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FACTORS IMPACTING THE INTENT TO USE AN INTERACTIVE VISUAL AID ON A  
TABLET PC PLATFORM BY A BIOTECHNOLOGY SALES FORCE

by

THOMAS A. DOTTER

A DISSERTATION

Presented to the Faculty of the University of the Incarnate Word  
in partial fulfillment of the requirements  
for the degree of

DOCTOR OF BUSINESS ADMINISTRATION

UNIVERSITY OF THE INCARNATE WORD

May 2018

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Thomas A. Dotter

## DEDICATION

I would like to dedicate my dissertation to my beautiful wife Susan and our four children, Emma, Michael, Abby, and Andrew. Without their love, support, and encouragement I could not have crossed the finish line. There were many weekends and evenings when my wife and children had to attend activities without me or cancel events due to my absence. I missed many events at my daughter's university and I am very grateful for her grace and abundant kindness. It was at my lowest moments in the journey, when I was most discouraged, that my sweet wife Susan, as she has done throughout my career, encouraged me to press on. I will never forget the sacrifice each of you made to help me accomplish my personal goals. You are my biggest cheerleaders and you inspired me to press on and complete this journey.

## FACTORS IMPACTING THE INTENT TO USE AN INTERACTIVE VISUAL AID ON A TABLET PC PLATFORM BY A BIOTECHNOLOGY SALES FORCE

Thomas A. Dotter, DBA

University of the Incarnate Word, 2018

The interactive visual aid on a tablet PC technology platform is a relatively new marketing tool. The interactive visual aid was developed to replace the visual aid brochure, also known as pharmaceutical promotional literature. The interactive visual aid is used by biotechnology area business managers to promote their respective medications directly to a healthcare provider.

Biotechnology corporations are equipping their sales forces with tablet PCs to leverage customer relationship management tools, adhere to compliance and Food and Drug Administration regulatory policies, and to launch marketing tools such as the interactive visual aid. Do these companies know the factors contributing to the sales representatives' utilization and adoption of an interactive visual aid? What are the factors that determine if a biotechnology sales representative will utilize an interactive visual aid in front of customers in the absence of management supervision? This study will identify the factors that contribute to the utilization of an interactive visual aid on a tablet PC platform by a biotechnology sales force.

Review of previous research resulted in the determination that a quantitative method in conjunction with a survey was the most appropriate given the objective and background of the research for this study.

Multivariate analysis was used to determine the correlation between the dependent and independent variables. As a result, inferential statistics were used to identify correlations between items, constructs, and the dependent variable in the form of a regression analysis.

Data was analyzed using Partial Least Squares a form of Structural Equation Modeling software. Consistent with prior research, analysis utilized a two-step process. In the first stage, the measurement model was evaluated to determine the reliability and validity of the constructs. Next, the structural model was evaluated to examine the predictive relevance of the model, magnitudes of effects, and variance.

This study demonstrates clear evidence of the intent to use an interactive visual aid by a biotechnology sales force is determined by the area business manager identifying a relative advantage (hypothesis supported) over the precursor. If the innovation, does not bring tangible advantages, then the likelihood of the area business manager using that technology will be reduced. Area business managers within the biotechnology corporation must find the interactive visual aid useful (hypothesis supported), they must be able to see others being successful using the innovation (hypothesis supported), and positive results need to be demonstrated (hypothesis supported).

This study aimed to apply Moore and Benbasat's (1991) modified *diffusion of innovation theory*, Sappington's (1991) *principal agent model*, and Davis' (1983) *technology adoption model* to determine usage intention of an interactive visual aid on a tablet PC platform by a biotechnology sales force. Consistent with prior research, the study found that factors pertaining to diffusion of innovation, agency theory, and technology adoption do affect area business managers' interactive visual aid usage intention. Through mediation, three variables became

more prominent in the alternative model's prediction of user intention: relative advantage, compatibility, and voluntariness.

In this study, the area business managers intent to use an interactive visual aid on a tablet PC platform during selling discussions with healthcare providers were impacted by the perceived advantages the interactive visual aid has over its predecessor, the compatibility the interactive visual aid had with the current work environment, and the area business managers' voluntary use of the interactive visual aid.



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## **Background of the Problem**

### **Context of Topic**

Pharmaceutical companies spent over \$7 billion on their sales forces in 2002 (Manchanda, Honka, & Honkat, 2005). By 2012, that number had grown to over \$15 billion (O'Connor, 2014). Personal selling by a pharmaceutical representative “accounted for about 60% of all global sales and marketing spending by pharmaceutical companies in 2012 out of a total of \$89.5 billion, with that percentage holding steady since 2007” (Chressanthi, Sfeka, Khedkar, Jain, & Poddar, 2014, p. 224). Traditional pharmaceutical marketing practices have included a pharmaceutical sales representative promoting a product directly to the health care provider (HCP). However, sales representative access struggles, and pressures on physician time have caused pharmaceutical companies to turn their attention to new technology alternatives as a supplement and substitute for traditional in-person personal marketing (Chressanthi et al., 2014).

The healthcare provider (HCP) can prescribe any medication per the Food and Drug Administration (FDA) prescribing guidelines. While the end consumer of either a pharmaceutical or biotechnology medication is the patient, in the pharmaceutical promotion model, the HCP is the target customer for direct pharmaceutical sales representative promotion. Cost concerns, sales representative access issues, and pressures on physician time have caused pharmaceutical companies to investigate e-detailing activities as a supplement and substitute for traditional in-person promotion

For this research, the terms biotechnology and pharmaceutical HCP direct promotion will be used interchangeably. However, there is a distinction between pharmaceutical and biotechnology industries, medications, and promotion. In the traditional pharmaceutical space,

medications are filled at a local pharmacy or via mail order through a pharmacy benefit management company. In the pharmaceutical space, marketing approaches can take various forms, including but not limited to, direct to HCP sales representative promotion, direct-to-consumer (print and media) advertising, social media, and e-detailing. E-detailing is defined as a broad and ever evolving term to describe the use of electronic, interactive media to facilitate sales presentations to HCPs in the pharmaceutical industry (Kwak & Chang, 2016). In the biotechnology space, medications are not only far more expensive than traditional pharmaceuticals but require more complex distribution pathways than simply acquiring the medication from the corner pharmacy. Direct to consumer advertising is far less prevalent in the biotechnology space versus the pharmaceutical industry. Rarely will the consumer see commercials or print advertising for highly specialized, very expensive biotechnology medications. For this research, biotechnology promotion will focus on the direct to HCP promotion by a biotechnology area business manager (ABM) also known as a biotechnology sales representative.

The traditional tool used by pharmaceutical and biotechnology sales representatives, when promoting their respective medication to an HCP, is the visual aid brochure also known as print promotional literature. The visual aid highlights key facets of the medication including: efficacy, safety, tolerability, side-effects, drug-to-drug interactions, pre-cautions, warnings, clinical trial data, indications, and usage. The visual aid may also emphasize the typical patient profile appropriate for the medication's intended use. Print promotional literature is intended to market, highlight, and simplify the information contained in the medication's prescribing information. The visual aid will use key promotional messages to highlight specific attributes of the medication and emphasize how the medication is different, better, or unique versus the



competitors. The print form of the visual aid, while commonly used today by biotechnology area business managers, evolved once the tablet PC came to market.

Since the launch of smart devices in 2007, companies such as Apple and Samsung created a new type of device that fit between a smartphone and a laptop and launched the tablet PC (Kwak & Chang, 2016). The tablet PC can best be described as a 7 to 10 inch touch-type device such as the iPad and Galaxy Tab. Over time, the iPad became the standard platform for pharmaceutical and biotechnology sales representatives to launch customer relationship management tools and launch an interactive visual aid (IVA) for product promotion.

The IVA on a tablet PC platform is a relatively new marketing tool developed to replace the paper visual aid brochure as the vehicle for biotechnology ABMs to promote their respective medications directly to the HCP. Although biotechnology corporations are spending a significant portion of their marketing budgets on the IVA on the tablet PC platform, in one study, it was found that sixty-two percent of sales representatives still use print brochures (Kwak & Chang, 2016). If only thirty-eight percent of a biotechnology sales force are using the iPad mobile technology platform, where IVA tools lie, why are pharmaceutical companies investing millions to place their promotional literature on a tablet PC technology platform?

Pharmaceutical companies are equipping their sales forces with tablet PCs to leverage customer relationship management tools, adhere to compliance and Food and Drug Administration regulatory policies, and to launch IVAs. Do these biotechnology companies know the factors contributing to the sales representative utilization and adoption of an IVA? What are the factors that determine if a biotechnology sales representative will utilize an IVA in front of customers in the absence of management supervision? This study will identify the

factors that contribute to the utilization of an IVA on a tablet PC platform by a biotechnology sales force.

### **Purpose of the Study**

The purpose of this study is to examine managerial and sales personnel behaviors which become factors impacting the intent to use IVA on a tablet PC platform in a U.S. biotechnology sales force.

### **Research Question**

What are the factors that affect the utilization of an IVA on a tablet PC platform by a U.S. biotechnology sales force?

### **Hypothesis Statements**

H<sub>1</sub>: Relative Advantage is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>2</sub>: Compatibility is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>3</sub>: Trialability is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>4</sub>: Results Demonstrability is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>5</sub>: Voluntariness is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>6</sub>: Image is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>7</sub>: Perceived Ease of Use is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>8</sub>: Visibility is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>9</sub>: Perceived Usefulness is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>10</sub>: Behavioral Evaluation is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>11</sub>: Monitoring is a predictor of the intent to use an interactive visual aid on a tablet PC.

H<sub>12</sub>: Repeated Contract is a predictor of the intent to use an interactive visual aid on a tablet PC.

### **Summary of Appropriate Methodology**

Exploring the research question in this study required an analysis of the theories, associated constructs, and behaviors that result in the intention to use the IVA on an iPad platform by biotechnology sales representatives. All research methods have their positive and negative attributes and no single research method is advantageous over another. Review of previous research resulted in the determination that a quantitative method in conjunction with a survey was the most appropriate given the objective and background of the research for this study.

Data for the present study were collected via self-report questionnaire in an online survey format. One of the reasons online surveys have been successful is related to the finding that the online population is very similar to the general population, for example, in gender distribution (McDaniels & Gates, 2005). It has also been established that when the subject under investigation is of equal interest for both populations (the internet and overall target population), quality of the information provided by internet survey is similar to using mail or telephone surveys (Coderre, Mathieu & St-Laurent, 2004). Another benefit of using online surveys is the high response and completion rates as well as the ability to reach difficult to access subjects such

as a sales force within a biotechnology corporation. As a result, an online survey was utilized for this study. There are other benefits to using the online survey format. The collection of data at a reduced cost, high response rates, the speed of data collection, and decreased data entry error are all advantages to online survey data capture (Gaide, 2005; Ilieva, Baron, & Healey, 2002; McDaniels & Gates, 2005; Wharton, Hampl, Hall, & Winham, 2003). Thus, the ability to reach a significant number of respondents combined with the collection of data in a short period make the online survey format a reasonable selection for the researcher (Esteva-Armida & Rubio-Sanchez, 2012).

### **Interactive Visual Aid**

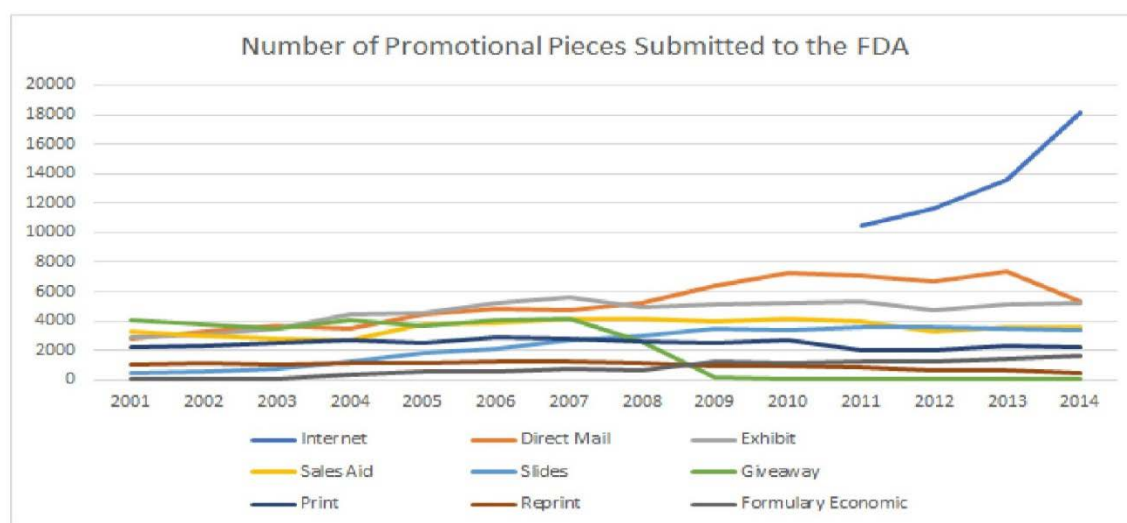
At the start of a new sales cycle, sales representatives are typically provided with print brochures for all products and associated service offerings by their respective product marketing departments. Simultaneously, the same materials contained in the print sales brochures are incorporated into an electronic media platform such as an IVA, usually launched from a customer relationship management application on a tablet PC platform. The media can contain video testimonials from experts, 3-D modeling of the mechanism of action, promotional messages and efficacy data, safety, warnings, contraindications, and clinical trial information.

From the mid-2000s to 2013, two market conditions occurred resulting in the transition from classic print promotional literature used by a biotechnology sales representative to the now widely accepted industry approach using IVAs launched from customer relationship management software on the tablet PC platform (Mehr, 2013). First, ABMs time in front of a healthcare provider had reduced dramatically during this period. Offices had limited the ability for the pharmaceutical representatives to gain access to the health care provider. This environment was due to the reduction in office visit reimbursement by the major insurers. Also,

Medicare and Medicaid office visit reimbursements declined over time due the increasing cost of medical care for the largest national payer – the Federal government. From the healthcare provider’s perspective, the solution to the decline in reimbursements was to increase the volume of patients seen by an HCP in any given day. As a result, restrictions made on pharmaceutical sales representatives’ access to the HCP was necessary to ensure valuable time was not wasted talking to a pharmaceutical sales representative but rather spent seeing patients.

Pharmaceutical promotion by a sales representative has become a focal point in the medical community and literature. “Numerous academic articles and physician anti-detailing campaigns have called for progressive tightening of access-limit policies and outright bans of contacts with industry representatives” (Chressanthis et al., 2014, p. 224). Thus, the pharmaceutical industry introduced the tablet pc platform as a unique tool to gain more time for personal promotion with a health care provider. Second, tighter FDA regulations resulted in the inability for pharmaceutical companies to modify and monitor the use of promotional literature in response to label updates (O’Connor, 2014). The introduction of the IVA on a tablet pc platform enabled pharmaceutical companies to accommodate the necessary monitoring required by the FDA. For example, if the FDA required a modification to a drug’s prescribing information, the edited version of the new promotional material could simply be pushed down to the entire salesforce tablet pc’s overnight using the sync button in the customer relationship management software. The IVA would contain the new revised promotional materials for the ABM to use the next morning, as opposed to waiting weeks for a new print promotional brochure. The introduction of the Apple iPad in the Spring of 2010 would transform the pharmaceutical and biotechnology marketing sales force promotional approach.

The universal mobile technology platform used by the biotechnology industry is the Apple iPad. One way to measure the changes in prescription drug promotion over time is to assess the number of promotional pieces submitted to FDA's Office of Prescription Drug Promotion. FDA regulations state that prescription drug advertising and promotional labeling must be submitted the FDA for review prior to dissemination in the market place. This phenomenon is illustrated by figure 1. From 2008 to 2014, printed material (Sales Aid) submissions to the OPDP declined while electronic slide submissions increased. By 2014 Sales aid submissions to the FDA and electronic slide submissions were nearly equal in number.



*Figure 1.* Professional Promotion trends from 2002 to 2014 based on pharmaceutical promotion and advertising submissions to the FDA. Data assembled and displayed by Sullivan et al., 2016.

### **iPad Technology Platform**

Salespeople today are required to do more with less time and technological advancements have become an integrated part of the sales person's role and responsibilities (Leigh & Tanner Jr., 2004). Although some discussions around the use of a tablet PC as a sales force tool have been published (Desisto, 2011), the iPad has become the standard mobile platform for the

biotechnology industry sales force. While there are many tablet options, the iPad continues to be the mobile platform of choice (Hallberg, 2011) (Table 1).

Table 1

*iPad Features: Advantages and Limitations*

iPad Feature	Advantage	iPad Feature	Limitation
Instant on	The device can switch on in seconds	Fragile	iPad requires a robust protective case to prevent breakage
Battery life	Batteries can now last for over a day, even when used extensively for sales presentations.	Price	Most expensive tablet
Weight	iPad much lighter than a laptop	No USB port	Cannot use flash drive but the advent of cloud storage makes this limitation negligible
Screen Resolution	Screen is intuitive to work with and allows for rich presentations.	Corporate Integration	Microsoft apps such as Excel and Word, while displayed on Apple's version, Excel Macros, for example cannot be displayed on an iPad.
Speakers	Good quality sound and volume		
Connectivity:	Support for 4G wireless network access and VPN connection		
Well Designed	Considered the pinnacle of cutting edge tablet design.		

*Note: iPad features and categories adapted from Hallberg, J. (2011). Pad Up the Sales Force: The Medium's Impact on Presentation Effectiveness.*

Regardless of the limitations, the iPad's advantages are too numerous versus the competitor tablet PCs on the market today. For these reasons, the iPad has become the platform of choice for the biotechnology salesforce and is used extensively for customer relationship management daily work tasks.

## **Theoretical Framework**

The literature search revealed a growing body of research defining innovation as any estimate, practice, or object that the adopting individual or organization regards as new (Damanpour, 1991; Damanpour & Evan, 1984). From this perspective, the newness attached to an innovation remains a topic of perception. Certainly, being the first to move on an innovation is relevant. “But in this approach to understanding innovation, the key question for the adopting unit involves uncertainty associated with the idea, process or object” (Cooper & Zmud, 1990, p. 495). Uncertainty arises because the adopter has incomplete knowledge with which to evaluate and make a judgement about the appropriateness of the innovation and the long-term consequences of adoption (Robertson & Gatignon, 1986).

According to Rogers (1983), the decision to adopt or reject an innovation is influenced by the following innovation variables: observability, relative advantage, compatibility, trialability, and complexity. The first four variables positively correlate with the rate of adoption, whereas complexity has a negative impact on adoption rate for innovative technology (Rogers, 1983). Rogers’ five attributes of innovation are best suited to measure a variety of diffusion studies and variety of disciplines, such as marketing and psychology. Moore and Benbasat (1991) extended the work of Rogers (1983) and identified two further constructs thought important in the decision to adopt an innovation: image and voluntariness of use. Also, Moore and Benbasat found observability to be a complex construct and split into visibility and communication.

While Davis’ (1989) *technology adoption model* (TAM) examines individual information technology (IT) usage and adoption, *diffusion of innovation* (DOI) focuses on how IT diffuses throughout an organization. However, these models have been found to explain a limited percentage of the variance in IT usage (Taylor & Todd, 1995). Neither model discusses two important aspects of technology utilization by a sales force: management incentives and control



(Bhattacharjee, 1996). A *principal-agent model* (PAM) exists whenever two groups are involved in a business partnership whereby one party (principal) depends on the actions of the other party (agent) (Arrow, 1985; Sappington, 1991). Thus, Bhattacharjee's (1996) paper combined PAM to TAM to explain an additional 9% of technology utilization.

This paper seeks to explain digital promotion usage by a biotechnology sales force using DOI, PAM and a variable from TAM. By exploring management incentives and controls through PAM, combined with elements of the Moore & Benbasat adaptation of Roger's DOI model, the research will seek to explain interactive visual aid utilization on an iPad platform by a biotechnology sales force.

### **Significance of the Study**

This study assists healthcare marketing and sales operations departments to evaluate the value, adoption, and utilization of an interactive visual aid on a tablet PC platform by their respective sales force personnel. Information technology managers planning to deploy new technology to their sales force should gain important insights from this study. The research may also assist healthcare firms' senior leadership, determine how to effectively position interactive visual aids as the preferred direct marketing vehicle to HCPs. Healthcare sales management information system departments may use the results of this study to evaluate how to integrate an interactive visual aid on its current mobile digital platform such as a tablet PC. The result from this research will enable healthcare firms to maximize the utility, impact, integration, and effectiveness of an interactive visual aid on a tablet PC device. Finally, future researchers may want to explore how a biotechnology sales force can more efficiently and effectively incorporate interactive visual aids using an iPad technology platform.

### **Definition of Terms**

Relative advantage – the degree to which an innovation is perceived as being better than its precursor (Moore & Benbasat, 1991).

Ease of Use – the degree to which an individual believes that using a particular system would be free of physical and mental effort (Moore & Benbasat, 1991).

Image – the degree to which use of innovation is perceived to enhance one's image or status in one's social system (Moore & Benbasat, 1991).

Compatibility – the degree to which an innovation is perceived as being consistent with existing values, needs, and past experiences of potential adopters (Moore & Benbasat, 1991).

Trialability – the degree to which an innovation may experiment with before adoption (Moore & Benbasat, 1991).

Results Demonstrability – the more visible technology advantages are then the more likely it is to be adopted (Moore & Benbasat, 1991).

Voluntariness – the degree to which the use of an innovation is perceived as being voluntary, or of free will. (Moore & Benbasat, 1991).

Visibility – the degree to which results of an innovation are visible (Moore & Benbasat, 1991).

