PDA. The independent variables were selected on the basis of previous adoption researches: relative advantage, compatibility, complexity, trialability, ownership of new technologies, and personal innovativeness.

There are three research questions and eight hypotheses in the present study. Hypotheses and research questions presented the relationship among the variables during the adoption process.

A total of 218 undergraduate and graduate students from a large southeastern university participated in the survey for this current study and 191 sets of valid data were acquired.

### **Summary of Results of Research Questions and Hypotheses**

This section will summarize findings and results of each of eight hypotheses and four research questions.

#### **Hypotheses**

Hypotheses 1 predicted the relationship between perceived attributes of PDA and attitude toward PDA.

*H1.1: Relative advantage will be positively related to attitude toward PDA.*

*H1.2: Compatibility will be positively related to attitude toward PDA.*

*H1.3: Complexity will be negatively related to attitude toward PDA.*

*H1.4: Trialability will be positively related to attitude toward PDA.*

These hypotheses were created based on diffusion theory. Rogers (1995) asserted that perceived attributes of innovations are significantly associated with the rate of adoption and are significant determinants to influence forming an attitude toward the innovation. Perceived attributes of the innovation have been used as a predictor to explain adoption of innovations (LaRose and Atkin, 1992; Eastlick, 1993 & 1996; Lin, 1998; Parthasarathy et al., 1998; Du, 1999). The findings of previous studies indicated that these variables (relative advantage, compatibility, complexity, trialability, and observability) are significant factors in predicting the adoption of innovations. Their findings were consistent with Rogers's assertion that perceived attributes of innovations play an important role in forming an attitude (Rogers, 1995).

Some results of H1 were consistent with the findings of previous researches and others were not consistent. In most previous researches, relative advantage was a significant predictor of adoption of innovations (Ostlund, 1974; Eastlick, 1993 & 1996; Parthasarathy and Bhattacharjee, 1998; Du, 1999; Sund et al., 2001). As this study expected, relative advantage was a significant predictor of attitude toward PDA in the current study. This study also found that compatibility and trialability are significantly and positively related to attitude. Compatibility (Ostlund, 1974; Eastlick, 1993 & 1996; Rogers, 1995; Lin, 1998; Parthasarathy and Bhattacharjee, 1998; Du, 1999; Sund et al., 2001) and trialability (Ostlund, 1974; Holak, 1988; Eastlick, 1996; Rogers, 1995; Sund et al., 2001) were factors influencing adoption of innovations in other researches. In terms of complexity, this study didn't support that complexity is significantly associated with attitude toward PDA. Ostlund (1974), Du (1999), and Sund et al. contended that complexity is one of the factors predicting an adoption, while Eastlick (1993) and Lin

(1998) found that there was no significant relationship between complexity and adoption. As long as an individual's technology apprehension is outweighed by the perceived advantage of innovations, complexity is not a serious concern for consumers (Lin, 1998). Results of this study mean that relative advantage and compatibility may be a strong predictor of adoption, while complexity may not be as strong a predictor as it appears to be in diffusion theory.

*H2: The number of ownership of new technologies (Mobile Phone, Video game player, DVD player, Digital camera, Digital Cable/Satellite TV, Broadband, and Personal Video Recorder) will be positively related to attitude toward PDA.*

H2 expressed that ownership of new technologies would be significantly and positively related to attitude toward PDA. In order to measure ownership of new technologies, this study asked respondents about ownership of seven technologies. Lin (1998) found that communication technology ownership is an important factor in predicting the personal computer adoption rate and ownership of other communication technology devices predicted PC adoption. Dupagne (1999) also contended that the number of home entertainment products was positively related to adoption of HDTV. The early adopters of personal computers owned other high technology products (Danko and MacLachlan, 1983). Therefore, it was expected that the more new technologies are owned, the more favorable attitude the subject would have. However, there was no significant effect of ownership of new technologies on attitude toward PDA. This result was not consistent with some past researches (Lin, 1998; Dupagne, 1999). Next paragraph will explain the reason why the result of this study were not consistent with previous studies.

The notion of functional similarity and need compatibility was suggested by several researchers. Atkin (1993) contended that the adoption of innovations is related to functionally similar media or technologies. Perse and Courtright (1993) asserted that the adoption of a functionally similar product has an impact on the adoption of new technologies. According to Henke and Donohue (1989), new technological advancement tends to affect the way consumers reorganize their view about the established media. In order to research functional similarity and functional displacement, the number of new technologies owned as well as exposure time to media, familiarity of established media, and other variables have been used as predictors. Even though ownership of new technologies was a significant predictor in previous researches, this study didn't support that ownership of new technologies would affect attitude toward PDA. Ownership of new technologies alone may not explain adoption of innovations and functional substitution.

*H3: Personal innovativeness will be positively related to attitude toward PDA.*

Hypothesis 3 presented that personal innovativeness would be a significant predictor of attitude toward PDA. In adoption studies, innovativeness has been an important variable to examine adoption. As in previous studies that suggested that personal innovativeness would lead to a more positive attitude (Venkatraman, 1991; Manning et al., 1995; Lin, 1998; Lin and Jeffres, 1998; Donthu and Garcia, 1999; Du, 1999; Citrin et al., 2000; Im et al., 2003), it was shown that personal innovativeness significantly influenced attitude toward PDA. In other words, consumers who have a higher level of innovativeness with innovations are more likely to have positive attitude toward PDA.

*H4.1: Attitude toward PDA will be positively related to purchase intention.*

*H4.2: Perceived uncertainty will be negatively related to purchase intention.*

Hypothesis 4 predicted that attitude would positively affect purchase intention and perceived uncertainty would negatively influence purchase intention at the decision stage. A person's attitude affects behavioral intention, which is a good forecaster of actual behavior (Fishbein and Ajzen, 1975; Ajzen, 1985). Previous researches found that attitude has a strong correlation with intent to purchase (Lutz et al., 1983; Brown and Stayman, 1992; Rogers, 1995; Ko, 2002). Based on previous studies, this present study expected that attitude would have a positively significant relation with purchase intention. As expected, there was significant relationship between attitude and purchase intention. Respondents were asked to rate their attitude (unfavorable/favorable, bad/good, and negative/positive) toward PDA, and the mean of attitude score was 4.74. This means that subjects of this study, by and large, have favorable attitude toward PDA and their attitudes were significantly related to purchase intention.

Contrary to attitude, perceived risks negatively affect adoption of innovations (Cox and Rich, 1964; Dowling and Staelin, 1994; Wood and Scheer, 1996; Mitchell, 1998; Pope, 1998; Ko, 2001). According to Cox and Rich (1964), perceived risk is a function of the amount at stake in the purchase intention. Pope (1998) contended that perceived risk was related to online purchase of sport products. Therefore, this current study expected that there would be a significant relationship between perceived risks and purchase intention. Contrary to the expectation, perceived uncertainty had no significant relation with purchase intention ( $p > .05$ ).

### Research Questions

*RQ1: Which factors influence attitude and perceived uncertainty toward Personal Digital Assistant (PDA) at the persuasion stage of the Innovation-Decision process and which variables have the relatively strong or weak influence on attitude and perceived uncertainty?*

Following from hypotheses 1, hypotheses 2, and hypotheses 3, research question 1 investigated which variables affect attitude and perceived uncertainty toward PDA and whether there are the relative weights of the significant variables on attitude and perceived uncertainty. The results present that relative advantage, compatibility, trialability, and personal innovativeness positively affect attitude, and perceived uncertainty is affected by relative advantage and complexity. The strongest variable in predicting attitude toward PDA among significant independent variables was compatibility, which explained 31.9 percent of the variation in attitude toward PDA, while relative advantage, which statistically explained 1.6 percent of the variation, was the weakest variable. Contrary to the result of attitude, among the variables which are significantly related to perceived uncertainty, relative advantage was the strongest variable, but it could explain only 10.9 percent of the variation in perceived uncertainty toward PDA. Only relative advantage had a significant impact on both attitude and perceived uncertainty, while ownership of new technologies was not significantly related to both attitude and perceived uncertainty.

*RQ2: Which factors will be useful for discriminating two purchase intention groups (high/low)?*

Research question 2 examined which factors would be useful in discriminating between the high purchase intention group and the low intention group. According to the results of discriminant analysis, discriminant function classified correctly 75.9 percent of the original grouped cases. As expected, variables (relative advantage, compatibility,

trialability, innovativeness, and attitude), which were found as significant predictors in hypotheses, were significant discriminant factors. Among the significant factors, attitude was the strongest discriminating factor, and trialability was the weakest discriminating factor. In addition, relative advantage, compatibility, and personal innovativeness significantly differentiated the high purchase intention group from the low purchase intention group.