Perceived Usefulness – the degree to which a person believes that using an innovation will enhance his or performance (Davis, 1989)

Behavioral Evaluation – the degree to which subjects believe their incentive was based on an absolute or relative behavior (Bhattacharjee, 1996)

Monitoring – the degree to which the subjects believe their usage is being monitored (Bhattacharjee, 1996).

Repeated Contract – the degree to which subjects believe that they can receive more incentives if the current task is performed (Bhattacharjee, 1996).

IT Usage – a multidimensional construct consisting of both breadth and depth of information technology acceptance and use (Bhattacharjee, 1996).

### **Limitations**

Like any research, this study has several limitations that one should understand before generalizing the results to other contexts and recommending future research. First, the respondents come from one specific biotechnology corporation. There may be an adverse impact on response rate due to the volume of surveys, time limitations, and skepticism assuring respondent anonymity due to the culture within the corporation.

Social desirability bias, introduced when respondents want to please the designer, may cause respondents to have greater adoption and utilization of digital promotion (Fisher, 1993). A second condition that may need further explanation, is the IVA on a tablet PC platform may not address key aspects of the area sales manager's job functions. "Many systems are rejected by users because, although easy to use and capable of producing high quality output, they do not address tasks that are important to the users' job" (Davis, Bagozzi, & Warshaw, 1989, p. 1127).

## **Literature Review**

### **Major Areas of Review**

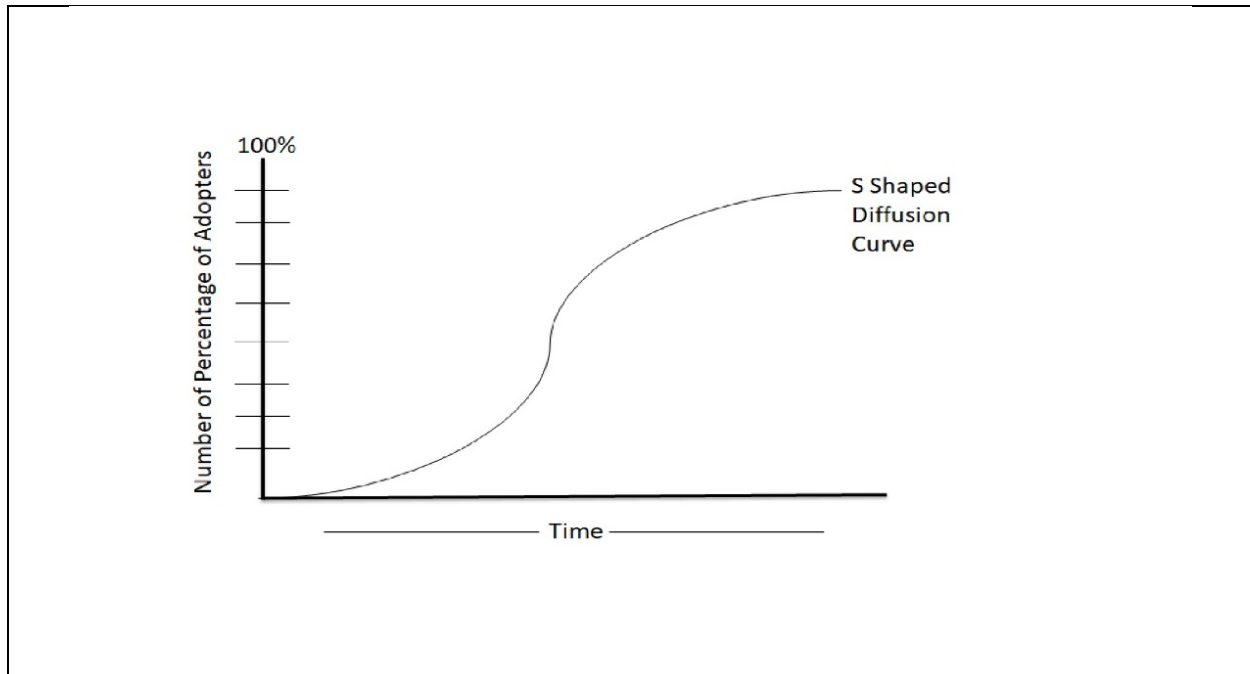
Everett Rogers (2003) stated diffusion “is the process through which an innovation, defined as an idea perceived as new, spreads via certain communication channels over time among the members of a social system.” Rogers DOI theory is one of the earliest innovation acceptance theories and is considered one of the perennial theories of innovation. It is the most referenced theory in IT adoption due to its thoroughly analyzed concepts and its wide use in innovation acceptance research (Schmitt & Michahelles, 2009; Soon & Gutiérrez, 2010). This literature review includes the historical background and in-depth exploration of the components of DOI theory. The review will also explore the variants of diffusion and diffusion of innovation theory. However, DOI ignores two important aspects of technology utilization by a sales force: management incentives and control (Bhattacharjee, 1996). Thus, the literature review will also examine *agency theory* and the principle agent model. The literature review will conclude with an exploration of tablet PC adoption research.

### **Theories**

Technology diffusion literature is extensive, expansive, and extremely diverse. technology diffusion research can be traced back to Joseph Schumpeter (Schumpeter, 1911; Joseph a Schumpeter, 1912) who developed a “linear progression from invention to innovation to imitation/diffusion.” (Sarkar, 1998).

Ryan and Gross’ (1950) first identified adopter categories in their landmark diffusion of innovation study, which focused on the adoption of hybrid corn by Iowa farmers in the 1930’s. A hybrid corn, originally developed in 1928, considered hardier and produced greater yields was reintroduced to the farming community in the early 1940’s. Most importantly, the new hybrid

corn could withstand drought conditions far better than traditional corn seed. Ryan and Gross conducted qualitative research to understand why some farmers were quick to adopt the hybrid corn while other farmers were extremely hesitant to adopt. It was in Ryan and Gross' (1943) study the S curve was introduced – steep curve for innovators and early adopters, a more gradual curve for “late adopters” and “Laggards.”



*Figure 2. S Curve based on hybrid seed adoption rates by adopter category. S-curve based on data obtained through qualitative research assembled by Ryan & Gross, 1943.*

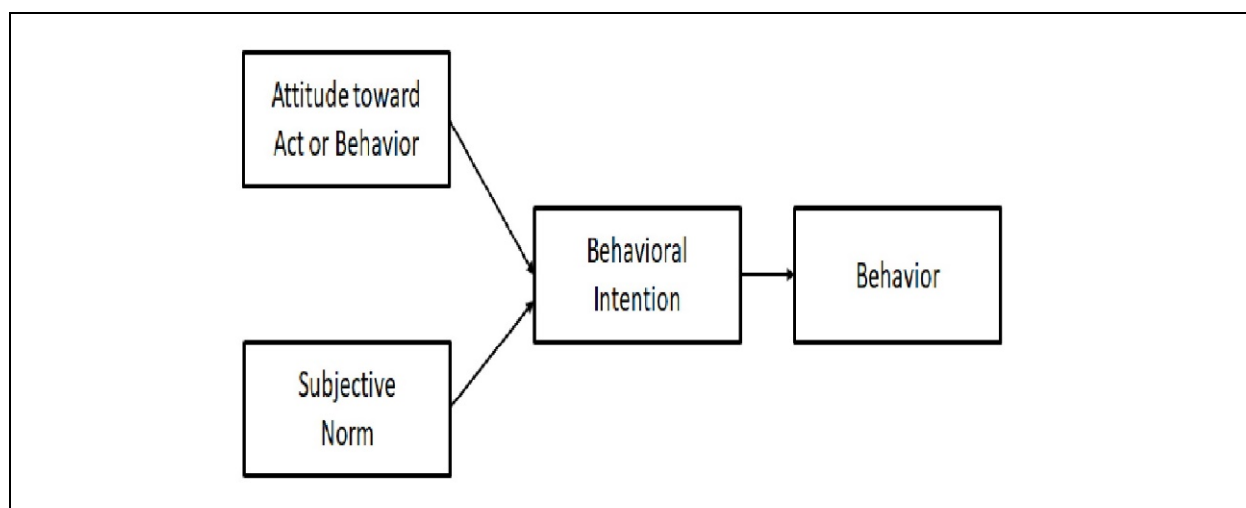
Ryan and Gross' landmark study had significant implications on future diffusion research in the field of sociology (Greenhalgh et al., 2005). It was from this research the concept of epidemic models of diffusion were developed in the 1950's. These models were based on the concept that the spread of technological innovation can be analogous to the spread of disease. The seminal author of the epidemic model of diffusion was Griliches (1957) diffusion of U.S. hybrid corn studies and Mansfield's (1961) work on the diffusion of industrial innovation. However, these models received extensive criticism over the years due to the epidemic diffusion model's reliance on human contact (Stoneman, 1980). While epidemic models can describe an

overarching industry's technology adoption, it may shed less light on an individual firm's adoption decision – why some firms adopt technology at a faster rate than others (R. Jensen, 1982).

Technology acceptance models and their derivatives have existed since the late 1980's with the development of TAM (Davis, Bagozzi, & Warshaw, 1989). TAM explores the extrinsic rationale or motivation for using a new technology. Extrinsic motivation refers to the performance of activity because it is perceived to be instrumental in achieving valued outcomes or job performance (Lawler & Porter, 1967; Mitchell & Biglan, 1971; Vroom, 1964). Davis (1992) raised a fundamental question as to whether people use computers because they are useful or because they are enjoyable to use. While perceived usefulness has been strongly linked to usage intentions in several studies (Davis, 1989; Davis, Bagozzi, and Warshaw, 1989), individuals may also use technology because of the intrinsic value. Simply stated, intrinsic motivation implies doing an activity for the pure pleasure, not considering if the action will result in a reward. In contrast to usefulness, enjoyment refers to using technology because it is perceived to be enjoyable (Carrol & Thomas, 1988; Deci, 1971; Malone & Lepper, 1987). Davis, Bagozzi, & Warshaw's (1992) research concluded that usefulness and enjoyment together represent a simple yet powerful example of what influences computer usage intentions (Davis, Bagozzi, & Warshaw, 1992). While TAM helped explain why an individual would adopt a new technology, more work was needed be done to explore how technology diffuses through an organization. Understanding the evolution of technology diffusion would require exploring the behaviors that precede adoption.

The *theory of reasoned action* explained the motivational influences on an individual's behavior (Figure 3). Fishbein and Ajzen's (1975) underpinning foundation is an individual's

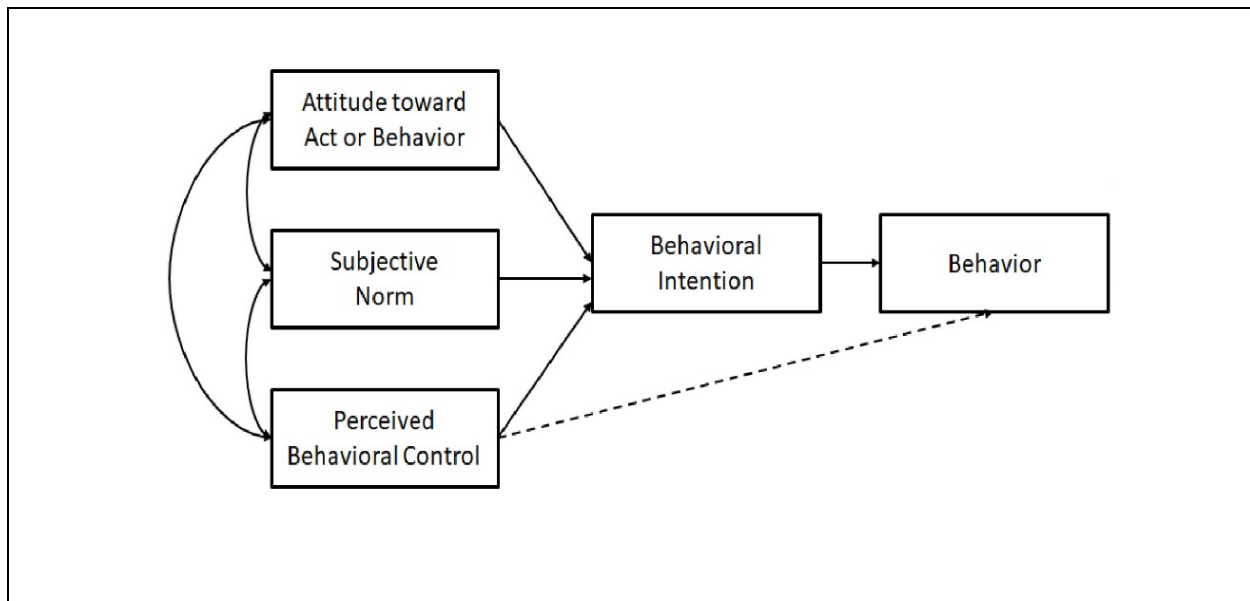
beliefs provide the causal basis for attitudes that translate to an act or behavior. Unlike latter theories, theory of reasoned action assumes that most behavior is under voluntary control but given a specific situation, an individual will form a specific intention that may influence subsequent outward behavior. In the case of subjective norm, an individual's beliefs may be influenced by those closest to the individual (injunctive norms) and those who influence beliefs in the individuals' social circle (descriptive norms). Ajzen (2012) stated, "It has been shown that behavioral, normative, and control beliefs provide the basis, respectively, for attitudes toward the behavior, subjective norms, and perceived behavioral control; that these three factors in behavioral intentions; and that intentions and perceived control can be used to predict actual behavior. Based on these insights, investigators have been able to design effective behavior change interventions" (Ajzen, 2012, p. 16).



*Figure 3.* Theory of Reasoned Action, by Fishbein and Ajzen, 1975, is based on voluntary and involuntary control of behavior and how behavior may be influenced by an individual's beliefs created

Theory of reasoned action did not explain behaviors that might not be in an individual's control (Fishbein, M. & Ajzen, 1975). As a result, the *theory of planned behavior* was developed to explain an individual's intentions and motivational factors that influence behavior (Ajzen &

Fishbein, 1980) (Figure 4). Theory of planned behavior also addressed behaviors over which people have “incomplete volitional control” (Ajzen, 1991, p. 181). Ajzen (1975, 1991) expanded the theory of reasoned action by including the variables of perceived behavioral control as a predictor of intentions and behavior. The perception of behavioral control stands on the premise that beliefs about “resources and obstacles” can either assist or hinder the ability to perform a behavior (Ajzen, 1991).



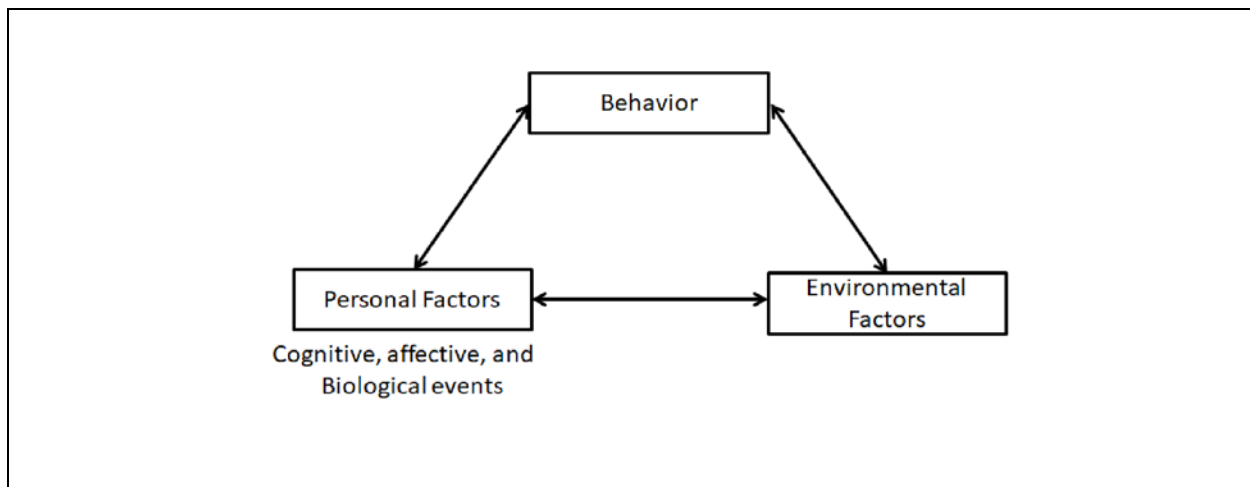
*Figure 4.* Theory of Planned Behavior, by Ajzen & Fishbein, 1980, developed to explain an individuals’ intentions and motivational factors which impact behavior.

*Social cognitive theory* played a significant role in technology utilization and adoption theory because of Bandura’s extensive research on self-efficacy and human behavior (Bandura, 1991, 1997) (Figure 5). Self-efficacy is defined as beliefs in one’s capabilities to command motivation, cognitive resources, and course of action required to meet given situational criteria (Wood & Bandura, 1989, p.408). Social cognitive theory suggests self-efficacy beliefs vary on three dimensions: level of difficulty, certainty in performing a task, and the extent to which magnitude and strength of ideas generalize across tasks and situations (Bandura, 1991, 1997). Bandura’s research identified the importance of perceived ease of use and self-efficacy, which



was subsequently incorporated into *unified theory of acceptance and use of technology* (UTAUT), (Venkatesh, 2000; Viswanath Venkatesh & Davis, 1996).

Chen et.al., (1992) developed the New General Self-Efficacy Scale (NGSE) giving research a tool for obtaining the potential benefits of general self-efficacy to organizational research and more specifically work motivation research. Chen, G., and Gully, (2001) demonstrated that the NGSE scale correlated more highly with several motivational variables than self-esteem. The literature supports, that social cognitive theory became an integral component to what would become technology adoption models developed in the late 1980's.



*Figure 5.* Social Cognitive Theory, developed by Bandura, 1986 based on how an individual's level of self-efficacy impacts behavior.

The UTAUT model suggests that four core constructs are direct determinants of technology acceptance (behavioral intention) and use behavior. These constructs are performance expectancy, effort expectancy, social influence, and facilitating conditions. The theory also suggests that the effect of the four constructs are moderated by four other variables: age, gender, experience, and voluntariness of use. Venkatesh (2000) showed that UTAUT could explain up to 70% of the variation in usage intention (acceptance) of technology, which is greater

than eight previous models and their variations. Venkatesh et al. (2003) developed an extension to UTAUT by adding constructs of hedonic motivation, price, value, and habit.

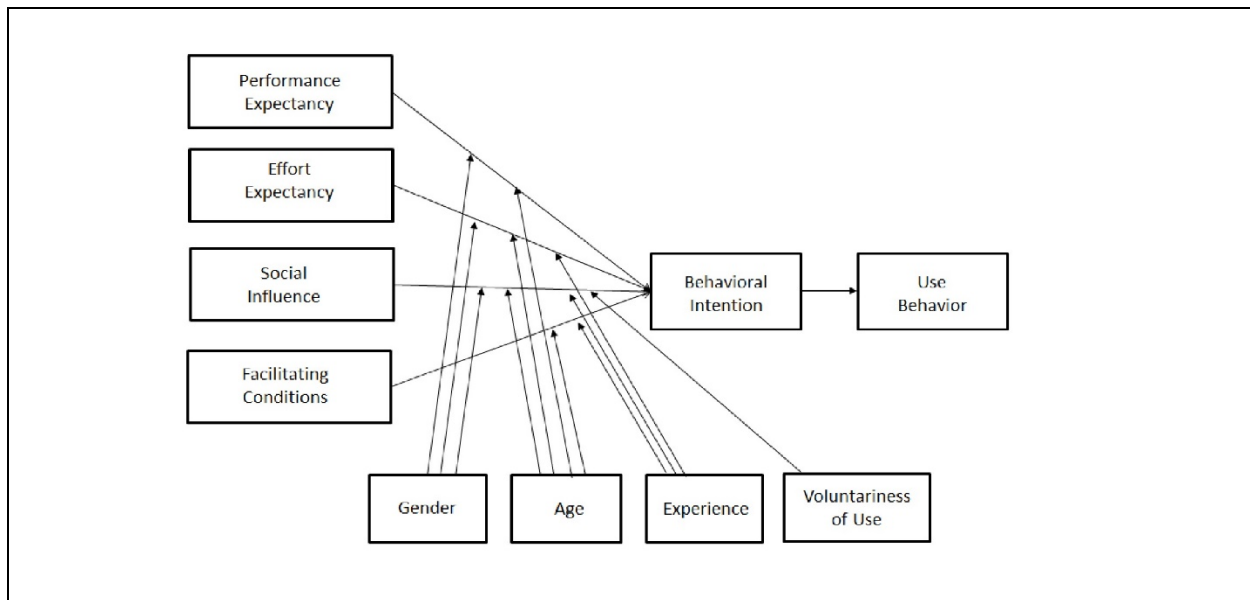
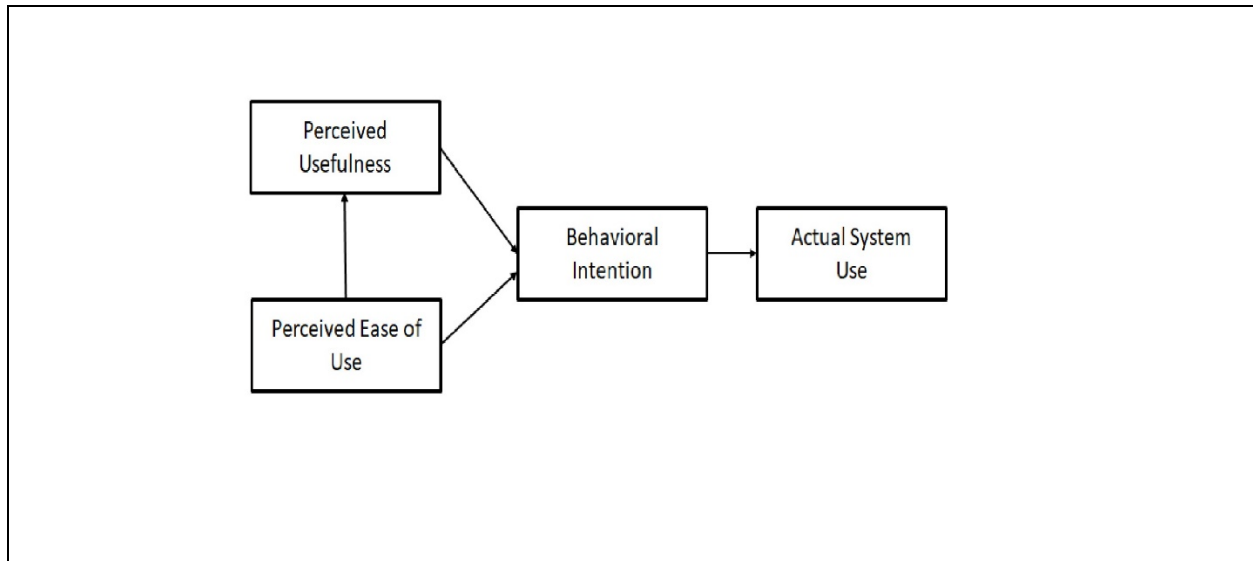


Figure 6. UTAUT, created by Venkatesh, 2000, based on four constructs and four moderators can explain up to 70's of a technology user's behavior.