*RQ3: Which functions of PDA are related with attitude toward PDA and purchase intention?*

Research question 3 intended to examine if there was any significant relationship between each function of PDA, and attitude and purchase intention. This study expected that each function of PDA would be related to attitude toward PDA and purchase intention. The results of Pearson correlation analysis revealed that attitude toward PDA was significantly correlated to mobile phone, video games, digital camera, and global positioning system. In addition, MP3 player, digital camera, and global positioning system had a significant correlation with purchase intention. Functions of PDA were classified with two factors by factor analysis. Factor 1 is composed of video games, MP3 player, digital camera, and global positioning system. Factor 2 consists mobile phone, Internet/Email, and wordprocessing/spreadsheet. Subjects perceived functions of factor 2 as more important function of PDA than those of factor 1 (see Table 6-14). A PDA is still likely to be perceived as a communication device for information rather than an entertainment. Digital camera and global positioning system, which are factor 1, were significantly correlated with both attitude and purchase intention, even though they were not perceived as an important function by respondents. Except two functions, mobile phone and video games were significantly correlated with attitude and MP3 player was

significantly correlated with purchase intention. Among functions of factor 2, only mobile phone had a significant relationship with attitude. It means that perceived importance for functions of PDA is not linked with attitude and purchase intention. Regardless of perceived importance, more significant correlations were found from variables of factor 1. This study provides an exploratory attempt to figure out the difference among each function of PDA.

This study examined only the relationship between attitude and purchase intention, and functions of PDA. Only perceived importance for each function of PDA is not sufficient to explain attitude and purchase intention. In order to effectively examine the relations between functions of PDA and attitude or purchase intention, other factors such as motivations or gratification linked with each function of PDA should be investigated.

### **Implications**

This section consists of three parts: theoretical implication, practical implication and future research.

#### **Theoretical Implications**

The theoretical background of this present study is diffusion of innovations. In particular, this study focuses on the innovation-decision process of diffusion of innovations. Rogers (1995) proposed that “such persuasion will lead to a subsequent change in overt behavior (that is, adoption or rejection) consistent with the attitude held, but in many cases attitudes and actions are quite disparate” (p. 169). In other words, attitude is a significant predictor for adoption, but the relationship between attitude and adoption is not strong. From this theoretical perspective, this study investigated the effect of attitude at the decision stage. The result was little different from Rogers’s (1995)

assertation. In this study, attitude was a strong significant predictor for purchase intention ( $R^2=.426$ ). Based on this result, this present study may offer the notion that attitude has a strong impact on adoption of innovations.

Additionally, this study partially supports the effect of perceived attributes of innovations in the persuasion stage. According to Rogers (1995), perceived attributes of an innovation, such as its relative advantage, compatibility, complexity, trialability, and observability, play an important role at the persuasion stage. This study examined whether perceived attributes of PDA have a significant relationship with attitude toward PDA. Consistent with previous findings of adoption researches, this study presents that perceived attributes, except complexity, are significantly related to attitude. Several previous researches also found that complexity was not a significant predictor of adoption (Eastlick, 1993; Lin, 1998; Parthasarathy and Bhattacharjee, 1998). The rapidly changing media environment provides consumers much opportunity to experience a variety of new technologies (e.g., Interactive Television, Satellite Radio, etc.). Under this circumstance, complexity may not be a significant predictor of adoption any longer. Lin (1998) asserted that “it is apparent that, as long as the perceived advantage of adopting outweighs one’s technology apprehension, perceived complexity is of no real concern” (p. 108). Therefore, this study may present the notion that complexity is not a significant factor in predicting adoption of innovations.

Rogers (1995) said that “at the persuasion stage, and especially at the decision stage, an individual is motivated to seek innovation-evaluation information, the reduction in uncertainty about an innovation’s expected consequences” (p. 168). From this perspective, this study intended to examine which factors are significantly related to

perceived uncertainty. According to Rogers (1995), in order to reduce uncertainty, an individual wants to know the innovation's consequences and advantage/disadvantage. Consistent with Rogers's assertion, the result of this current study shows that among the independent variables, relative advantage was the strongest factor in predicting perceived uncertainty. This study supports that an individual has some degree of uncertainty for innovations, and knowledge about an innovation's expected consequences and advantages can reduce individual's perceived uncertainty.

Finally, this study used trialability as an independent variable. A number of adoption studies excluded trialability from perceived attributes of innovations for particular reasons (e.g., Parthasarathy and Bhattacharjee, 1998), or trialability was not a significant predictor of adoption in previous studies (e.g., Eastlick, 1993). Agarwal and Prasad (1997), however, contended that trialability had a significant and important impact on the acceptance of information technologies. Rogers (1995) asserted that trialability will speed up the rate of adoption, and most individuals will not adopt an innovation without trialability in order to know its relative advantage in their own situation. Even though this study didn't examine if trialability affects adoption (purchase intention) of PDA, this study shows that trialability has a significant affect in predicting attitude, which is the strongest predictor of adoption of PDA in the current study. This current study expects that under the rapidly changing media environment, consumer want to get more opportunity to try out new technologies before they decide to purchase them. This study may offer the notion that triability plays an important role in adoption research.

### **Practical Implications**

The current study contributes to the practical field of marketing for a PDA.

First, this study examined whether attitude toward PDA leads to a purchase intention. According to the results pertaining to causal relationship, there was a strong relationship between attitude and purchase intention. In the basis of this result, marketers should have the ability to influence consumers' attitude toward PDA, providing information on the benefits associated with a PDA. Marketers should identify important factors influencing attitude toward PDA, because attitude toward PDA has been found as the foremost predictor of purchase intention.

Second, this study contributes to the practical field of development of PDA. In this study, relative advantage, compatibility, and trialability appeared to be influential in forming attitude toward PDA. In addition, perceived uncertainty was influenced by relative advantage and complexity. Lin (2001) asserted that unless an innovation can provide better content, superior technical benefits, and cost efficiency to consumers, an innovation can hardly displace the traditional technologies. The main attributes of PDA should present dimensions of relative advantage over other technologies (Atkin et al., 1998). Developers and researchers should focus on identifying which aspects of PDA lead to better benefits, compared to other technologies.

Third, several types of PDAs should be offered. This current study found that Internet, video games, digital camera, and GPS were significantly correlated to attitude toward PDA, and purchase intention is significantly related to MP3 player, digital camera, and GPS. Functions related to entertainment have stronger impact on attitude and purchase intention than functions related to information or others. Consumers are likely

to purchase a PDA with different motivations and objectives. Some consumers focus on entertainment aspects of PDA rather than others of PDA. Some consumers will purchase a PDA as a mobile communication device. As a rule of thumbs, the number of functions affects the price. In other words, the more functions, the higher price. For example, hedonic innovators will be little interested in functions related to interaction or information. Word processor and GPS are useless functions to hedonic innovators. They just increase the production cost. Marketers should provide diverse consumers various PDAs such as a PDA, which focuses on entertainment aspects, or a PDA, which focuses on information aspects. It also can decrease the price of PDA.

Fourth, the result of this present study showed that trialability had a significant impact on attitude toward PDA. In other words, it seems that consumers want to try a PDA out long enough to see what they can use it for before deciding to use a PDA. The more consumers try it out, the less risk about a PDA they will have. Therefore, marketers should give consumers more opportunity to try it out. For example, companies should provide several ways to try it out such as 30-day free trial or booth for trial in big stores (e.g. Best Buy, Circuit City).

Finally, personal innovativeness has been an important predictor of adoption of innovations. This study also shows that personal innovativeness is a significant factor in predicting attitude toward PDA, which is the strongest determinant of purchase intention. Personal innovativeness can help marketers identify early adopters of PDA (Citrin et al., 2000). According to Citrin et al. (2000), early adopters can provide important interpersonal communication about an innovation to later adopters. If a marketer can identify potential early adopters by personal innovativeness, he/she is able to provide

early adopters a positive image of PDA, and then encourages them to engage in subsequent positive interpersonal communication to the later adopters. Even though this present study didn't examine which demographic and socioeconomic factors are related to personal innovativeness, it is generally known that earlier adopters are younger, better educated, richer, and more literate than later adopters (see table 2-1).

This present study expects that a sound understanding of the predictors of the adoption of PDA lays a useful foundation to approach for future opportunities in marketing strategy.

### **Future Research**

This current study will present several ideas for future research.