A major contribution to the acceptance and usage technology research has been the introduction and modification of Davis' *technology adoption model* (TAM). TAM was designed to explain individual computer usage behavior (Davis, Bagozzi & Warshaw, 1989). TAM theorizes that an individual's behavioral intention to adopt or use any information technology are determined by the two beliefs: perceived usefulness and perceived ease of use (Davis, Bagozzi & Warshaw, 1989). TAM was designed to explain computer usage behavior: computer usage is affected by behavioral intentions, beliefs, and attitudes of the end-user. Users form intentions toward usage based on the cognitive consideration of how it will improve their job performance. TAM proposed the intention to use a technology was influenced significantly by the user's beliefs of perceived ease of use and perceived usefulness of the technology (Sledgianowski & Kulviwat, 2008).



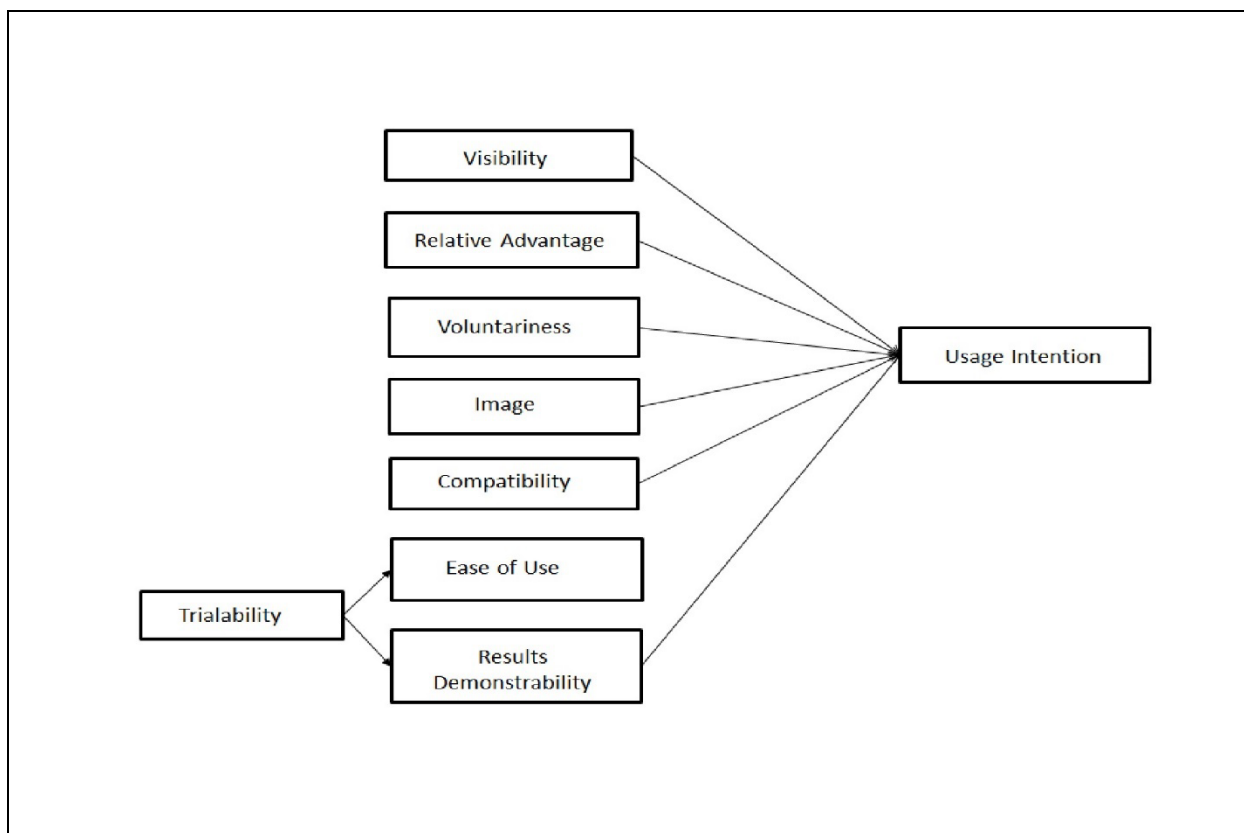
*Figure 7.* Technology Acceptance Model created by Davis et. al, 1989, theorizes technology user acceptance is based on two constructs: perceived usefulness and perceived ease of use.

A recognized deficiency of TAM and other adoption models is they were used to study the adoption of technology for utilitarian purposes. In one case, Davis et al., (1993) adapted TAM to include intrinsic motivator of perceived enjoyment. However, TAM explored technology from an individual perspective while DOI focuses on how a technology diffuses throughout an organization. Thus, DOI is the most appropriate theory to be applied in this research.

*Diffusion of innovation theory* (DOI), developed several years after TAM, helped explain the diffusion of an innovation throughout an organization (Rogers, 1983). DOI has been studied in a variety of areas including market, social system, organization, and individual innovation adoption. For example, Bass (1969), identified specific innovation attributes that play an important role in the way in which an innovation diffuses throughout a market (Bass, 1969b). Per Rogers (1983), the decision to adopt or reject an innovation impacted by the following innovation variables: observability, relative advantage, compatibility, trialability, and complexity. The first four variables positively correlate to the rate of adoption, whereas

complexity has a negative impact (Rogers, 1995). Over time, Rogers' five attributes of innovation have been found to be best suited to measure a variety of diffusion studies and in a variety of disciplines. Moore and Benbasat (1991), further built upon the core constructs by emphasizing that individual behavior is conditioned on how primary product characteristics are perceived.

Moore and Benbasat (1991) extended the work of Rogers (1983) by identifying and validating two additional constructs found to be important in the decision to adopt an innovation: image and voluntariness of use. Also, Moore and Benbasat found observability to be a complex construct and split into visibility and results demonstrability.



*Figure 8.* Moore and Benbasat's modification of Roger's Diffusion of Innovation theory by adding two additional constructs: image and voluntariness of use.

Moore and Benbasat's modification to DOI were supported by Triandis' (1977) research. Triandis (1997) argued behavior is influenced by social norms, which depends on messages

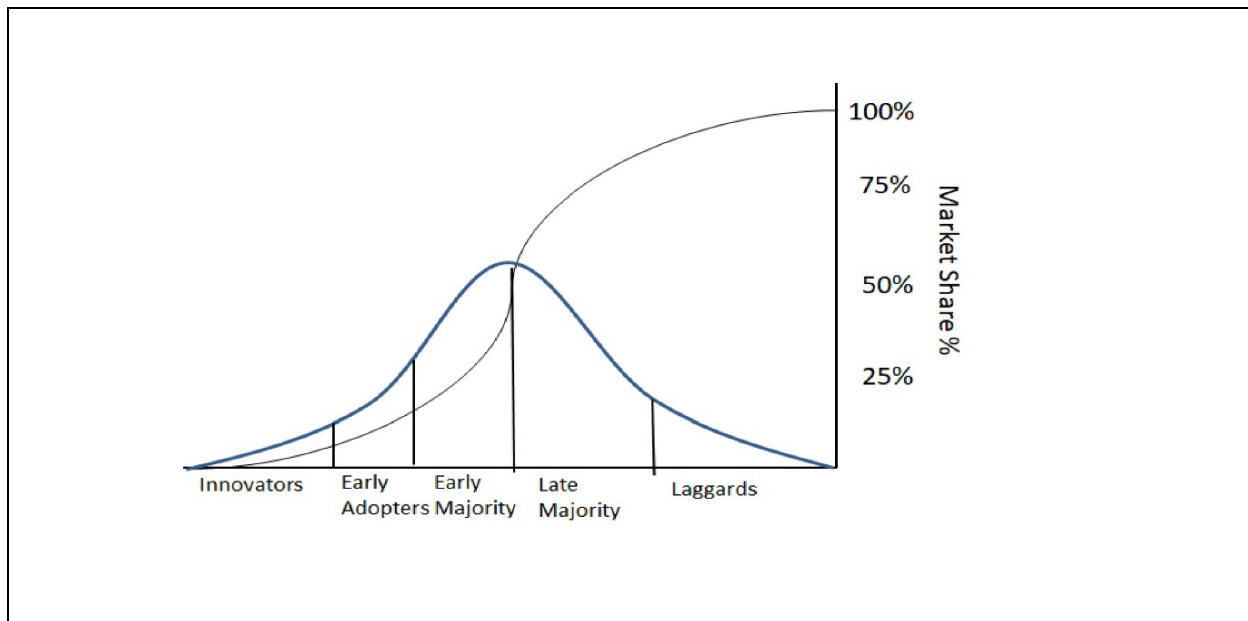
received from others and reflect what individuals think they should do. Triandis (1980) expanded his idea and called it social influence, whereby, “the individuals' internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations” (Triandis, 1980, p. 196). In 1988, Pavri demonstrated a positive relationship between social norms and the utilization of PC's by managers in a variety of working environments (Thompson, Higgins, & Howell, 1991). Exploring the history of technology adoption provides insight into understanding the evolution of technology adoption and diffusion. However, other technology diffusion theories must be examined further.

The testing of theories is an accepted method of conducting scholarly research (Creswell, 2014a). A theory is “a set of interrelated constructs (variables), definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables, with the purpose of explaining natural phenomena” (Kerlinger, 1979, p. 64). Study preparation required research to identify key theories that had potential applicability to model development. The literature review revealed several theories and frameworks including the Epidemic and Probit models.

Rogers (1976a) diffusion of innovation theory rests on the concept of the S curve: usage of a technological innovation over time follows an S curve (figure 9).

Rogers expanded the S curve by describing different types of diffusion. For a steep curve, the innovation must diffuse rapidly through an organization. If the diffusion was slow, the slope of the S curve is lazy or gradual. Rogers also believed that different social systems impacted the rate of adoption. Rogers defined a social system as a set of interrelated units engaged in joint problem solving to accomplish a common goal (Rogers, 1995). Those social systems include

individuals, informal groups, organizations and subsystems. Kats (1961) stated to study diffusion one must study social structures.



*Figure 9.* Diffusion of Innovation Theory, created by E. M. Rogers, 1995, and expanded the work of Ryan and Gross's S-curve by categorizing individual adopters by their rate of technology adoption.

However, there are alternative theories that support and question the fundamental nature of Rogers' S curve. The most common diffusion theory to support the S curve is the Epidemic Model. This model demonstrated the lack of information limits the speed of usage of a new technology and how the technology is used (Geroski, 2000b; Khelil, Becker, Tian, & Rothermel, 2002; Rogers, 2014). "The process of technological diffusion in epidemic models is likened to the spread of disease by infection" (Nawaz Sharif, 1986, p. 5). The number of adopters of an innovation is assumed to increase over time as nonadopters encounter the adopters and gather information on the innovation. Diffusion in epidemic models is determined by the 'epidemic' spread of information among potential adopters. However, while epidemic models have been used in empirical studies, especially in such areas as geography, marketing and sociology, the

literature suggests the theory “really necessitate a starting point somewhat divorced” from these models (Karshenas and Stoneman, 1995).

The most cited alternate model to the S curve is the Probit model (Karshenas & Stoneman, 1993). This model proposes different types of firms gradually adopt an innovation based on their respective goals and abilities (Geronsky, 2002). Furthermore, the Probit model depends on goals, abilities, and “information cascades” whereby the diffusion is dependent on the very first adopter and subsequent diffusion “is best described as herd-like behavior” (Baskerville & Pries-Heje, 2003, p. 251).

### **Related Research**

Diffusion is defined as the mechanism by which an innovation is communicated through certain channels over time among the individuals in a social system (Rogers, 1995). Further research suggests there are variants to the diffusion of innovation theory. Diffusion models are either homogeneous or heterogeneous in their makeup (Shi, Chumnumpan, & Fernandes, 2014). Both models show a bell-shaped curve of diffusion and both are widely used in research (Geroski, 2000). Homogeneous diffusion models are constructed from a two-step flow theory (Elihu Katz & Lazarsfeld, 1955). The two-step process states that information of an innovation will initially spread through mass media, reaching a few individuals but ultimately spread through the word of mouth effect. Heterogeneous bell-shaped curves are expressed with a wider dispersion around the average than homogenous bell-shaped curves due to a more diverse, varied population. As a result, the heterogeneous bell curve’s distribution will be more closely dispersed around the mean.

The *Bass (1969) model of diffusion* is considered the most widely used homogenous model especially in the marketing and consumer sectors. The bass model is also known as the

mixed influence model (Mahajan & Peterson, 1978). The bass model made a significant impact on a variety of areas of research including sociology, economics, marketing, and technology adoption and organizational theory (Jeyaraj & Sabherwal, 2014). Bass' work pioneered the examination of consumers purchases over time, distinguishing two types of buyers: innovators and imitators. "Innovators are not influenced in the timing of their initial purchase by the number of people who have already bought the products, while imitators are influenced by the number of previous buyers. Imitators 'learn' in some sense, from those who have already bought" (Bass, 1969, p. 217). Due to it being more mathematically and empirically based, the Bass model has not been a commonly utilized model in technology diffusion studies (Ilie, Van Slyke, Green, & Lou, 2005; Karahanna, Straub, & Chervany, 1999; Mustonen-Ollila & Lyytinen, 2003; Premkumar, Ramamurthy, & Nilakanta, 1994).

In addition to the bass model, there are other models, while less common, that have been used to explain technology diffusion. Some of the lesser known diffusion models are shown in table 2.

There are three additional models associated with information technology diffusion. The Interactive Model focuses on the product perspective of innovation diffusion. "Technology push" was a concept affiliated with the early work in diffusion of technology (Rothwell, 1992). The interactive model examined technology diffusion form a linear and sequential process where "discovery and research were the major innovation drivers" (Baskerville & Pries-Heje, 2003, p. 252). Unfortunately, this model diminished in importance due to its linear perspective. Through further research, innovation at the industry level, was determined to be a result from science, technology, and the marketplace (Rothwell, 1992).



Unlike the interactive model of technology diffusion, the *Linked-Chain model* rose in importance because it added a knowledge component to technology diffusion. Kline (1985) determined the organizational knowledge continues well beyond any single innovation.

Table 2

*Variant Diffusion Models*

Diffusion Model	Study	Summary
Critical Mass	(Markus, 1990)	Critical mass of a potential adopter is essential in enhancing diffusion. Diffusion is dependent on threshold levels of potential adopters in the population. Diffusion is facilitated by potential adopters occupying similar structural positions. Diffusion is determined by the proximity of members to others in the population. Two types of communication channels affect potential adopters who are considering an innovation: mass media and interpersonal relationships. Potential adopters are subject to both mass media and interpersonal relationships.
Threshold	(Granovetter, 1978)	
Homophily	(Valente, 1996)	
Proximity	(Rice & Aydin, 1991)	
Influence	(Nilakanta & Scamell, 1990)	
Mixed Influence	(E. M. Rogers, 1976b) (Bass, 1969) (Hanssens, 1985) (Hu, Saunders, & Gebelt, 1997)	

Rogers (1995) also emphasized the importance of knowledge in the stages of innovation. “Knowledge is placed between the innovation chain and research as a buffer to imply that the store of human knowledge may often fuel elements of the innovation chain without further research processes” (Baskerville & Pries-Heje, 2003, p. 254). While the interactive model was linear, the linked-chain model included five connections or links to innovation diffusion (Figure 10).

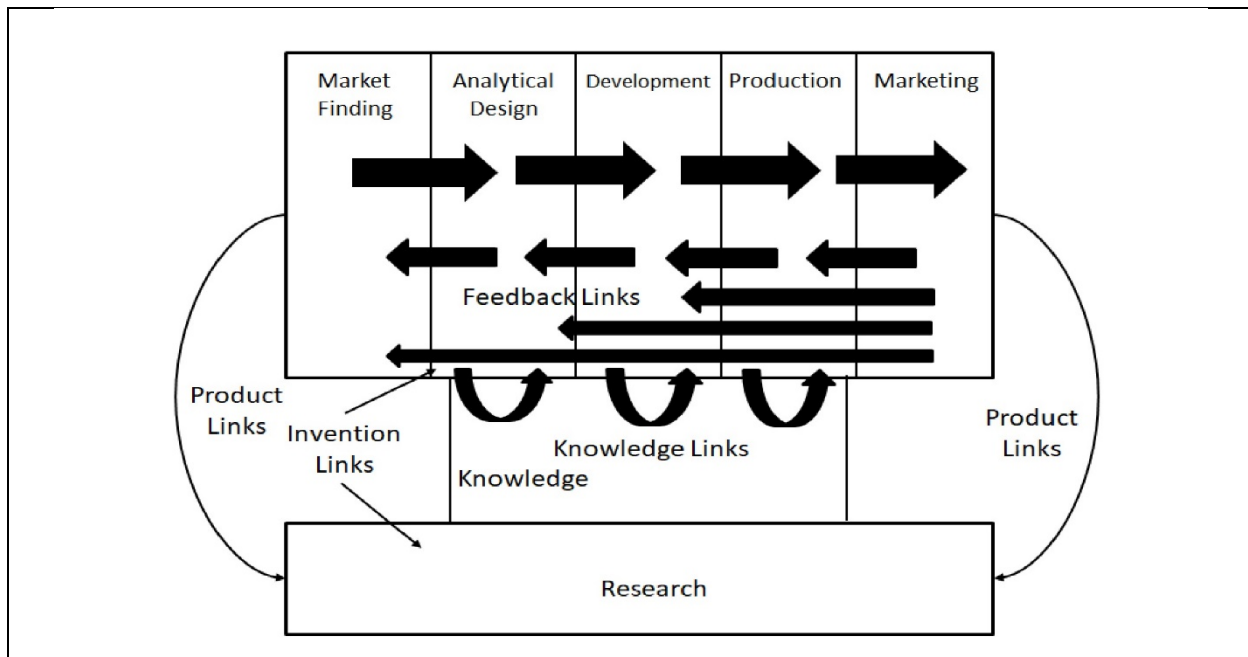


Figure 10. The Linked-Chain model of innovation based on technology organizational knowledge and feedback links as technology diffused throughout an organization developed by Kline & Rosenberg, 1986.

In contrast, the *emergent model of innovation of diffusion* presupposes that previous models operated “under cooperative and compliant actors” (Baskerville & Pries-Heje, 2003, p. 254). Organizational change has utilized the emergent model due to its emphasis on holistic systems versus process systems. The emergent model emphasizes innovation diffusion as more unstructured and cannot be modeled using steps or phases. Furthermore, the model postulates that innovation is always evolutionary and a combination of the old and new.

While many of these variants of DOI have been utilized in research, DOI theory is still the most often used with diffusion of technology in a business setting (Swanson, 1994). In this study, DOI will provide the foundation for understanding how an interactive visual aid on an iPad platform is diffused throughout a biotechnology sales force. Therefore, it is essential to understand the fundamental components of Roger’s diffusion of innovation theory including the variance and process models of DOI.

In Roger's theory of diffusion, he identifies four elements of diffusion: innovation, communication, channels, and time. These elements work in conjunction to create diffusion: "an innovation is communicated through a variety of channels, over time, among the members of a social system" (Mehmood, Barbieri, & Bonchi, 2016, p. 2). An innovation is an idea, practice, or object deemed as "new" (Rogers, 1983). However, the innovation does not have to be new if the exposure to the end user who is adopting the innovation is new (Lundblad & Jennifer, 2003). Rogers defines "newness" in terms of knowledge, persuasion, or a decision to adopt an innovation. The characteristics of an innovation determines the rate of adoption. Those characteristics include: relative advantage, compatibility, trialability, and observability (Rogers, 1983). As these four attributes increase, the hypothesized result (table 3) is an increase in the rate of adoption (Lunblad, 2003).

Table 3

*Diffusion of Innovation Hypothesis*

Hypothesis	Description	<i>p</i> -Value Threshold
H <sub>1</sub>	Relative Advantage is a predictor of the intent to use an innovative technology	> .05
H <sub>2</sub>	Compatibility is a predictor of the intent to use an innovative technology	> .05
H <sub>3</sub>	Trialability is a predictor of the intent to use an innovative technology.	> .05

*Note:* Relative advantage, compatibility, and trialability originate from Roger's DOI theory. "New Product Adoption and Diffusion," by E. M. Rogers, 1976, *Journal of Consumer Research*, 2(4), 290.

Relative advantage is the degree in which an individual perceives he or she will gain or benefit from the adoption of an innovation. Those benefits could include, but are not limited to, meeting needs, reduce costs, higher efficiency, or simply complete a task (Cooper, 1979).

Rogers maintains that relative advantage of an innovation, as perceived by members of a social

system, is positively correlated to its rate of adoption. Lee and Kim (2007), “observes that the staff’s appreciation for the relative advantage of the new system had a direct impact on the implementation and performance of that system” (Kapoor, Dwivedi, & Williams, 2014, p. 80). Prior studies support relative advantage as the best predictor of an innovation’s rate of adoption (Holak & Lehmann, 1990).

Compatibility is the degree to which an innovation is “perceived as consistent with the existing socio-cultural values and beliefs, past experiences, and needs of potential adopters” (Al-Gahtani, 2003, p. 60). As a result, an innovation that may place the adopter outside of his or her social group may be perceived as less compatible. The compatibility of an innovation, as perceived by an adopter in a social system, is positively correlated to the rate of adopting the innovation (Rogers, 1983). As a result, this attribute is positively correlated to an innovation adoption decision.

Trialability is the ability for an adopter to test the innovation prior to adoption on a limited basis. The trial can reduce the adopter’s potential uncertainty about the innovation. Rogers suggests the trialability of an innovation, as perceived by a social group, is positively related to its rate of adoption (Rogers, 1983). As a result, this attribute is positively correlated to technology adoption.

Moore and Benbasat (1991) extended the work of Rogers (1983) and identified two additional constructs thought important in the decision to adopt an innovation: image and voluntariness of use. In addition, Moore and Benbasat found observability to be a complex construct and split into visibility and results demonstrability. Image and Ease of Use address subjective norms while perceived usefulness comes from TAM (Table 4).

Table 4

*Moore and Benbasat Perceptions of Adoption (Moore & Benbasat., 1991)*

Hypothesis	Description	<i>p</i> -Value Threshold
H <sub>4</sub>	Results Demonstrability is a predictor of the intent to use an innovative technology	> .05
H <sub>5</sub>	Voluntariness is a predictor of the intent to use an innovative technology	> .05
H <sub>6</sub>	Image is a predictor of the intent to use an innovative technology.	> .05
H <sub>7</sub>	Ease of Use is a predictor of the intent to use an innovative technology.	> .05
H <sub>8</sub>	Visibility is a predictor of the intent to use an innovative technology.	> .05
H <sub>9</sub>	Perceived Usefulness is a predictor of the intent to use an innovative technology.	> .05

*Note:* Constructs modified or created (visibility and results demonstrability) by Moore & Benbasat's adaptation of Roger's DOI theory. "Development of an instrument to measure the perceptions of adopting an information technology innovation" by Moore, G. C., & Benbasat., I., 1991, *Information Systems*, 2(3), pp. 192–222.

Results Demonstrability suggests the more available to demonstration the innovation is, the clearer its advantage will be and, in turn, the technology will be adopted (Zaltman, Duncan, & Holbek, 1973). While observability focused on the results of using the innovation, Moore and Benbasat chose to rename the construct "Result Demonstrability" (Moore & Benbasat, 1991). Importantly, the user must believe that the innovation is better or an improvement to the current alternative. Results demonstrability is positively correlated to the rate of adoption of an innovation (Moore & Benbasat, 1991).

Voluntariness, in this case, is defined as the "free will" to adopt or reject an innovation. For example, if an employee was mandated to use a new technology verses having the freedom to decide on their own whether or not to adopt and use the technology, then adoption is not voluntary (Moore & Benbasat, 1991). However, it may be the case that an individual may be

more impacted by the perception of voluntariness than the actual freedom to use or not to use a technological innovation.

Image relates to how one perceives the technological innovation improves one's social standing (Rogers, 1983). Rogers stated, "undoubtedly one of the most important motivations for almost any individual to adopt an innovation is the desire to gain social status" (Rogers, 1983, p. 215). Image, or social approval, is a necessary factor because it is considered different from relative advantage (Holloway, 1977).

Ease of use has its roots in Davis' TAM. Davis used perceived ease of use in the TAM model. Davis defined ease of use as the degree to which an individual believes that using a particular system would be free of physical and mental effort (Moore & Benbasat, 1991). Davis also interpreted perceived ease of use as the user perceiving the use of an innovation as free of effort. Davis stated that perceived ease of use has its underpinnings in Bandura's research in self-efficacy. Self-efficacy is determined by how well the user believes he or she has successfully completed a task (Bandura, 1982). As a result, ease of use is a necessary factor due to its strong correlation to the user's intent to use a dependent variable (Moore & Benbasat, 1991).

Visibility is the degree to which an innovation is visible to others. However, some innovations are more visible than others. For example, Rogers (1983) uses the example of the software component of a technological innovation. Software is far less visible than the output of the innovation. Thus, if a technological innovation relies heavily on the software component, then the technological innovation would be less visible. The visibility of an innovation, as viewed by a social system, is positively correlated to the rate of adoption (Moore & Benbasat, 1991).

Perceived Usefulness originates from Davis' Technology Adoption Model (TAM). TAM was designed to specifically explain computer usage behavior (Davis, Bagozzi, & Warshaw, 1992). TAM theorizes that an individual's behavioral intention to adopt or use information technology is determined by two beliefs: perceived usefulness and perceived ease of use (Davis, 1989). In Davis' model, perceived usefulness is defined as the degree to which a person believes that using a particular system will enhance performance (Davis, 1989). In TAM, it was found that if an innovation is perceived to be easy to use then it will have a direct impact on perceived usefulness and in turn the two variables influence behavioral intention. This effect between perceived usefulness and ease of use on usage intention has been studied in previous research (Adams, Nelson, & Todd, 1992; Davis et al., 1992; Davis, 1989).

While the word useful can mean capable of being used advantageously, another interpretation of the factor, is perceived effectiveness. Is the technology, in this case an IVA, viewed as effective by the biotechnology area business managers? Adams et., al (1993), further explored the effectiveness model using perceived ease of use and perceived usefulness (Adams et al., 1992). Relative Advantage examines if the innovation is advantageous to use and better than alternatives. Perceived Usefulness examines utilitarian motivation; how the innovation can help an individual complete a task or increases job performance.

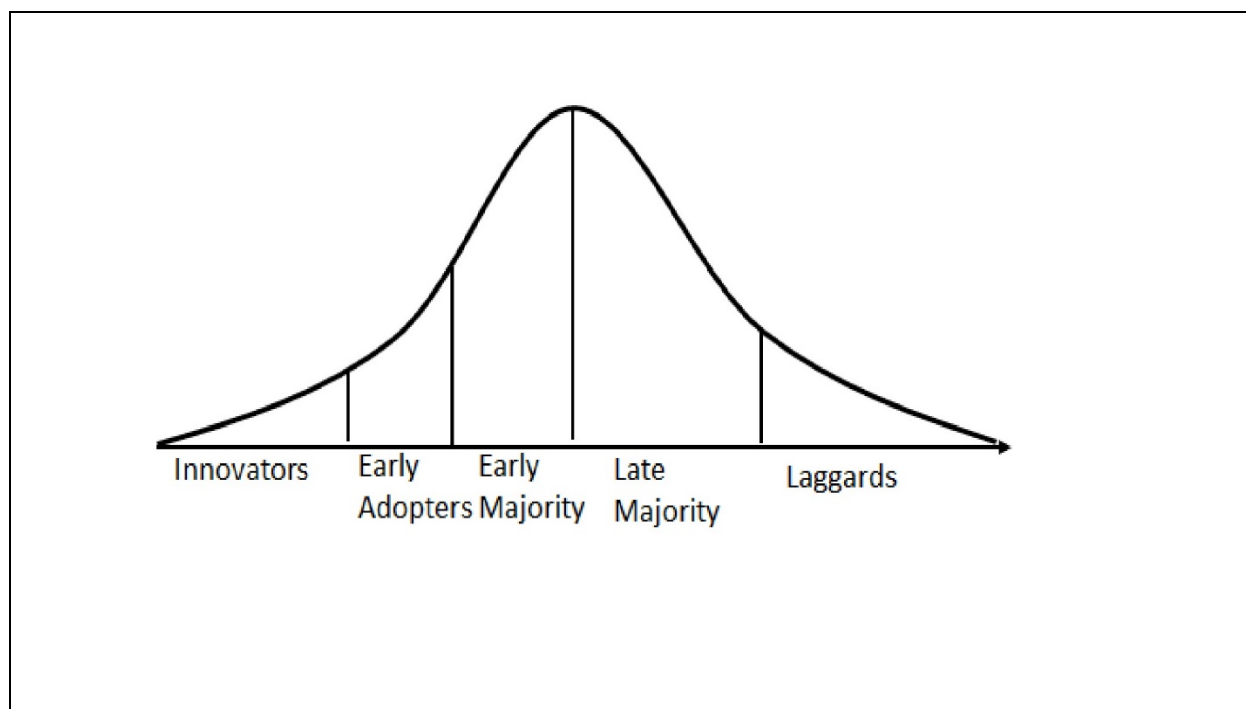
### **Process Model**

Rogers and prior research have confirmed the rate of adoption is best illustrated by the S shaped curve (Rogers, 1995). If a technology diffuses rapidly through an organization, the S shaped curve will be steep. However, if the innovation diffuses slowly, the slope of the S shaped curve will be "lazy and gradual" (Rogers, 1995). While social systems (individual, group, organization, subsystem) can influence the rate of adoption of an innovation, adopter categories

can also affect the time to adopt an innovation. In Everett Rogers (1983) book, *Diffusion of Innovation*, he further explains the categories of adoption as it relates to the time to adopt an innovation:

- (1) Innovator: An individual, who is eager to try new ideas, may have substantial financial resources, and someone who can cope with a high degree of uncertainty. This individual will be the first to adopt an innovation.
- (2) Early Adopter: An individual, who is respectable in a local social system and who has the highest degree of opinion leadership. Rogers describes this individual as the “individual to check with (Rogers, 1995). The early adopter is considered respectable and will have the highest degree of opinion leadership. This individual will adopt an innovation early and have the greatest impact on change agents due their respectability in their local social system.
- (3) Early Majority: This individual frequently interacts with their peers and is not the first but not the last person to adopt an innovation.
- (4) Late Majority: This individual presents with skepticism towards an innovation and may require peer pressure to adopt an innovation. The adoption of an innovation may be based on nothing more than an economic necessity.
- (5) Laggards: Are individuals who are the last to adopt an innovation. The laggard prefers to do what was done in the past and suspicious of any innovation. The laggard focuses on the past and is not forward looking. As a result, the laggard is the last to adopt an innovation (Mehmood et al., 2016).





*Figure 11.* Adopter categorization by innovativeness based on the Diffusion of Innovation theory developed by E. M. Rogers, 1995.

Rogers (1995) emphasized the significant impact social learning theory, opinion leadership, and peer networks play in the rate of innovation adoption. E. Katz, Levin, & Hamilton (1963) believed that to study diffusion an individual also needs to study social structures. An innovation will diffuse in a society because a society is a microcosm for a large learning system (Bandura, 1971; Pitcher, Hamblin, & Miller, 1978). Social learning theory also emphasizes how individuals can learn from the observation of other people's activities. Rogers described opinion leadership as the "degree to which an individual can informally influence individuals' attitudes or overt behavior in a desired way with relative frequency" (Rogers, 1995). Peer networks can best be illustrated by Coleman et. al, (1966) research in new drug adoption by physicians. Coleman determined that doctors with the most network links were the most innovative. Conversely, the physician who did not have a network of peers were less innovative (Coleman, Katz, & Menzel, 1957). Rogers and Kinkaid (1981) called this type of group of

individuals “Network Isolates” when referring to the family planning behavior of Korean women.

While the process DOI model is essential for understanding the diffusion of innovation over time in a variety of disciplines, Moore and Benbasat’s (1991) paper validates the variance model of the diffusion of innovation. “This paper reports on the development of an instrument designed to measure the various perceptions that an individual may have of adopting an information (IT) innovation” (Moore & Benbasat, 1991, p. 192). Furthermore, while DOI has been used in individual adoption cases, DOI is most often used in the business setting. In this study, the biotechnology corporation has acquired a technology, IVA on a tablet PC platform, and is trying to promote its use by the biotechnology sales force.

The source of communication will determine the rate in which an innovation diffuses across an organization and therefore is essential in understanding DOI. Communication is the process by which individuals create and share information with each other to achieve common understanding (Rogers, 1983). Rogers determined the familiarity of the source communicating information about the innovation to an adopter can be far more important than the innovation itself (Rogers, 1995). Communication channels can take various forms including email, phone, text, face-to-face, and non-traditional pathways such as social media. Media messages can be effective especially amongst innovators and early adopters (Darley & Beniger, 1981). External forces can also play an important role in the diffusion of innovation. Communication of the message concerning the innovation by external sources is important throughout the innovation process (Ball, Ogletree, Asunda, Miller, & Jurkowski, 2014; Darley & Beniger, 1981; Lundblad & Jennifer, 2003). Personal referrals can also impact the rate in which an innovation is used by an adopter. There is a growing body of evidence personal contacts play a significant role in

communicating media messages with the majority of adopters (Ball et al., 2014). Prior research suggests “people adopt innovations only after their effectiveness has been demonstrated through the experience of friends and acquaintances” (Coltrane, Archer, & Aronson, 1986, p. 142).

Communication networks can play an important role in bringing awareness to an innovation and influence on the adopter (Mackinder, 1974). When considering why adopters hold certain views, communication networks can impact and influence the awareness of the adopter (Zimmer, 1986). Non-verbal communication can also play an important role in the diffusion of innovation process. Two other areas that can affect the role of awareness and influence are peer pressure (Zenger & Lazzarini, 2004) and groupthink (Janis & Mann, 1977).

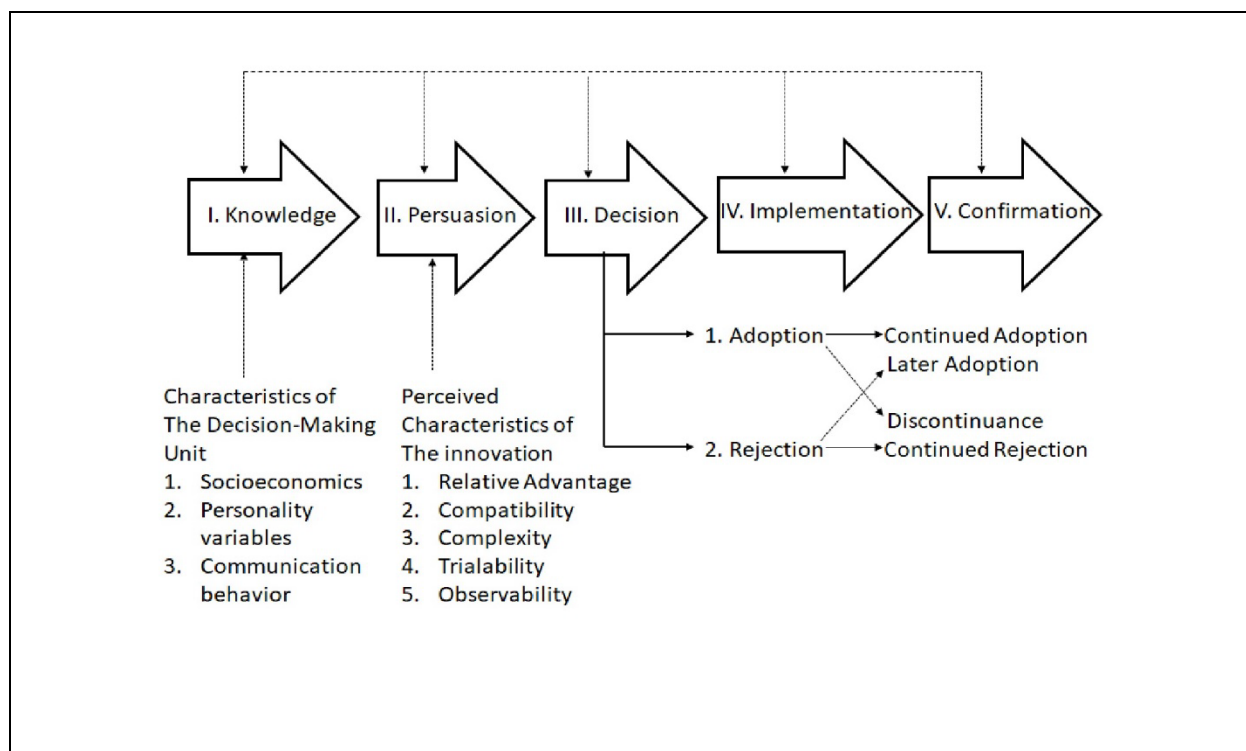
Diffusion is the concept whereby an innovation, such as a new technology, communicates through a variety of channels over time among the members of a society (Bhattacharya, 2015). Rogers discusses three types of communication channels when focusing on the third element of the diffusion of an innovation. The first channel is simply the source – the originator of the message. The second communication channel is mass media which is comprised by radio, television, newspaper and the internet. Mass media can reach large audiences quickly, create knowledge and spread information, and can change weakly held perceptions about an innovation (E. M. Rogers, 2003). The third communication channel is the interpersonal or face-to-face interaction. Interpersonal communication provides a two-way exchange of information. Rogers emphasizes this third channel of communication is the best method for changing a strongly held attitude. Interpersonal channels help “overcome the social-psychological barriers of selective exposure, perception and retention” (Rogers, 1995, p. 198).

The elements and channels of DOI, are the fundamental building blocks to technology diffusion within an organization. In conjunction, the stages of diffusion can provide a window

into how an individual learns, evaluates and ultimately adopts a new technology. It is these fundamental principles of adoption which build the case for using Diffusion of Innovation theory in this study.

Rogers defined the adoption process as “the process through which an adopter unit passes first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision” (E. M. Rogers, 1983). Rogers outlined how diffusion progresses within a market or a system of users as information about a particular innovation is transferred amongst potential users (MacVaugh & Schiavone, 2010). Specifically, Rogers (1983) stated that the determination to adopt or reject an innovation is revealed by the following five stages. These five stages are linked together and can apply to an individual or a “decision making unit” (Rogers, 1983). The five stages of the innovation-decision process are:

1. Knowledge: in this stage, the individual becomes aware of the innovation for the first time.
2. Persuasion: in this stage, the individual either forms a favorable or unfavorable attitude towards the innovation.
3. Decision: in this stage, the individual participates in activities that lead to a choice to adopt or reject the innovation.
4. Implementation: in this stage, the individual puts the innovation to use.
5. Confirmation: in the final stage, the decision-making unit is seeking reinforcement after a decision has already been made.



*Figure 12.* Five Stages of Innovation are based on Rogers (1995) diffusion of innovation theory, and how an innovation is transferred among users. Roger’s findings were presented at the International Academic Forum, 2011.

In the knowledge phase of the innovation decision process, several types of knowledge are described including general awareness, “how to” knowledge, and principle knowledge (Rogers, 1983). Acknowledging the innovation exists and understanding the status of the innovation fits into the general knowledge category. Once an individual is aware of the innovation, then that individual will seek the “how to” knowledge in order to use the innovation in a correct manner (Bhattacharya, 2015). Principle knowledge is obtained once the individual understands the fundamental principles behind the innovation. As a result, the knowledge phase is the foundation for the user to obtain the necessary information needed to understand the innovation (Cooper & Zmud, 1990; Del Aguila-Obra & Padilla-Meléndez, 2006; Premkumar & Roberts, 1999).

In the persuasion stage, (Rogers, 1995) it is the state in which an individual seeks “innovation-evaluation” information to reduce uncertainty. It is in this stage, an individual will either establish a favorable or unfavorable perception towards the innovation. A perception of the innovation will form in the persuasion stage (Cooper & Zmud, 1990; Del Aguila-Obra & Padilla-Meléndez, 2006; Premkumar & Roberts, 1999). An attitude is formed (by the user) about the innovation as to how the innovation will help or hurt the individual in the future. Rogers described this stage as “the decision making unit mentally applies the new idea to his or her present or anticipated future situation before deciding about trying it” (Rogers, 1983, p. 170).

In the decision phase, the user will conduct the necessary activities that ultimately result in either the adoption or rejection of the innovation. Those activities may include using the innovative technology on a trial basis to determine how useful the technology will be to the individual. If the individual is not convinced, the innovation will make a measurable difference then ultimately the user will reject the innovation (Bhattacharya, 2015).

Once in the implementation phase, the individual has decided to use the innovation and put the technology to use in daily life (Rogers, 1995). Problems can occur during this phase as the end user determines how to incorporate the innovation into practice. The innovation will also migrate from individual use into organizational use. This transition to widespread use will reside in the confirmation stage. Rogers explains, that during this stage, the end user is seeking confirmation the appropriate action has been taken (Rogers, 1995). These stages take time to develop, form, and transition from stage to stage. Another impact on time to adopt an innovation is the type or category of individual who is considering using the innovative technology. Roger’s could categorize individuals and their specific rate of adoption. By understanding different categories and the associated rate of adoption, one will be able to ascertain how technology

diffuses throughout an organization. However, the model does not explain the impact a manager (Principal) may have on an employee's (Agent) intent to use an innovation. Hence, it is the principal agent model which seeks to understand the relationship between Principal and Agent.