First, future research will need to examine the effect of demographic and socioeconomic factors on the adoption of PDA. Rogers (1995) contended that earlier adopters are younger, better-educated, upscale, and more literate than later adopters. A number of adoption researches also indicate that demographic and socioeconomic factors are significantly related to the adoption of innovations (Dickerson and Gentry, 1983; Dutton, Rogers, and Jun, 1987; LaRose and Atkin, 1988 & 1992; Atkin et al., 1998; Lin, 1998). On the other hand, several researches found that demography is not a significant determinant of adoption of innovations (Jeffres and Atkin, 1996; Lin and Jeffres, 1998). Since little work has directly addressed PDA adoption, it may be useful to examine demographic and socioeconomic factors (Atkin et al., 1998).

Second, considering the functions of PDA, a PDA is definitely one of convergence communication devices. Future PDA will have functions such as Internet, Email, video games, mobile phone, global positioning system, digital camera, and so on. Rogers (1995) presented that one or more distinguishable elements of technology can be

interrelated. Lin and Jeffres (1998) said that “the introduction of a new medium encourages a restructuring in the way consumers view established media” (p. 342). Even though functional substitution assumptions have been widely studied for the impact of television on radio and that of video on television (Atkin et al., 1998), there is no literature on PDA adoption research providing the indication of the impact of PDA on other established communication technologies, such as mobile phone, Internet, etc. This current study investigated only the relationship between ownership of new technologies, and attitude and perceived uncertainty. This study, however, didn’t support other hypothesis. In the future research, ownership of new technologies as well as related media use level, satisfactions, familiarity, and other variable should be investigated for functional displacement research.

Third, a PDA has a variety of functions. Among them, some functions are related to escape/interaction, some functions are about information and learning, and some functions are related to entertainment. In other words, one PDA has several functions, which can satisfy several gratification-seeking motivations. This present study investigated whether functions of PDA are significantly associated with attitude and purchase intention. The result showed that functions related with entertainment were significantly associated with attitude and purchase intention. According to Ko (2002), motivations for using the Internet have a significant effect on Internet usage. From a uses and gratifications perspective, this study believes that the motivations for using a PDA will be different with consumers and motivation will be a significant determinant in predicting the adoption of PDA. For example, future research should examine the difference in attitude and purchase intention among several PDAs such as a PDA that has

only functions related to entertainment, a PDA that has only functions related to information, and a PDA that has both entertainment and information functions, and then researchers can discover which motivation is significantly correlated with the adoption of PDA.

Fourth, during the past decades, the relationship between consumer innovativeness and adoption behavior has been examined (Venkatraman and Price, 1990). A few of researchers developed conceptualizations of innovativeness and its relation with the adoption of innovations (Manning et al., 1995). Innovativeness is not homogenous but can be differentiated as different types of new experiences consumers prefer and seek (Venkatraman and Price, 1990). Some researchers classified innovativeness into several types for measuring innovativeness or exploring the adoption of innovations (Midgley and Dowling, 1978; Hirschman, 1980 and 1984; Foxall, 1988; Venkatraman and Price, 1990; Goldsmith and Hofacker, 1991; Goldsmith and Flynn, 1992; Venkatraman, 1992; Manning et al., 1995; Citrin et al., 2000). Venkatraman and Price (1990) focused on differentiating between cognitive and sensory innovativeness by concepts, measurement, and implications. Sensory innovators and cognitive innovators are similar to each other in that both of them like novelty and consider the newness of innovations in a purchase decision. Generally, however, cognitive innovators have different adoption behaviors from sensory innovators in that cognitive consumers are likely to focus on functional and practical aspects of innovations, whereas sensory innovators focus on the sensory qualities of the innovations (Venkatraman, 1991). Based on this predisposition, Venkatraman and Price (1990) posited that “cognitive and sensory innovativeness have significant positive relationship with the purchase of functional and hedonic products,

respectively” (p. 303). The newest PDA has a variety of applications. Considering the functions, one PDA has both characteristics: “functional” and “hedonic”. Sensory innovators prefer hedonic products to functional products and cognitive innovators, in contrast, prefer functional products to hedonic products (Hirschman, 1984). In addition, Okolica and Stewart (1996) found that individual innovativeness is positively related to extent of use of the innovation. Since a PDA has both functional and hedonic aspects, it may be useful in investigating whether both cognitive and sensory innovators have a significant positive relation with attitude toward PDA and purchase intention.

Fifth, this study examined the relationships based on a model of the innovation-decision process of diffusion theory. This current study investigated whether the independent variables (relative advantage, compatibility, complexity, trialability, ownership of new technologies, and personal innovativeness) had a significant impact on attitude toward PDA. Several adoption researches examined the relationship between perceived attributes of the innovation, innovativeness, and other variables and adoption (purchase intention). This study expected that the independent variables would affect attitude, and then attitude would influence purchase intention. However, it may be argued that the independent variables would have a significant direct effect on purchase intention. Therefore, future research should use other statistical methods such as path analysis, in order to identify the relations among all variables.

Finally, future research is needed to provide insight into the exact nature of relationships among variable. This current study used multiple regression, discriminant analysis, and Pearson correlation. However, most first generation regression models such as linear regression can analyze only one layer of linkages between independent and

dependent variables at a time (Gefen et al., 2000). Contrary to first generation statistical tools such as regression, a Structural Equation Modeling (SEM) enables “researchers to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis by modeling the relationships among multiple independent and dependent constructs simultaneously” (Gefen et al., 2000, p. 6-7). Therefore, future study will need to use further analysis such as a SEM to investigate insight into the exact nature of relations among variables.

### **Limitations**

Like most researches, this current study is not without limitations.

First, this current study used students as sample. As one of the major weakness in academic research, a homogeneous student sample might have a different result from a general population sample (Ko, 2002). According to Brown and Stayman (1990), past studies which used students as subjects had a biasing effect in the causal relationship. The sample composition of this study was not representative of the U.S. population. Therefore, this study has a limitation on the generality of the results. The young age group is more comfortable with computer-based media (Ferguson and Perse, 2000). Even though a student sample for this study limits the generalization of findings, this study may offer an initial look at the adoption of PDA.

Second, it may be argued that several variables – relative advantage, compatibility, and complexity – were not effectively measured without exposure to real-life demonstrations of PDA. Most subjects answered questionnaires without having experienced a PDA. Instead of real experience for a PDA, this study provided the same instruction and information of PDA to all subjects. Dupagne (1999) contended that

respondents' interest and purchase intention in relation to innovation could not really be measured without exposure in real life. Therefore, this may be the limitation of this study.

Third, two scales were less reliable than expected: trialability and perceived uncertainty. The scales for trialability and perceived uncertainty were adapted from a previous study. Although they were considered to be reliable measures of trialability and perceived uncertainty, their reliability were not as high as in the previous studies in this study. In addition, this study measured reliability of scales, while validity was not measured. Improved reliability and validity may be achieved in future research.

Fourth, this current study used cross-sectional data. According to Rogers (1995), there are two types of researches needed to answer the question whether stages exist in the innovation-decision process: "process research" and "variance process" (p. 188). Process research is defined as "a type of data gathering and analysis that seeks to determine the time-ordered sequence of a set of events," and variance process is defined as "a type of data gathering and analysis that consists of determining the co-variances among a set of variables, but not their time-order" (p. 188). Most diffusion studies have used variance process (Rogers, 1995). Because such studies involve gathering data with cross-sectional methods, such as a survey, researchers cannot investigate backward in time to examine what happened across several stages, and which variables would affect the next stage (Rogers, 1995). In other words, variance process can not explore the cause and results of a series of events over time in terms of the nature of the innovation-decision process. This present study assumed that a PDA exists between the knowledge stage and the persuasion stage. This study didn't examine at which stage a PDA exists

now. Since this study is based on this assumption, it may be a limitation of this current study.

### **Conclusion**

This present study explored factors influencing the adoption of Personal Digital Assistant. Under rapidly changing new media environment, it is important to know what affects the adoption of innovations. With this purpose, this study examined a few of relationships and showed the results of data analysis. Consistent with past studies, some hypotheses were supported, while other hypotheses were not supported. This study partially supported diffusion theory. As expected, most perceived attributes of PDA were significant determinant in this study. The lack of support might be from limitations of this study. This study dealt with only a few part of diffusion theory. There remain many topics to be dealt with in future PDA adoption research. It is hoped that this study will provide PDA markets improved information for targeting and identifying potential adopters and other researchers useful information and implications in understanding what affects adoption.

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