Agency theory is defined by a contract in which one or more persons (principal) engage another individual (agent) to conduct some form of service on their behalf that requires decision-making to rest on another authority (Jensen & Meckling, 1976; Ross, 1973). Agency theory describes the sometimes-tumultuous relationship between a principal and an agent. In a corporate environment, examples of this type of relationship include manager/employee (principal/agent) and shareholder/corporate management (principal/agent). The underlying principle of agency theory is people act in their own best interest. In contrast to the theory of reasoned action (Balram & Dragicevic, 2005), agency relationship behaviors may not always be voluntary. "Agency theory is concerned with resolving two problems that can occur in agency relationships. The first is the agency problem that arises when (a) the desires or goals of the principal and agent conflict and (b) it is difficult or expensive for the principal to verify what the agent is doing. The problem here is that the principal cannot verify that the agent has behaved appropriately. The second is the problem of risk sharing that arises when the principal and agent have different attitudes toward risk. The problem here is that the principal and the agent may prefer different actions because of the different risk preferences" (Eisenhardt, 1989, p. 89). There can also be costs associated with all agency relationships. Agency costs arise from a variety of sources including the cost of recruitment, adverse selection (poor hiring choices), moral hazard (agent's self-interests), level of incentives, and "shirking, stealing, self-dealing, corruption, monitoring and policing, self-regulation, bonding and insurance, agents oversee agents who oversee agents, as well as failures in these costly corrective devices" (Shapiro, 2005, p. 281). While the level of

risk acceptance may differentiate the principal and the agent, values and objective evidence may also distinguish the parties in agency theory.

Jensen (1983) identifies normative and positivist elements to agency theory. Normative elements are formed as a result of the manager asking the question, “How can the principal best avoid the agency problem?” (Arthurs & Busenitz, 2003, p. 147). Normative perspectives are objective and based on values not based on evidence. Normative elements are prescriptive and focus on achieving an objective while recognizing specific limitations (Arthurs & Busenitz, 2003). A normative perspective desires to avoid the agency problem and therefore the individual will take the necessary steps to prevent the moral hazard or negative behaviors. Positivist elements of agency theory provide an explanation for a specific phenomenon.

Jensen (1983) wrote, “answers to positivist questions, on the other hand, involve discovery of some aspect of how the world behaves and are always potentially refutable by contradictory evidence.” Thus the essential normative underpinning of agency theory is that the principal should avoid or dispel the agency problem (Jensen & Meckling, 1976). This problem is defined as goal incongruence between the principal (management) and the agent (employee). Therefore, the normative perspective of agency theory is to avoid or “mitigate” the potential agency problem. While agency theory emphasizes controls, incentives and monitoring to address goal incongruence, there can be other psychological and sociological behaviors driven by motivations not addressed by agency theory. It is this “Model of Man” that can be addressed by theory x and y.

*Theory X* addresses the organizational behaviors outlined by agency theory (McGregor, 1966). In theory x, the self-interested employee methodically attempts to maximize their own financial gain. Theory x acknowledges that there is a conflict between the manager and the



employee (Donaldson & Davis, 1991). In addition, theory x presupposes that each employee is calculating costs versus benefit and desires financial rewards versus punishment.

Conversely, *theory y* is based on non-financial motivators which drive the employee's performance. Specifically, the employee is motivated by the desire to achieve, exercise responsibility and gain "intrinsic satisfaction through successfully performing inherently challenging work" (Donaldson & Davis, 1991, p. 51). McClelland (1961) identified the recognition from peers and supervisors as a driving force to theory y. Theory y builds the foundation for an alternative theory to the agency problem (Litterer & Etzioni, 1964).

Stewardship theory is based upon the theoretical principals of theory Y and provides an alternative perspective to the agency theory's managerial motivators (Litterer & Etzioni, 1964). "Stewardship theory holds that performance variations arise from whether the structural situation in which the executive is located facilitates effective action by the executive" (Donaldson & Davis, 1991, p. 51). Stewardship theory addresses the criticism sociologists have had with agency theory, namely the behavior by employees is not necessarily driven by self-interest (Perrow, 1986).

Behavioral agency theory makes some assumptions regarding an agent's performance and contradicts the fundamental agent motivations characterized by agency theory. Rather than base an agent's performance on incentives alignment or monitoring, behavioral agency theory argues that the behavior by the agent is based on the agent's motivation to perform. Wiseman and Gomez (1998), theorize that agent performance and job motivation should be at the center of the agency model. "Behavioral agency theory argues that maximizing agent performance should be a key objective of the principal agent relationship and that the importance of the agent's work motivation, including intrinsic motivation, should not be

underestimated” (Pepper & Gore, 2015, p. 1048). There is a fundamental difference in how agency theory and its variants define the “economic model of man” (Table 5). Behavioral agency theory also contradicts agency theory by assuming senior leadership are more focused on primary loss avoidance while risk avoidance becomes a secondary priority (Wiseman & Gomez-Mejia, 1998). Behavioral agency theory is further expanded by causal agency theory’s definition of an agent’s self-determination. It is the self-determination of the agent that drives performance versus careful monitoring, incentives, and controls outlined in agency theory. While agency theory was further developed by Jensen and Meckling (1976), it was Sappington who would form the principal agent model which, unlike stewardship and behavioral agency theory, addresses the goal incongruence between the principal (manager) and agent (employee).

Table 5

*Comparison of Agency Theory and Stewardship Theory*

Characteristic	Agency Theory	Stewardship Theory
Model of Man Behavior	Economic Man/ Self-serving	Self-actualizing man – Collective Serving
Psychological behaviors: Motivation	Lower order/economic needs (physiological, security, economic) Extrinsic	High order needs (growth, achievement, self-actualization) Intrinsic
Social comparison Identification/Power	Other principals (managers) Low value commitment	Stakeholders High value commitment Personal (expert, referent)
Situation mechanisms	Control-oriented	Involvement-oriented
Management philosophy	Control mechanisms	Trust
Risk-orientation	Cost Control	Performance Enhancement
time frame	Short Term	Long-term
Objective	Individualism	Collectivism
Cultural Differences	High-power distance	Low-power distance

*Note:* Characteristics and between Agency and Steward ship theories come from the article, “Toward a Stewardship Theory of Management,” by Davis, J. H., Schoorman, F. D., & Donaldson, L., 1997, *Academy of Management Review*, 22(1), 27.

Jensen and Meckling (1976) defined agency costs as the sum of the costs of structuring contracts both formal and informal by monitoring expenditures by the principal, bonding expensive expenditures by the agent, and the residual loss. A principal-agent model exists whenever two groups are involved in a business partnership whereby one party (principal) depends on the actions of the other party (agent) (Arrow, 1985; Sappington, 1991). The principal can represent management, and the agent can represent a sales force due to management's need to hire a sales force to accomplish the desired output and perform a task. However, the agent "may not share the same goals as the principal, and thus the agent's rational choice of behavior may be inconsistent with the principal's interests" (Bhattacharjee, 1996, p.308).

Sappington (1991) described a series of events attributed to the principle agent model. First, the principal creates a contract which includes specific incentives to be awarded to the agent if the desired outcome is achieved. Second, the agent can either agree to the terms of the contract or reject the terms. If the agent accepts the terms, then he or she must determine the amount of effort required to satisfy the terms of the contract. Conflict can develop between the principal and the agent when incentives are introduced to produce the desired effort from the agent (Sappington, 1991). Thus, the agent determines a level of effort which benefits his or her realized payoff (Sappington, 1991). Regardless of the agent's effort, the principal will reward the agent based on the fulfillment of the desired outcomes outlined in the contract. At the heart of PAM is the goal incongruence between the agent and the principal. The actions of the principal depend on the actions of the agent. Agency theory acknowledges the friction between parties and proposes incentive and control systems. The principal-agent model addresses this dilemma. PAM addresses the agency problem with three necessary actions:

1. The agent and the principal's goals must be aligned

2. The principal must have visibility to the actions of the agent
3. The risk level between parties must be acknowledged and addressed.

The Principal-agent model of interorganizational IT usage addresses these actions by including material incentives and controls followed by monitoring, incentive levels and multiple contracts. Fichman (1992), saw that while TAM and the Theory of Planned Behavior (TPB) provide acceptable estimates of IT usage in a personal use setting, the theories do not consider organizational usage through management incentives and controls (Fichman & Drive, 1992). Incentives and control mechanisms are intended to overcome users' involuntariness regarding IT usage in organizational settings. It is possible that although voluntary usage (in personal use settings) is determined primarily by individual attitudes (as suggested by TAM), involuntary usage in organizational setting may be predicted jointly by both attitudes and subjective norm (defined as a collection of incentive and control variables) (Sappington, 1991). PAM can therefore provide valuable insights on involuntary usage (Bhattacharjee, 1996).

Behavioral evaluation (table 6) is an essential component to PAM because it aids in addressing what Sappington coined as the "moral hazard dilemma" (Sappington, 1991). The literature calls this information disconnect a moral hazard whereby a user may take advantage of the fact that management cannot accurately monitor a system's use (Arrow, 1985). Behavioral evaluation may help reduce user opportunism in moral hazard settings by informing the management of user behavior (Sappington 1991). Behavioral evaluation is a key component to monitoring, and in turn PAM, because it aids in assessing employees' (agent) observable behaviors desired by management (principal).

Table 6

*The Effect of Incentives and Control (PAM) Hypothesis*

<u>Hypothesis</u>	<u>Description</u>	<u>p-Value Threshold</u>
H <sub>10</sub>	Behavioral Evaluation is a predictor of the intent to use an Innovative technology	> .09*
H <sub>11</sub>	Monitoring is a predictor of the intent to use an Innovative technology	> .05
H <sub>12</sub>	Repeated Contract is a predictor of the intent to use an innovative technology.	> .05

*Note:* “Chi-squares for the other two treatments (i.e., behavioral evaluation) were significant at the 0.10 level. This lack of fit was not of significant concern since model validation was performed using the perceptual measures only, which demonstrated adequate levels of reliability and validity” (Bhattacharjee, 1996, p. 334).

Monitoring is a critical component to PAM because it addresses the three components of the agent and principal problem: goal incongruence, differential risk, and observable behaviors. A dilemma can occur when a user may, for example, log on to a new software application, but incorrectly use the software application (Bhattacharjee, 1996). Thus, management may be able to see an employee using a system but may not be aware if the employee is using the system correctly. As a result, PAM addresses this problem via monitoring mechanisms, for example, impromptu checks, and checking system usage timesheets (Sappington, 1991). Bhattacharjee (1996) goes on to explain how multiple users can also prevent “user optimism” whereby a user feels he or she can cheat the system. Multiple users allow management to compare user behavior across a group of employees versus examining behavior one employee at a time. The result is identification of outliers. Bhattacharjee (1996) hypothesized monitoring has a direct correlation to usage in an incentive based working environment.

Repeated contract is optimally leveraged in an incentive-based environment and, private employee information cannot be accessed by management, the current behavior is linked to

“better” future incentives (Eisenhardt, 1989). Bhattacharjee further concluded, as managers established long term relationships with employees, management would be able to understand the employee better and can “assess their behavior more accurately” (Bhattacharjee, 1996, p.147).

Incentive level, while not included in the research, refers to the amount of incentives (low vs. high) available to the agent. Incentives can be separated into two distinct types: outcome based, or behavior based. Outcome based incentives could include achieving a sales goal or commission. In contrast, behavior-based incentives are more granular and focus on rewarding a specific behavior that is aligned with the desired outcome. Unfortunately, if the employee cannot make a distinction between the two incentive types then the perceived value of the incentives may be diminished (Bhattacharjee, 1996). For this reason, incentive level was excluded from this study. “PAM holds that managers can induce potential users to utilize the IT by providing them with incentives (e.g., commissions, promotions, praise) for IT use and penalties (e.g., threats, dismissals) for non-use” (Bhattacharjee, 1996, p. 309). Per agency theory, the principal and agent have opposing goals that require alignment. While a managers’ goal is for employees to utilize a specific technological innovation, employees may prefer to reject the innovation. Thus, PAM postulates that incentives will encourage employees’ behavior by aligning the goals of the employee and management. The alignment of goals between management and users is achieved by raising the incentive level (Bhattacharjee, 1996).

Since the introduction of the first commercial tablet PC in fall 2002, tablet PCs have grown in acceptance and represented 34% of the entire computers sold in the United States in 2013 (Zickuhr, 2013). Many believed tablet shipments would overtake PC’s by 2016, but that has not been the case due to the many variations of PC’s resulting in thinner and lighter laptops.

However, in the pharmaceutical industry, there has been a rush to equip sales forces with tablet PC technology. In 2005, Pfizer was the first major pharmaceutical corporation to adopt the tablet PC technology by purchasing 5,000 iPads for its US sales force (Iskowitz, M., 2010). Most recently, Eli Lilly bought 15,000 iPads from Apple in February 2016 to provide the entire global sales force with a tablet PC digital platform (Briggs, 2016). The acquisition of the iPad by Eli Lilly for its sales force was estimated to be six million dollars (Briggs, 2016). Pharmaceutical and biotechnology firms are rushing to equip their respective sales forces with digital technology. The interactive visual aid is usually launched from CRM housed on the iPad technology platform. Because of the proliferation of Apple's iPad use by the pharmaceutical sales industry, it's important to explore the literature on tablet PC adoption.

Tablet PC adoption was comparable to smartphones in the early diffusion of smart devices (Lee, Lee, & Chan-Olmsted, 2017). Lower tablet PC prices, high levels of social network penetration, and income level were all drivers of initial tablet PC diffusion. Much of the literature highlights the benefits of iPads in the classroom environment particularly in primary and secondary education (El-Gayar, Moran, & Hawkes, 2011). Gartner's 2011 report was the most prevalent author of iPad adoption research in the business environment (David, 2011). Soon after the introduction of Apple's iPad, corporate America saw the benefits to employee efficiency, effectiveness and improvement in productivity especially in a mobile workforce. This assessment was highlighted in Madeline Weiss' APC Forum assessing the value of tablet PC's in the business environment (Weiss, 2011). The iPad, along with other tablet versions, signified a shift in the way in which print and other media products are purchased and consumed by users. While the iPad faced initial skepticism, the quick uptake of the iPad in numerous industries was a result of tablet industry's ability to tailor the device to corporation's specific

needs (Murphy, 2011). The literature review identifies three specific industries that have been dramatically transformed by tablet pc technology, they include engineering, architectural, and design professions (Goncher, Kothaneth, & Johri, 2010).

The iPad revolutionized the way in which information is disseminated in the pharmaceutical, medical device, and biotechnology industry. The iPad platform has enabled mobile sales forces to leverage a lightweight technology platform (in comparison to a laptop) to house CRM, Microsoft applications, multimedia, and in the case of this research, an interactive visual aid. The literature review has determined the iPad is the most prevalent tablet PC device, widely adopted across many industries, and the most prevalent mobile technology in the biotechnology industry.

### **Methodological Approach**

The literature review found several surveys that addressed technology diffusion in an organization and the role of incentives and controls impacting the intent to use technology. Two survey instruments focused on the factors that affect the intent to use technology. Bhattacharjee's (1996) paper combined principle agent model to the technology adoption model to explain technology utilization (Bhattacharjee, 1996). However, TAM is most appropriate for individual technology adoption while diffusion of innovation is more appropriate for examining the factors that effect a new technology diffusing through an organization or business (Rogers, 1995). Furthermore, while TAM was designed to understand IT adoption, interactive visual aid use is considered more as a marketing tool rather than IT (albeit launched from an iPad platform). This may suggest that adoption of technology is less likely to play an important role in IVA adoption. Everett Rogers diffusion of innovation theory appears to be a conceptual model that is more suitable for IVA usage than TAM, and therefore is used in this research (Gönül & Carter, 2010).



The literature review identified constructs from three instruments, when combined, will examine the effect of management incentives and controls through PAM (Bhattacharjee, 1996), combined with elements of the Moore & Benbasat adaptation of Roger's DOI model (Moore & Benbasat, 1991) and one variable from Davis' TAM (Davis, 1985). The literature review resulted in the removal of an element in the PAM model. First, in Bhattacharjee's 1996 instrument validation research, it was identified that incentive type did not achieve statistical significance on interorganizational usage. Behavioral evaluation is included in the instrument even though this construct did not meet statistical significance. Bhattacharjee explains in his seminal paper, "chi-squares for behavioral evaluation were significant at the 0.10 level. This lack of fit was not of significant concern since model validation was performed using the perceptual measures only, which demonstrated adequate levels of reliability and validity" (Bhattacharjee, 1996, p. 334). Also, the removal of this construct enabled the survey to be a more appropriate length to prevent respondent fatigue bias (Deutskens, De Ruyter, Wetzels, & Oosterveld, 2004).

In TAM, it was found that if an innovation is perceived to be easy to use then it will have a direct impact on perceived usefulness and in turn the two variables influence behavioral intention. This effect between perceived usefulness and ease of use on intent for current system usage has been studied in previous research (Adams et al., 1992; Davis et al., 1992; Davis, 1989). Perceived usefulness was the third component added to the model.

The fourth component of the instrument comes from Agarwal and Prasad's (1997) work on the role of innovation characteristics and perceived voluntariness in the acceptance of information technologies incorporation of "intent to use" as the dependent variable,

Some models (e.g., TAM and TRA) use intentions as a dependent variable, based on the supposition that intentions to use are predictors of future usage behavior. In a recent empirical examination of TAM (Davis, 1993) current usage has also been utilized as a dependent variable. Innovation diffusion research, on the other hand, postulates that

many different outcomes are of interest in technology adoption, including the initial decision to use the system and the continued or sustained use of the innovation. This view is consistent with the stage model of information technology implementation as proposed and empirically validated by Cooper and Zmud (1990). (Agarwal & Prasad, 1997, p. 558)

The authors continue to explore if current use is a predictor of future use and in doing so mention the work of Moore and Benbasat (1991). Agarwal (1997) suggests, the intention to use may be measuring the individual's perceived intent to use and thus measuring the intent to use in the future. For this research, "Current Use" will define the intention to use an interactive visual aid by a biotechnology sales force and subsequent survey items will come from Agarwal and Prasad's 1997 research.

For the purposes of this study, the population will be a biotechnology sales force from a single organization. Diffusion of innovation in a population requires the adoption by individuals in the targeted population. If individuals are in a single organization (as is the case of this research) then one may hypothesize the targeted population is homogenous. However, there can also be heterogeneity in the population due to individual differences in adoption. "The assumption of homogeneity implies that, at any point in the process all individuals who are yet to adopt have the same probability of adopting in a given time period, so that differences in adoption times are purely stochastic." (Chatterjee & Eliashberg, 1990, p. 2013). The targeted participants in this research are ABMs who currently use an iPad for daily customer relationship management duties. The usage of an interactive visual aid, available on an iPad and accessed through customer relationship management software, is the focus of this research study.

## Methodology

### Overall Approach and Rationale

An approach to research is founded on philosophical assumptions combined with research design and a specific method (Creswell, 2014b). A philosophical approach to research can be summarized into four paradigms: Postpositivism, Constructivism, Transformative and Pragmatism (Guba & Lincoln, 1994; Mertens, 2012). Creswell (2014), proposed a classification of methods, grouping them according to the positivist or constructivist worldviews (Table 7).

Table 7

#### *Qualitative and Quantitative Approach*

Qualitative Approach (Constructivist)	Quantitative Approach (Postpositivist)
<ul style="list-style-type: none"> <li>• Case Study</li> <li>• Ethnography/ narrative</li> <li>• Open-ended questions</li> <li>• Interview data</li> <li>• Focus on single concept or phenomenon</li> <li>• Brings personal values into study</li> <li>• Makes interpretations of the data</li> </ul>	<ul style="list-style-type: none"> <li>• Surveys</li> <li>• Experiments</li> <li>• Instrument based questions</li> <li>• Pre-determined questions</li> <li>• Numeric data</li> <li>• Tests or verifies theories</li> <li>• Identifies variables to study</li> <li>• Uses standards of validity and reliability</li> </ul>

*Note.* Categories and examples come from “Psychotherapie in der Psychiatrie,” by Munz, E. D., 2017, *Nervenheilkunde*, 36(10), 800–805.

Two broadly acknowledged research strategies are the quantitative and qualitative techniques. Frechtling et al., (2010) recognized both strategies had a part in research and the information required to answer the exploration questions drove the determination procedure. To address the research question posed by the current study, a broad dataset regarding the number of data points and participant responses was necessary to establish credibility. This need suggested a requirement for a highly generalizable, non-abstract research approach. A quantitative approach is “appropriate when the investigator identifies a research problem based

on trends in the field. Describing a trend means that the research problem can be answered best by a study in which the researcher seeks to establish the overall tendency of responses from individuals and to not how this tendency varies among people” (Creswell, 2002, p. 18).

With a specific end goal to address the exploratory questions postured by the present examination, an extensive dataset as far as the quantity of information focuses and member reactions was important to build up validity. This need recommended a prerequisite for a very generalizable, non-unique research approach. Subsequently, the quantitative technique seemed to provide a superior fit.

Runkel and MacGrath (1972) developed a well-recognized work regarding the area of behavioral sciences research. Among different apparatuses and ideas, they incorporated the McGrath Wheel, a model for breaking down research techniques. McGrath and Runkel (1972) expressed there was no single best strategy, battling that each had inborn qualities and shortcomings (Table 8).

When evaluating research methods, one must balance generalizability, precision, and conceptual realism (Runkel and MacGrath 1971). While it is well understood that there is no one best research method, the method chose should be the one that best fits the phenomena under study and the research objectives (Benbasat 1984; Benbasat et al. 2013; Bhattacharjee 2012). The research method should be relevant to the phenomena being studies and the implementation and execution should be rigorous.

### **Rationale for Chosen Research Method**

After reviewing the literature and the different research methods, a survey method was chosen for this study.

Surveys are an organized means for gathering reactions to questions intended to deliver the information required by research and as a result have several strengths and weaknesses. Surveys can be used to study a large population by looking at a representative sample. They are useful in finding distributions, relative incidence, and interrelationships among psychological constructs. Surveys tend to be strong concerning generalizability, but do sacrifice some of the precision and contextual realism associated with other methods (Kerlinger & Lee, 2000).

The survey method also has several advantages over other methods. Surveys can be used in descriptive, exploratory, and explanatory research. While best suited for an individual unit of analysis, they have also been used to study groups and organizations. They are excellent for measuring data that are not directly observable such as preferences, traits, opinions, attitudes, and beliefs. In addition, surveys are unobtrusive compared to other methods. Questionnaires can often be completed at the respondent's leisure. The data collected can be analyzed to detect relatively small effect sizes among several variables and can be segmented in order to study and compare subgroups within the data (Bhattacharjee, 2012).

The study participants were business executives who can be very challenging to access. They are very busy and often have limited time to participate in academic research. In addition, anonymity is of utmost importance to the business executives.

This study explores factors that impact whether individual sales people use company sanction material in the process of doing their job. This is a sensitive subject area and requires that the respondent participate without fear that their identity would be compromised. Therefore, given the research objectives of this study, and the fact that the primary target of the study are sales professionals, the survey method is appropriate.

Table 8

*Advantages and Disadvantages of Quantitative Data Collection Techniques*

Technique	Strengths	Weaknesses
Tests	<ul style="list-style-type: none"> <li>• Provide objective information</li> <li>• Flexible content and format</li> <li>• Straightforward scoring</li> <li>• Widely accepted</li> <li>• Credibility</li> </ul>	May be: <ul style="list-style-type: none"> <li>• Oversimplified</li> <li>• Time consuming</li> <li>• Biased towards some groups</li> <li>• Subject to influence by outsiders</li> </ul>
Document Studies	<ul style="list-style-type: none"> <li>• Available regionally</li> <li>• Inexpensive</li> <li>• Grounded in setting and language</li> <li>• Useful for determining value, interest, positions, political climate.</li> <li>• Provide historical data trends</li> <li>• Provide trend study data</li> </ul>	May be: <ul style="list-style-type: none"> <li>• Incomplete</li> <li>• Inaccurate or inauthentic</li> <li>• Difficult to locate and access</li> <li>• Time consuming to locate and analyze</li> <li>• Out-of-date information/data</li> </ul>
Surveys	<ul style="list-style-type: none"> <li>• Effective for gathering descriptive data</li> <li>• Cover a broad range of topics</li> <li>• Design flexibility – questions that align with the specific needs of the study</li> <li>• Provide survey creator greater control over data collection process</li> <li>• Select different survey distribution methods</li> <li>• Data can be analyzed using a variety of analytics tools</li> </ul>	<ul style="list-style-type: none"> <li>• Self-reporting may lead to biased analysis</li> <li>• Social Desirability Bias</li> <li>• Superficial data – may not be granular               <ul style="list-style-type: none"> <li>○ Not enough information regarding context</li> </ul> </li> </ul>

*Note:* Techniques, advantages, and disadvantages come from “The User-Friendly Handbook for Project Evaluation,” by Frechtling, J., Mark, M., Rog, D., Thomas, V., Frierson, H., Hood, S., & Hughes, G 2010, *Science*, 159.

### Theoretical Development and Hypotheses

The proposed model and constructs used in this study originate from three theories DOI (Rogers, 1983, 2003), modified by Moore and Benbasat’s 1991 study, the principle agent model (Bhattacharjee, 1996; Sappington, 1991) and Davis’ TAM (Davis, 1989).

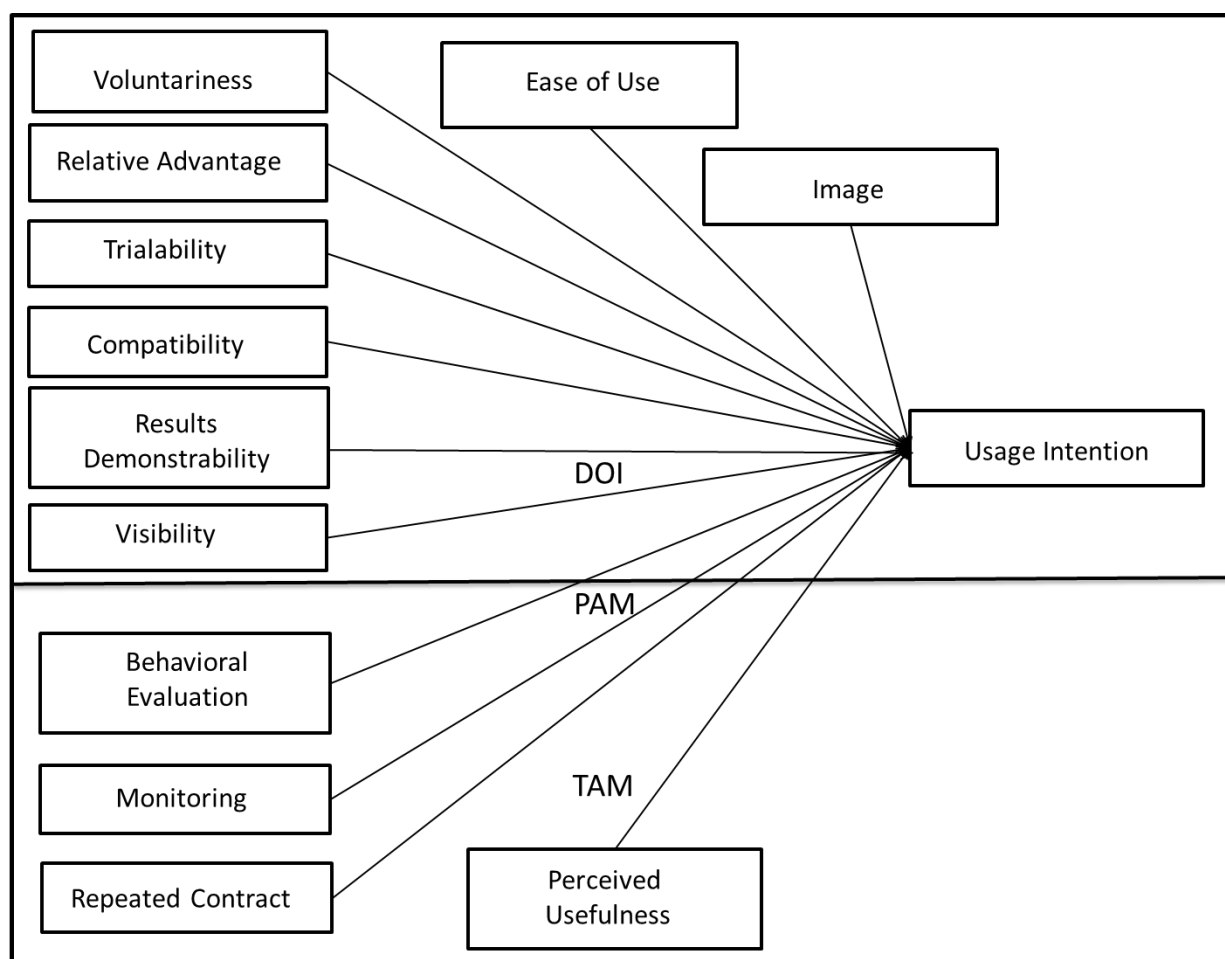


Figure 13. Proposed Model based on theory and constructs developed by Bhattacharjee, 1996; Davis, 1985; Moore & Benbasat, 1991.

## Diffusion of Innovation

Diffusion is the spread of an idea, concept, or innovation which spreads or diffuses between individuals throughout an organization or social system. The diffusion of innovation theory has been widely used to evaluate individual, group, firm, industry, and general diffusion of technology. Moore and Benbasat (1991), focused in the information technology space, placing emphasis on the five factors impacting the adoption of innovations developed by Rogers (1983), creating eight factors (voluntariness, relative advantage, compatibility, image, ease of use, result demonstrability, visibility, and trialability) that impact the adoption of IT. Scales used to

operationalize these factors were validated in their associated research (Moore & Benbasat., 1991).

The following variables are found in DOI theory and are defined as follows. Relative advantage is defined as the innovation is perceived by the user as having an advantage over a previously used technology. Voluntariness is defined as the use of a new technology is perceived to be completely voluntary, not determined by another party but on the user's own volition. Compatibility is defined by the user's perception that the technology is compatible with existing systems, beliefs, and environment. Image, considered to be a strong predictor of usage intention as is relative advantage, is defined by how the user perceived the use of the technology will improve one's social standing (Moore & Benbasat, 1991). Ease of use is derived from Roger's original DOI research. This construct is defined by the user's perception of how easy it is to use the new technology. Results demonstrability is defined by Moore and Benbasat (1991) as the user's perception the new technology's results are clearly observable and tangible. Thus, Roger's observability construct was merged into results demonstrability by Moore and Benbasat's 1991 validated scale research. Visibility is defined by the user's perception of how the innovation is clearly seen or visible throughout the organization. Moore and Benbasat (1991) created the visibility construct to address the removal of observability from their DOI model while still recognizing the distinction from results demonstrability. Lastly, trialability is defined by the user's ability to test and practice with the technology prior to the adoption of the innovation. Therefore, consistent with DOI, I propose the following hypotheses, as presented in Table 9.



Table 9

*Diffusion of Innovation Hypothesis*

Hypothesis	Definition
H <sub>1</sub>	Relative Advantage is a predictor of the intention to use an IVA on a tablet PC.
H <sub>2</sub>	Compatibility is a predictor of the intention to use an IVA on a tablet PC.
H <sub>3</sub>	Trialability is a predictor of the intention to use an IVA on a tablet PC.
H <sub>4</sub>	Results Demonstrability is a predictor of the intention to use an IVA on a tablet PC.
H <sub>5</sub>	Voluntariness is a predictor of the intention to use an IVA on a tablet PC.
H <sub>6</sub>	Image positively is a predictor of the intention to use an IVA on a tablet PC.
H <sub>7</sub>	Ease of Use is a predictor of the intention to use an IVA on a tablet PC.
H <sub>8</sub>	Visibility is a predictor of the intention to use an IVA on a tablet PC.

*Note:* Construct and definition come from “Development of an instrument to measure the perceptions of adopting an information technology innovation” by Moore, G. C., & Benbasat, I., 1991, *Information Systems*, 2(3), pp. 220.

**Technology Adoption Model**

TAM was designed to specifically explain computer usage behavior. Perceived usefulness originates from Davis’ TAM but has been closely aligned with relative advantage (Moore & Benbasat, 1991). Perceived usefulness is defined as the user’s perception the use of the technology will improve job performance (Davis et al., 1992). Therefore, consistent with TAM, I propose the following hypotheses: (Table 10):

Table 10

*TAM Perceived Usefulness*

Hypothesis	Definition
H <sub>12</sub>	Perceived Usefulness is a predictor of the intention to use an IVA on a tablet PC.

*Note:* Perceived usefulness construct was derived from, “Perceived Usefulness, Perceived Ease Of Use and User Acceptance,” by Davis, F. D., 1989, *MIS Quarterly*, 13(3), 319–339.

## Principal Agent Model

The principal-agent model provides resolution to the agency problem by recommending incentive schemes (“contracts”) and/or control mechanisms (e.g., monitoring) to create alignment between the agent’s goals with that of the principal, and as a result motivate the agent to respond in the principal’s best interests (Sappington, 1991). PAM is a derivative of agency theory developed by Jensen and Meckling (1976). PAM states managers can induce potential users to utilize IT by providing them with incentives (e.g., commissions, promotions, praise). “The positive effects of incentives (both monetary and non-monetary) on usage are empirically supported by Howard and Mendelow (1991) and Currid (1995). The following variables are contained in PAM and are defined as follows. Behavioral evaluation is defined by the individual user’s perception that financial incentives are based on their respective usage (or evaluated behavior) of a technology. Repeated contract is defined by the user’s belief that financial incentives are based on the continual use or a completing a repeated task using the technology.

Bhattacharjee’s (1996) research determined that behavioral based incentives only had an indirect relationship on IT usage and therefore were removed from the proposed model. Bhattacharjee further determined in his seminal 1996 paper that behavioral evaluation, monitoring, and repeated contract were maintained, and therefore used in the proposed model. due to each variable having chi-square values significant at the 0.05 level, while incentive type was not significant indicating that this variable did not have a strong correlation to IT usage. Monitoring is defined as the user’s belief that technology usage is being monitored by management. Therefore, consistent with PAM, I propose the following hypotheses (Table 11):

Table 11

*Principal Agent Model*

Hypothesis	Definition
H <sub>10</sub>	Behavioral Evaluation is a predictor of the intention to use an IVA on a tablet PC.
H <sub>11</sub>	Monitoring is a predictor of the intention to use an IVA on a tablet PC.
H <sub>12</sub>	Repeated Contract is a predictor of the intention to use an IVA on a tablet PC.

*Note:* Behavioral evaluation, monitoring, and repeated contract are constructs that were developed in “American Economic Association Incentives in Principal-Agent Relationships,” by Sappington, 1991, *The Journal of Economic Perspectives*, 5(2), 45–66.

**Hypothesis Summary**

Table 12

Hypotheses	Description
H <sub>1</sub>	Relative Advantage advantage is a predictor of the intention to use an IVA on a tablet PC.
H <sub>2</sub>	Compatibility is a predictor of the intention to use an IVA on a tablet PC.
H <sub>3</sub>	Trialability is a predictor of the intention to use an IVA on a tablet PC.
H <sub>4</sub>	Results Demonstrability is a predictor of the intention to use an IVA on a tablet PC.
H <sub>5</sub>	Voluntariness is a predictor of the intention to use an IVA on a tablet PC.
H <sub>6</sub>	Image is a predictor of the intention to use an IVA on a tablet PC.
H <sub>7</sub>	Ease of Use is a predictor of the intention to use an IVA on a tablet PC.
H <sub>8</sub>	Visibility is a predictor of the intention to use an IVA on a tablet PC.
H <sub>9</sub>	Usefulness is a predictor of the intention to use an IVA on a tablet PC.
H <sub>10</sub>	Behavioral Evaluation is a predictor of the intention to use an IVA on a tablet PC.
H <sub>11</sub>	Monitoring is a predictor of the intention to use an IVA on a tablet PC.
H <sub>12</sub>	Repeated Contract is a predictor of the intention to use an IVA on a tablet PC.

*Note:* Constructs originate from Moore and Benbasat’s (1991) DOI theory, Davis’ (1989) TAM theory, and Sappington’s (1991) principal agent model.

**Research Instrument**

The survey was created using Survey Monkey. The survey was developed by using validates scales where possible. The initial survey was reviewed by fellow researchers to validate the instrument. The final version of the questionnaire is provided in Appendix B.

## **Protection of Human Subjects**

Before the research study was implemented, approval was obtained from the UIW Institutional Review Board. Participation in this study was strictly voluntary and each participant received an email invitation to be a participant explaining the purpose and benefits, and risks if any, of the study and the role and time commitment of the participant. Complete anonymity was maintained. Names did not appear in any data collected, and participants cannot be identified from what demographic data was collected. Only group data was used in the study. The letter indicated that completion and submission of the online questionnaire by each participant constituted consent to participate in the study. See Appendix A.

## **Data Analysis**

Multivariate analysis was used to determine the correlation between the dependent and independent variables. Multivariate analysis is a method by which statistical techniques are utilized to simultaneously analyze multiple techniques on individuals under investigation (Hair, J., Black, W., Babin, B. and Anderson, 2010). As a result, inferential statistics were used to identify correlations between items, constructs, and the dependent variable in the form of a regression analysis.

Data was analyzed using Partial Least Squares (PLS) a form of Structural Equation Modeling (SEM) software (Ringle, Wende, & Will, 2005). PLS was used due to its appropriateness in studies in the exploratory stage such as the one described in this study. Consistent with prior research, analysis utilized a two-step process (Anderson & Gerbing, 1988; Hair, J., Black, W., Babin, B. and Anderson, 2010). In the first stage, the measurement model was evaluated to determine the reliability and validity of the constructs. Next, the structural

model was evaluated to examine the predictive relevance of the model, magnitudes of effects, and variance (Henseler, Ringle, & Sinkovics, 2009).

To address the research questions, a purposive sample of 172 ABMs was used for this study. Multiple regression requires a minimum sample size of 50 and preferably 100 observations for most research situations (Hair, J., Black, W., Babin, B. and Anderson, 2010).

An a priori power analysis was performed using G\*Power (Version 3). Based on prior research (Bhattacharjee, 1996) this study choose a medium effect size,  $f^2 = 0.15$ . In addition, the study used values of  $\alpha = 0.05$  and power  $(1 - \beta) = 0.90$ . The analysis indicated that the desired sample size needed should be  $n = 123$  (Faul, Erdfelder, Lang, & Buchner, 2007). Based on this, the sample size used for this study was sufficient to achieve power greater than 0.90, which is well above the 0.80 level that is typically used as a standard of adequacy (Ellis, 2009).

Descriptive statistics, such as frequency of response, were used to determine aggregate respondents' age, and gender utilized in this study. Cronbach's Alpha was used to ensure satisfactory levels of internal consistency of the scale items. Questions with a sufficient level of reliability from previous research were selected. Fellow researchers reviewed the survey to determine the final questionnaire items.

### **Data Collection**

A Self-report questionnaire in an online survey format will be used to collect the data for this present study. The main variables of the instrument (Relative Advantage, Voluntariness, Results Demonstrability, Ease of Use, Image, Trialability, Visibility, Compatibility) will be measured with previously validates scales (Moore & Benbasat, 2001). Behavioral evaluation, monitoring, and repeated contract will be measured with a perception scale developed by Bhattacharjee, (1996). Some of the scale items were slightly reworded to reflect the current

research context. Each of the items was constructed using a Likert scale with five response categories (grounded by Strongly Agree – Strongly Disagree). A Likert scale is appropriate when the research measures the respondent's attitudes toward the constructs (McDaniels & Gates, 2005).

### **Quantitative Research Variables**

The independent variables in the quantitative study were ordinal scale values provided by survey responses describing behavioral factors. Questions related to the independent variables employed a 5-point likert scale.

### **Dependent variable**

The dependent variable, “usage intention” comes from Agarwal and Prasad's 1997 research (Agarwal & Prasad, 1997). For this research, the literature review supports a direct relationship between each factor and the dependent variable usage intention.

### **Role of Researcher**

As in any quantitative research study, the role of the researcher should be non-existent. (Parry, 2002). Quantitative researchers endeavor to stay withdrawn from the examination, and from the sample (when the subjects involved comprise of people). They endeavor to pursue objectivity - at the end of the day they attempt to not impact the research with their own bias or emotion. Quantitative researchers know that bias association in the investigation could affect the outcome. Biasing an examination and accumulation of the data is a poor logical approach and is unacceptable in quantitative research.

### **Trustworthiness**

To protect human subjects, address non-response and response bias, and ensure the anonymity of human subjects, the following steps were taken by the researcher: First, the

implementation of the anonymous response feature in Survey Monkey was initiated before the launch of the survey. The researcher ensured the respondents' IP addresses were blocked and not visible in Survey Monkey. "Response bias is the effect nonresponses have on survey estimates, and it means that if non-respondents had responded, their responses would have substantially changed the overall results of the survey" (Creswell, 2014a, p. 248). Response bias was addressed through list wise deletion, straight line deletion, maximum likelihood estimation (MLE) to input missing values in IBM SPSS and assessing common method bias. To address nonresponse bias, the organization's senior leadership made it clear verbally and in writing to managers and sales representatives, they would not have visibility to the survey results. Also, no geographic data was obtained which might single out a region, state or geography. Several reminder emails were sent to managers within the division to encourage voluntary participation by the ABMs. To ensure appropriate response rates, confidentiality of the respondents was routinely emphasized in email communication and within the survey itself. To protect the anonymity of the participants, and to reduce response bias, senior leadership and the researcher emphasized verbally and in email communication to region directors and area business managers, the survey was for purely academic purposes and the participants would remain anonymous. In consonance with well-established research practices, throughout the survey, respondents were reminded their responses would remain anonymous.

The research was conducted from a secure laptop using secure WIFI access at the front, home office located at 621 Pinon Boulevard, San Antonio Texas 78260. All research will be conducted using a 2015 ASUS laptop. The laptop is password protected to access the operating system, and only the researcher knows the password. Microsoft Office software, EXCEL, SPSS, and Smart PLS software will be used to conduct the study. No other individual has access to the

2015 ASUS Zenbook laptop. The laptop uses 512 GB of memory storage and 12 GB of RAM.

Survey Monkey will be used; access will be through a password that is only known to the researcher. Data was saved on a cloud-based data retrieval network (Dropbox) and the researcher will only know the password. For data analytics purposes, the researcher will make available a Dropbox file only accessible to the researcher and the dissertation committee chairman.



### **Research Findings**

One hundred seventy-two surveys were collected over a three-week period using an online survey. Email reminders were sent to company managers to encourage participation in the study. In the email, participants were reminded their survey responses would be anonymous and would only be used for academic purposes. An introductory, protection of human subjects, statement and explanation was provided at the beginning of the survey. Participants were told that their participation was voluntary. The survey contained a total of 59 questions and two demographic questions (sex and age). 172 out of 230 possible sales representatives from a biotechnology corporation, responded to the survey. The survey achieved a 74% response rate. The sample collected captured 74% of the target population. Of these respondents, 43.6% male and 57.4% female.

### **Data Cleaning**

Of the 172 surveys submitted, five were incomplete and were deleted. Straight line deletion was necessary for four surveys due to respondents selecting the same response for a high proportion of the responses (Hair, Hult, Ringle, & Sarstedt, 2014). This resulted in 163 usable responses.

The final data set contained 104 missing values, 1.1% of total responses. Given the size of the data set it was decided to impute missing values using IBM SPSS and the Expectation Maximization Algorithm (EMA). EMA is an appropriate method for missing value imputation. EMA can also identify population parameter values most likely given the sample data. EMA utilizes regression coefficients instead of the mean (Peugh & Enders, 2004). The EMA technique is preferred over mean and median replacement due to the limited impact it has on variable variance (Hair, J., Black, W., Babin, B. and Anderson, 2010). Finally, to ensure that missing

values were random the Little's Missing Completely at Random (MCAR) test was run (Little, 1988). Test results were not significant (Chi-Square = 124.06 Significance = .58) indicating that missing values were indeed random.

### **Common Method Bias**

Common method bias, also known as common method variance (CMV), can be introduced when variance is attributable to the measurement method (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). "It has become widely accepted that correlations between variables measured with the same method, usually self-report surveys, are inflated due to the action of CMV, despite some sources that suggest the problem is overstated" (Spector, 2006, p. 221). To test for CMV a Harmon's one-factor test (Morrison & Harman, 1961) was performed. In this test an exploratory factor analysis, using unrotated principal components with varimax rotation is run. If CMV exists, then a single factor will emerge, or one factor will account for more than 50% of the total variance. Results of this test indicated that the maximum variance explained by a single factor was 28.8%, not a majority. Hence, CMV is not an issue.

### **Data Analysis**

Data were analyzed using Smart PLS3, a structural equation modeling application. Smart PLS software is appropriate for this research due to its explanation of the variance in the dependent variable by using an estimation procedure through an ordinary least squares (OLS) regression-based method. PLS is robust against structural data problems such as skew distributions, omission of regressors, and makes minimal demands on sample size and distributions (Chin, 1998; Srivastava & Thompson. Teo, 2007). SmartPLS, developed by Ringle, Wende, and Will (2005) is an effective tool in testing theoretically supported causal models such as the one included in the current study (Lowry & Gaskin, 2014).

The research model was tested using a two-step structural equation modeling approach, consistent with the recommendations of Anderson and Gerbing (1988). In the first step the measurement model is evaluated to determine reliability and validity of the constructs. Next, the structural model is evaluated to examine the predictive relevance of the research model (Henseler et al., 2009).

### **Measurement Model**

The original proposed model of constructs with the factor loadings are depicted in Figure 14. Several variables did not load properly (EASE01, EASE03, EASE04, EASE05, EASE08, RES04, VIS02, VIS03, TRL01, TRL03, VOL02, VOL04, RECON03) resulting in the removal from the model. The PLS-SEM Algorithm was rerun with the indicators in question removed (Figure 15).

The revised model (Figure 15) explains 60% of the variance associated with the intention to use. It is desirable that factor loadings meet or exceed 0.70, although for exploratory studies 0.60 may be considered acceptable (Henseler et al., 2009). As can be seen all values, except VIS01 (0.677), are all greater than 0.70. This is an indication of good discriminant validity (Henseler et al 2009).

Reliability is an assessment of the degree of consistency between multiple measurements of a variable. Cronbach's Alpha (Cronbach, 1951) is the most widely accepted measure. The generally agreed upon lower limit for Cronbach's Alpha is .70, although it may decrease to .60 in exploratory research (Hair et. al., 2010). All constructs in the model were greater than 0.70 with the exception of Visibility (0.68) (Table 13).

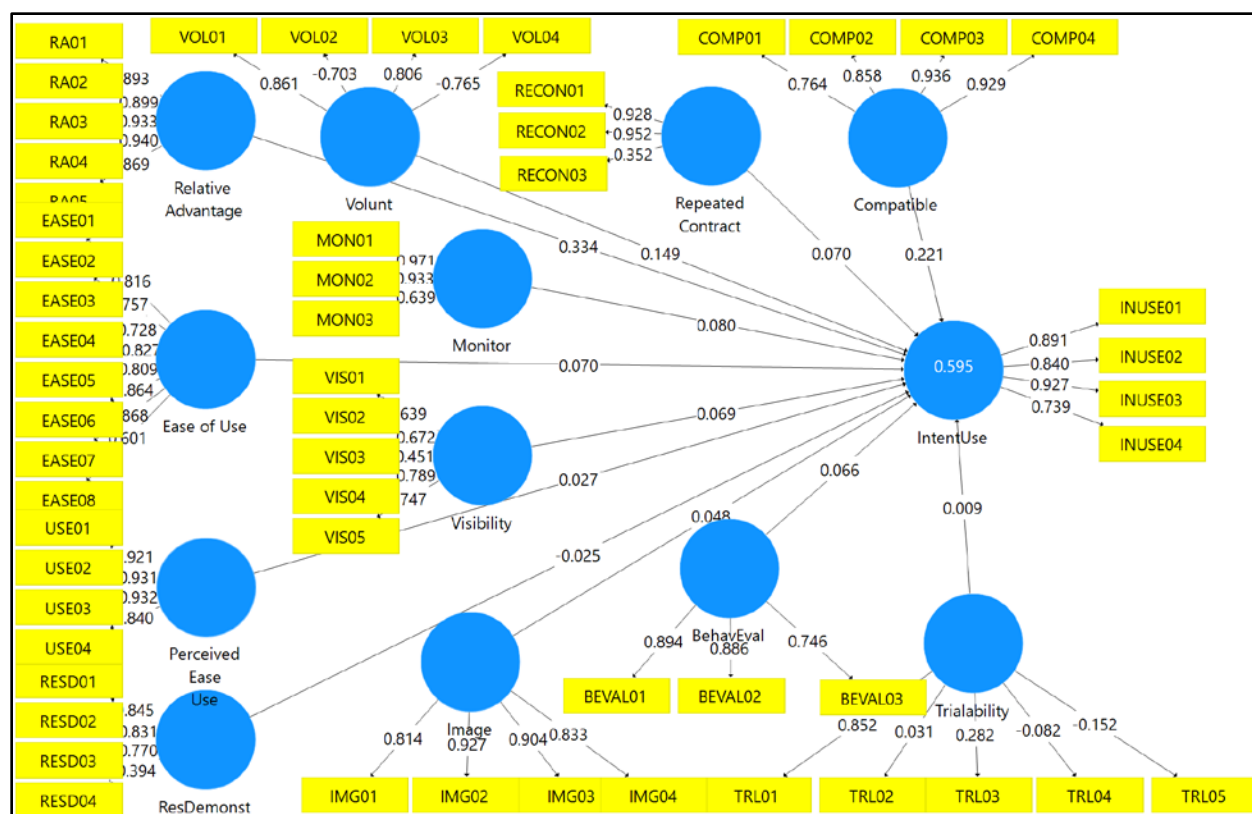


Figure 14. Original model including all indicators created by Dotter (2018).

Composite reliability is another commonly used measure for internal consistency. The accepted minimum values for composite reliability is 0.60. In the current model all values are above 0.81 which indicates satisfactory internal consistency (Henseler et al 2009).

Convergent validity, measured by average variance extracted (AVE), is a common measurement of the “communality of a construct” (Hair et al., 2014, p. 103). An AVE value of .50 or higher indicates, on average, the construct explains more than half the variance of its indicators (Henseler et al., 2009). AVE in the current model and its associated constructs meet the AVE greater than .50 criteria.

Discriminant validity assesses how truly distinct one construct is from another. The Fornell-Larcker criterion is a “more conservative approach to assessing discriminant validity. It

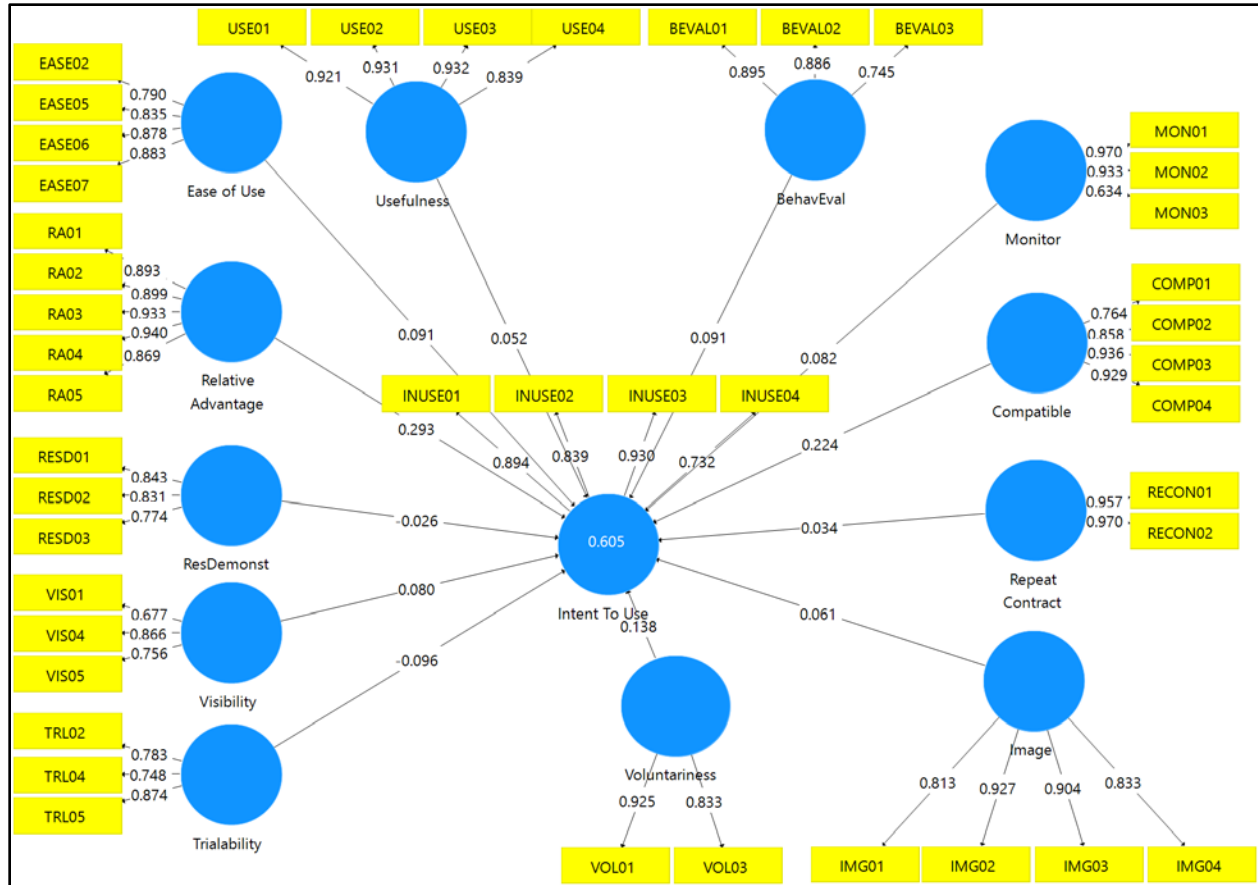


Figure 15. Revised model after removal of insignificant indicators created by Dotter (2018).

Table 13

*Construct Reliability and Validity*

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
BehavEval	0.795	0.881	0.714
Compatible	0.900	0.928	0.765
Ease of Use	0.868	0.910	0.718
Image	0.892	0.926	0.758
Intent To Use	0.873	0.913	0.726
Monitor	0.895	0.891	0.738
Relative_Advantage	0.946	0.959	0.823
Repeat_Contract	0.922	0.962	0.927
ResDemonst	0.750	0.857	0.666
Trialability	0.764	0.845	0.646
Usefulness	0.927	0.949	0.822
Visibility	0.681	0.812	0.593
Voluntariness	0.717	0.872	0.774

compares the square root of the AVE values with the latent variable correlation. AVE should be greater than its highest correlation with any other construct” (Hair et al., 2014, p. 105).

Discriminant validity was assessed in SmartPLS 3’ using the Fornell-Larcker Criterion (Table 14).

Based on the Fornell & Larcker criterion, the model demonstrates discriminant validity due to each construct’s AVE is greater than its highest correlation with any other construct.

### **Structural Model**

Having established validity and reliability of the constructs through the assessment of the measurement model, a closer examination of the structural model is necessary. Figure 16 shows the  $R^2$  values and the path coefficients. The  $R^2$  value indicates that 60.3% of the variance of usage intention is explained by the proposed model. However, only three of the 12 hypotheses are significant. Relative advantage is a significant predictor of usage intention ( $p < .5$ ) with a path coefficient of 0.015. Compatibility is a significant predictor of usage intention ( $p < .5$ ) with a path coefficient of 0.036. And, Voluntariness is a significant predictor of usage intention ( $p < .5$ ) with a path coefficient of 0.028.

### **Hypothesis Summary**

Data analysis indicated support for three out of the 12 hypotheses (Relative Advantage, Compatibility, and Voluntariness). See Table 15 for a complete summary of outcomes.

Table 14

*Fornell-Larcker Criterion Using Smart PLS3-SEM*

Construct	Behavior Evaluation	Compatible	Ease of Use	Image	Intent To Use	Monitor	Relative Advantage	Repeat Contract	Results Demonstrability	Trialability	Usefulness	Visibility	Voluntariness
BehavEval	0.845												
Compatible	0.474	0.875											
Ease of Use	0.381	0.645	0.847										
Image	0.445	0.430	0.157	0.871									
Intent To Use	0.487	0.679	0.531	0.442	0.852								
Monitor	0.065	-0.030	-0.044	0.210	0.093	0.859							
Relative_Advantage	0.490	0.815	0.617	0.449	0.700	-0.072	0.907						
Repeat_Contract	0.515	0.367	0.284	0.302	0.333	-0.181	0.351	0.963					
ResDemonst	0.398	0.484	0.433	0.226	0.382	-0.023	0.477	0.200	0.816				
Trialability	0.037	0.093	0.122	-0.029	-0.046	-0.010	0.038	-0.084	0.089	0.804			
Usefulness	0.485	0.755	0.519	0.535	0.632	-0.033	0.797	0.319	0.389	0.060	0.907		
Visibility	0.255	0.355	0.338	0.185	0.359	-0.078	0.340	0.156	0.327	0.146	0.278	0.770	
Voluntariness	0.221	0.238	0.247	0.231	0.390	0.265	0.277	0.046	0.200	-0.028	0.289	0.316	0.880

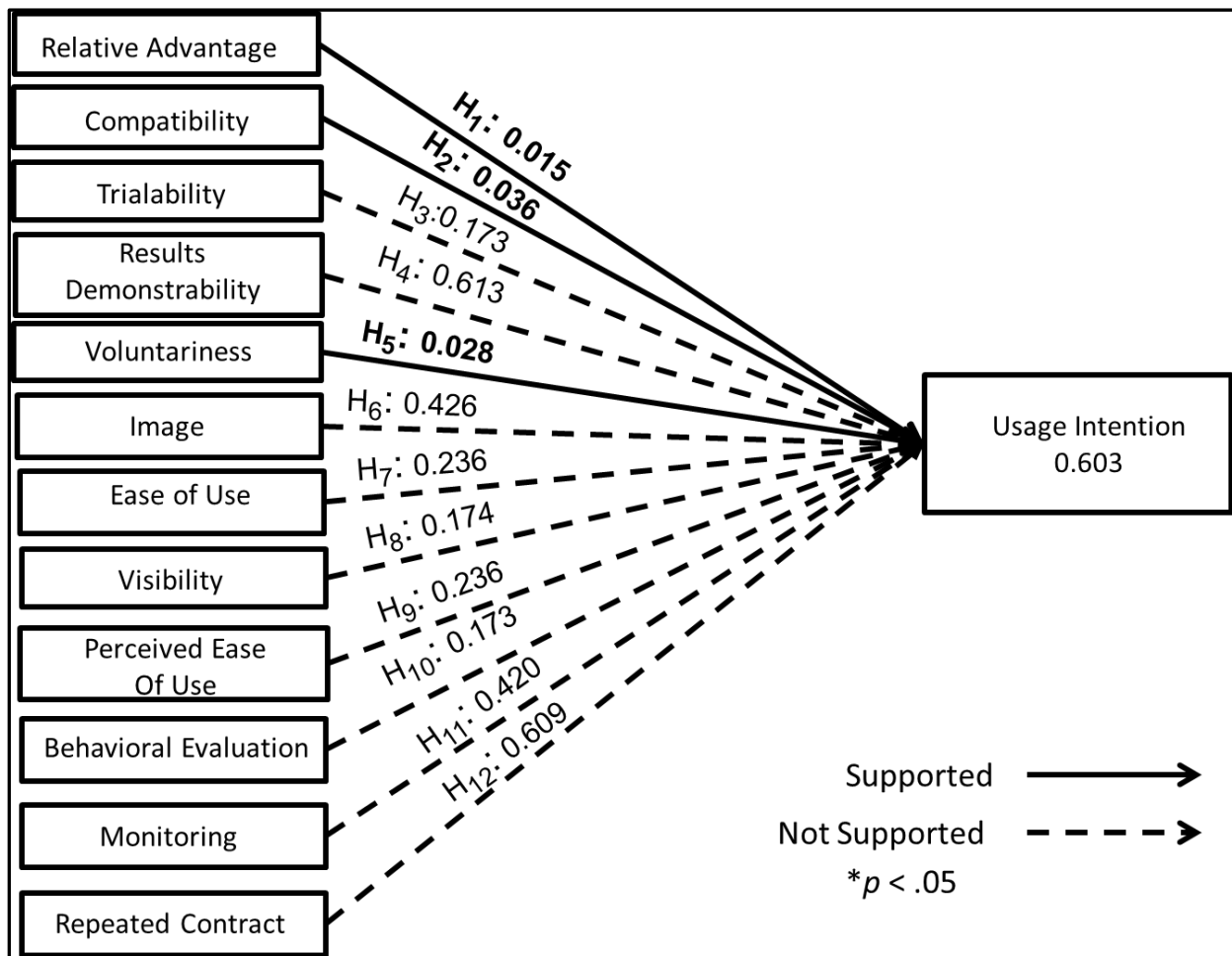


Figure 16. Structural Model showing Path Coefficients created by Dotter, 2018.

### Further Investigation

Upon the completion of the data analysis, the data were examined to determine if there were any mediating conditions present (see Table 16). The next section will provide the theoretical rationale for possible mediating conditions based on existing theory found in the literature.



## Relative Advantage

First, I will explore the relative advantage as a mediator between ease of use, usefulness and results demonstrability and usage intention. Of the 5 characteristics Rogers (1983) proposed that impact an innovation's rate of diffusion, one characteristic determined to be the most predictive is relative advantage (Holak & Lehmann, 1990). An individual will more likely adopt an innovation if it is believed to have an advantage over its predecessor (Rogers, 1983). A vast amount of research supports the relationship between perceived usefulness and the intent to use a

Table 15

### *Hypothesis Summary*

	Hypothesis		Path Coefficient	<i>p</i> Value
H <sub>1</sub>	Relative Advantage is a predictor of the intention to use an IVA on a tablet PC.	Supported	.297	.015
H <sub>2</sub>	Compatibility is a predictor of the intent to use an IVA on a tablet PC.	Supported	.222	.036
H <sub>3</sub>	Trialability is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>4</sub>	Results Demonstrability is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>5</sub>	Voluntariness is a predictor of the intent to use an IVA on a tablet PC.	Supported	-.096	.028
H <sub>6</sub>	Image is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>7</sub>	Ease of Use is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>8</sub>	Visibility is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>9</sub>	Usefulness is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>10</sub>	Behavioral Evaluation is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>11</sub>	Monitoring is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		
H <sub>12</sub>	Repeated Contract is a predictor of the intent to use an IVA on a tablet PC.	Not Supported		

Table 16

*Impact on Mediation*

Path	Path Coefficient	<i>t</i> Statistics	<i>p</i> Values
BehavEval -> Intent To Use	0.067	1.347	.178
Compatible -> Intent To Use	0.094	2.372	.017
Ease of Use -> Intent To Use	0.073	1.242	.214
Image -> Intent To Use	0.072	0.856	.392
Monitor -> Intent To Use	0.095	0.867	.386
Relative_Advantage -> Intent To Use	0.113	2.596	.009
Repeat_Contract -> Intent To Use	0.058	0.581	.561
ResDemonst -> Intent To Use	0.056	0.466	.641
Trialability -> Intent To Use	0.069	1.377	.169
Usefulness -> Intent To Use	0.091	0.568	.569
Visibility -> Intent To Use	0.062	1.301	.193
Voluntariness -> Intent To Use	0.065	2.107	.035
Path	Path Coefficient	<i>t</i> Statistic	With Mediation
BehavEval -> Voluntariness	0.072	3.537	.000
Compatible -> Intent To Use	0.086	3.617	.000
Ease of Use -> Relative_Advantage	0.056	4.241	.000
Image -> Monitor	0.076	4.101	.000
Monitor -> Voluntariness	0.076	3.110	.002
Relative_Advantage -> Intent To Use	0.094	4.124	.000
Repeat_Contract -> Monitor	0.072	4.013	.000
ResDemonst -> Relative_Advantage	0.048	2.812	.005
Trialability -> Compatible	0.100	0.901	.375
Usefulness -> Relative_Advantage	0.050	12.365	.000
Visibility -> Usefulness	0.064	4.741	.000
Voluntariness -> Intent To Use	0.057	3.684	.000

technological innovation (Davis et al., 1992). A new technology would need to demonstrate usefulness over the preceding technology if the user perceives a relative advantage. “Many systems are rejected by users because, although easy to use and capable of producing high quality output, they do not address tasks that are important to the users’ jobs” (Ismail, 2012). In addition, Moore and Benbasat (1991), acknowledged the inter-relationship between perceived usefulness and relative advantage. A search of the literature further supports the identified correlation between relative advantage and perceived usefulness ( Davis et al., 1992; Viswanath

Venkatesh, Morris, Gordon B. Davis, 2003). Therefore, it is reasonable to propose that the impact of perceived usefulness on usage intention is mediated through its effect on relative advantage.

But, what factors might impact the perception of usefulness? Perceived Usefulness originates from Davis' TAM which was developed to explain computer usage behavior (Davis, Bagozzi, & Warshaw, 1992). It is reasonable to believe that the visibility of an innovation's usage by others in a social system would positively impact the perception that the innovation delivers value. An exploration of the research found support of a technology's use, visible by others, positively impacts usage perception (Fisher & Price, 1992). Hence, based on this it is reasonable to propose that visibility would have a positive effect on usefulness.

Ease of use, similar to perceived usefulness, is a characteristic that would impact an individual's perception that an innovation has advantage over prior technologies. Consistent with Davis' TAM the easier an innovation is to use, the more likely that innovation will be adopted (Davis, Bagozzi, & Warshaw, 1992). Thus, consistent with literature discussed earlier, it is reasonable to suggest that ease of use, like usefulness, will have a positive impact on the individual's perception of relative advantage.

An innovation's propensity for demonstration will result in more visible advantages and increase the probability of user adoption (Zaltman et al., 1973). Rogers (1983) defined observability and communicability as the degree in which a user can see and communicate the results of using an innovation. It wasn't until 1991, when Moore and Benbasat combined observability and communicability into one attribute called results demonstrability (Moore & Benbasat, 1991). Research supports results demonstrability's affect on relative advantage by the fact result demonstrability, which, as argued earlier, works in concert with perceptions of relative

advantage (Agarwal & Prasad, 1997). Based on this it is proposed that results demonstrability has a positive impact on relative advantage.

The introduction of relative advantage as a mediator is highlighted in the updated model shown in Figure 17.

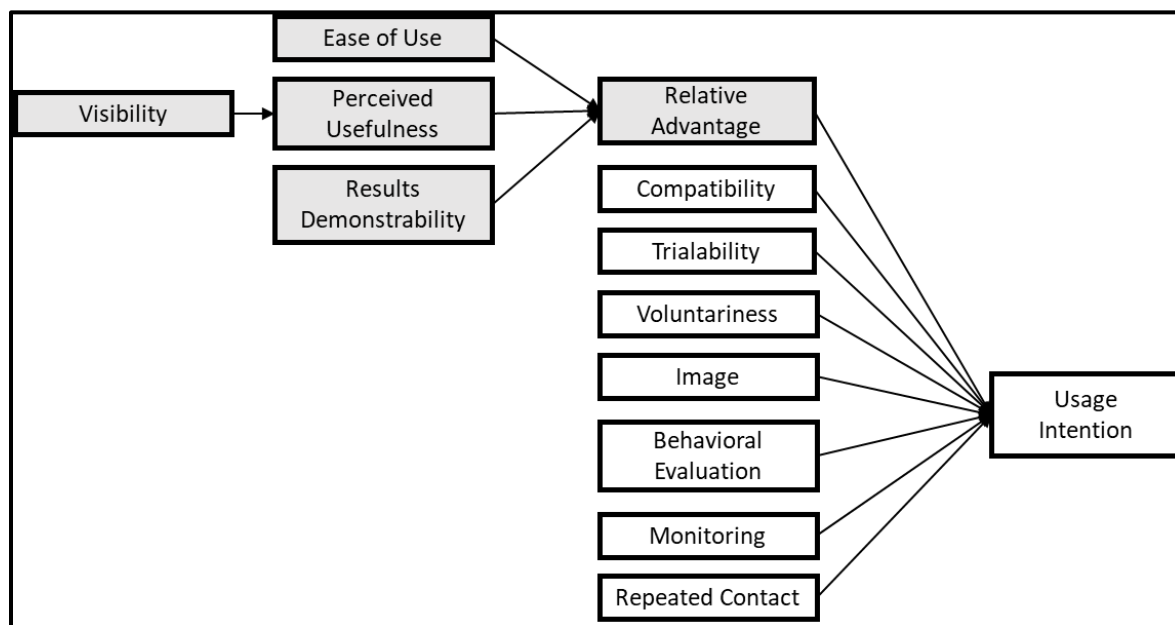


Figure 17. Relative Advantage as a mediator created by Dotter, 2018.

### Voluntariness

Next, I will explore the role of voluntariness as a mediator between monitoring, behavioral evaluation, and their impact on usage intention. An individual's intention to use an innovation may be dependent on the user's perception that the use is completely voluntary. The research has shown that the perception of voluntary use may be more important than the actual freedom to use the innovation (Moore & Benbasat, 1991). An additional characteristic of voluntariness is the individual's behavior to use a technology is not mandated by a supervisor (Agarwal & Prasad, 1997). Based on this evidence, voluntariness should positively impact user intention.

Monitoring may have a direct impact on the perception of voluntariness especially if the user believes management is monitoring usage. Sappington (1991), determined that monitoring mechanisms can enhance behavior which is in alignment with management's goals.

Bhattacharjee (1996), identified that monitoring can impact an individual's usage behavior.

Agarwal and Prasad (1997), determined there was significant evidence suggesting monitoring can have an impact on voluntariness. "The result suggests that initial usage of a system may be influenced by perceptions of voluntariness (i.e., superior mandate), but people will continue to use the system (i.e., institutionalize and assimilate the technology) only if they can view its benefits unequivocally (i.e., they find it useful)" (Agarwal & Prasad, 1997, p. 532). Hence, based on the literature it is proposed that monitoring has a positive impact on the individual's perception of voluntariness.

As we explore monitoring, it is reasonable to suggest that image has a positive impact on monitoring. "Undoubtedly one of the most important motivations for almost any individual to adopt an innovation is the desire to gain social status" (Rogers, 1983, p. 215). Image is the construct that impacts behavior by how one's use is perceived to have on the individual's social status (Moore & Benbasat, 1991). In a professional environment, social status could be interpreted as how management or supervisors view the individual. Thus, it is reasonable to suggest that if the individual desires to have a positive image and their actions are monitored by management, then image could have a positive impact on the perception that they are being monitored. Hence, consistent with previously cited literature it is proposed that image will have a positive impact on monitoring.

"Behavior-based contracts insure users from potential unfavorable outcomes due to non-use of IT, and thereby may induce them to shirk from the intended behavior" (Bhattacharjee,

1996, p. 310). When combined with monitoring, repeated contract may have an even greater impact on an employee's voluntary usage of IT technology. Hence, it is proposed that repeated contact positively impacts monitoring.

Behavioral evaluation may have an impact on voluntariness due to specific usage behaviors evaluated by management. Sappington (1991), introduces the concept of goal incongruence (moral hazard) between the employee and management. While an employee would prefer to voluntarily adopt a new technology, behavioral evaluation is a construct that is employed to ensure behavior is in alignment with management's goals. In this case, behavioral evaluation may have a direct impact on voluntariness. "Although IT usage in personal-use settings is entirely voluntary, this is less so in organizational settings, where users are expected to behave by the management's goals. As such, incentives and control mechanisms are intended to overcome users' involuntariness regarding IT usage in such settings." (Bhattacharjee, 1996, p. 320). Therefore, it is suggested that behavioral evaluation has a positive impact on voluntariness.

This modification to position voluntariness as a mediator is highlighted and shown in Figure 18.

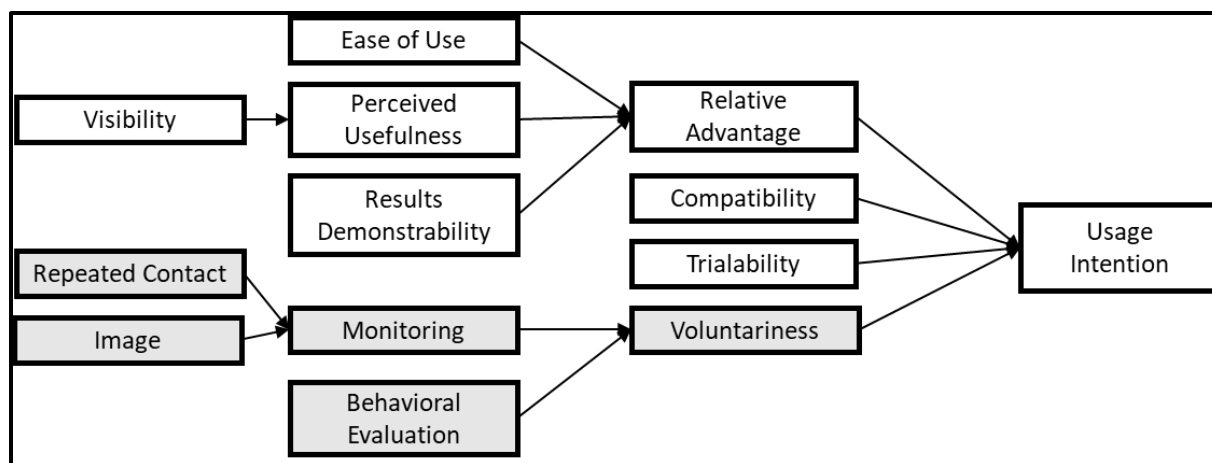


Figure 18. Voluntariness as a mediator created by Dotter, 2018.

### Compatibility

Finally, we explore the role of compatibility as a mediator between trialability and usage intention. The case for compatibility as a mediating condition between trialability and usage intention is a reasonable pathway due to an individual becoming more comfortable with new technology after a trial period (Moore & Benbasat, 1991; E. M. Rogers, 1983). “Trialability measures the extent to which potential adopters perceive that they have an opportunity to experiment with the innovation before committing to its usage” (Agarwal & Prasad, 1997, p. 562). Thus, an individual would prescribe to a trial period before determining if there is an intention to use the innovation. Hence, based on this and prior literature it is proposed that trialability positively impacts compatibility. Based on the evidence contained in the literature, the modification of the model to position compatibility as a mediator between trialability and user intention is highlighted and shown in Figure 19.

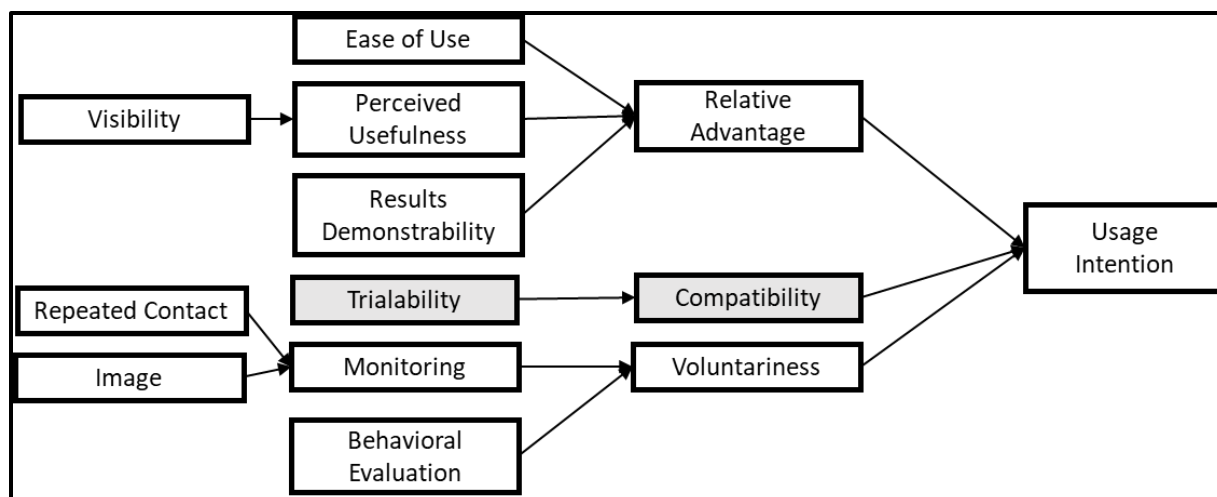


Figure 19. Compatibility as a mediator created by Dotter, 2018.

### Alternative Structural Model

The PLS algorithm and bootstrapping modeling were rerun in Smart PLS3 and were subsequently run to test the alternative model. To test for mediation, relative advantage, voluntariness, and compatibility are tested as mediators for the model. The  $R^2$  values for relative advantage, voluntariness, and compatible suggest that 70.9, 13.1, and 0.8 percent respectively is explained by the model. In addition, the  $R^2$  for usefulness is 9.3% and monitoring is 12.5%. The amount of variance captured by the model with respect to intention to use is 56.2%. The alternative model in figure 20 shows that all but one of the hypotheses, trialability, positively impacts compatibility, are significant.

The trialability construct was not supported under the alternative structural model, but nine constructs in question found significance at the  $p < .001$  level. Two other constructs (Monitor and results demonstrability) found significance at the  $p < .05$  level. The exhibit of the alternative model hypothesis summary can be found in Table 17.



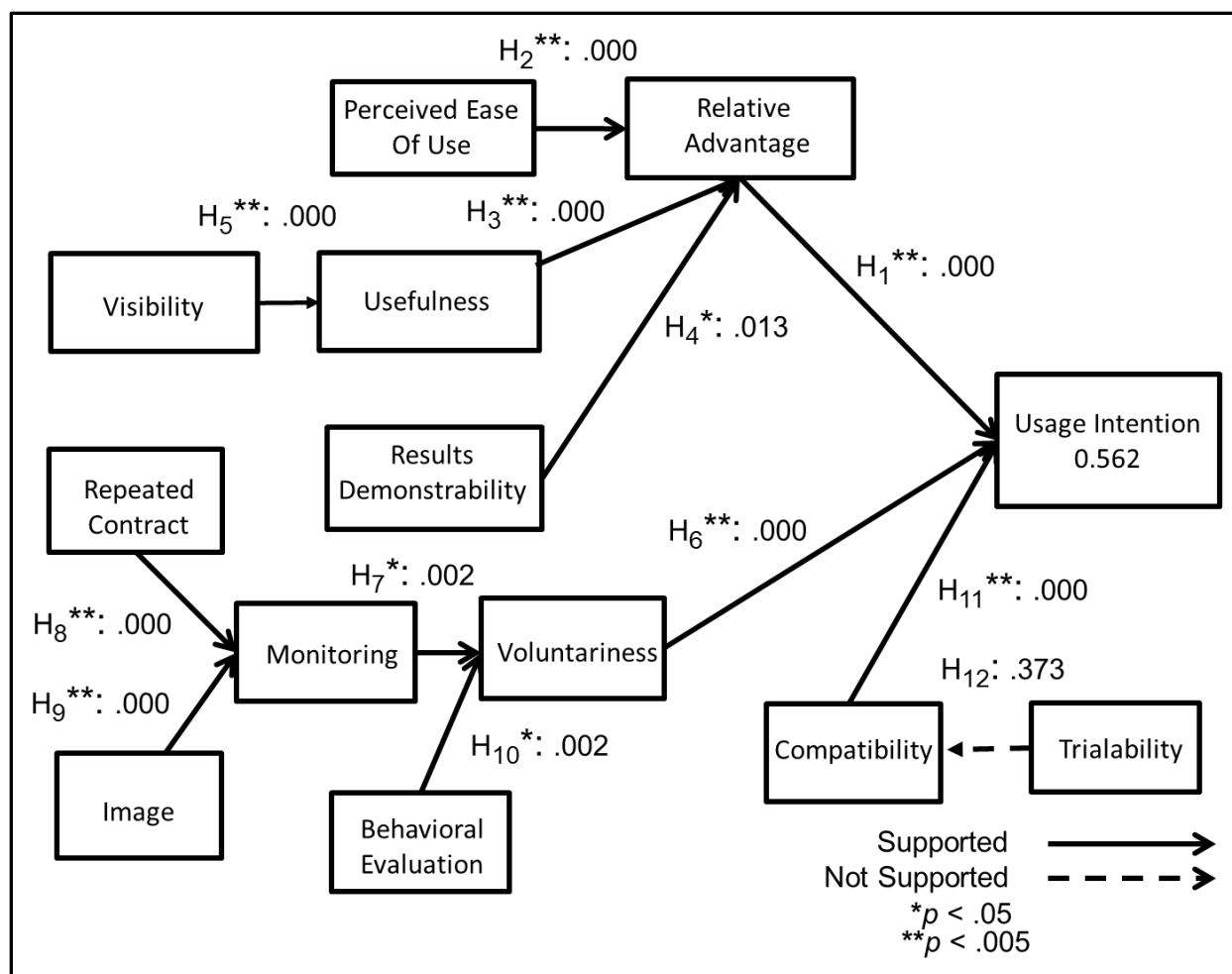


Figure 20. Alternative structural model created by Dotter, 2018.

Table 17

*Alternative Model Hypothesis Summary*

	Hypothesis		Path Coefficient	<i>p</i> Value
1	Relative Advantage is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.387	.000 (< .001)
H <sub>2</sub>	Compatibility is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.331	.000 (< .001)
H <sub>3</sub>	Trialability is a predictor of the intent to use an IVA on an iPad technology platform.	Not Supported	NA	NA
H <sub>4</sub>	Results Demonstrability is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.134	.003 (< .05)
H <sub>5</sub>	Voluntariness is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.210	.000 (< .001)
H <sub>6</sub>	Image is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.310	.000 (< .001)
H <sub>7</sub>	Ease of Use is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.623	.000 (< .001)
H <sub>8</sub>	Visibility is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.035	.000 (< .001)
H <sub>9</sub>	Perceived Ease of Use is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.623	.000 (< .001)
H <sub>10</sub>	Behavioral Evaluation is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.253	.000 (< .001)
H <sub>11</sub>	Monitoring is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	.235	.002 (> .05)
H <sub>12</sub>	Repeated Contract is a predictor of the intent to use an IVA on an iPad technology platform.	Supported	-.288	.000 (< .001)

## Demographic Data Analysis

Table 18

### *Demographics*

	<i>n</i>	%
Gender		
Female	100	61.3%
Male	63	38.70%
	<i>n</i>	%
Age		
25-34	8	4.9%
35-44	61	41.1%
45-54	71	43.6%
55-64	16	19.8%
65-74	1	.6%

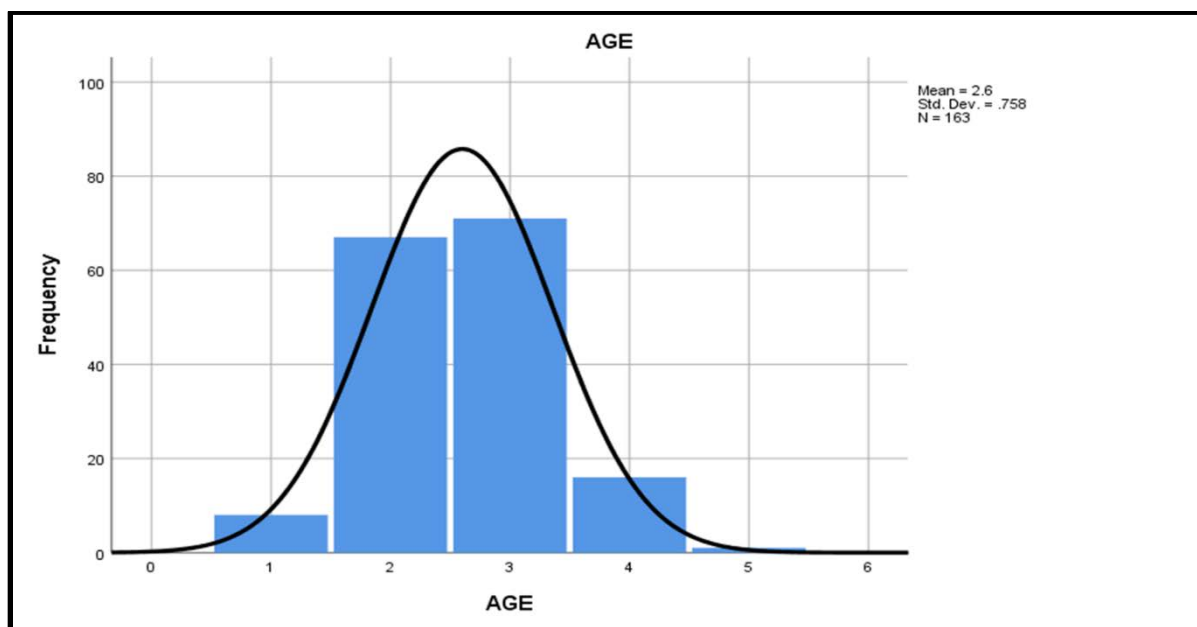


Figure 21. Histogram (AGE) Using IBM SPSS based on concepts created by Dotter, 2018.

## **Discussion and Limitations**

The purpose of this study was to understand the factors that affect the intent to use an IVA on a tablet PC platform by a biotechnology sales force. This study utilized diffusion of innovation theory (Moore & Benbasat, 1991; Rogers, 1983) and the principal agent model (M. C. Jensen & Meckling, 1976; Sappington, 1991) as its theoretical lens. In addition, a factor from the technology adoption model (Davis, 1985) was also used. This study explored one main research question. What are the factors that affect a biotechnology sales force usage of an IVA on a tablet PC platform? During the timeframe of this study, two models were empirically tested. Both models focused on the diffusion of innovation theory, modified by Moore and Benbasat (1991) and the principal agent theory (Sappington, 1991) which was adapted from Meckling's (1976) agency theory. In the alternative model, eleven of the twelve hypotheses were supported.

### **Relative Advantage**

An individual will more likely use an innovation or new technology if the individual believes there is an advantage over its predecessor (Rogers, 1983). Relative advantage is considered the most influential factor used in diffusion of innovation theory. Consistent with prior research, the individual sales person must be able to perceive some level of advantage over what was done in the past before they will adopt the new technology. This study found support for the positive influence of relative advantage on usage intention (H1).

Next, the factors that impact the perception that an innovation is superior or has advantages over its predecessor were explored. Moore and Benbasat (1991) acknowledged the significance of social influence on relative advantage by emphasizing how social factors can play a role of influencing an individual's intent to use an innovation. In this study we considered the impact of ease of use, usefulness and results demonstrability on the individual's perception of

relative advantage. Consistent with prior research, perceived ease of use is considered a precursor to usefulness and both are considered to have a positive influence on technology adoption (Davis, 1986; Viswanath Venkatesh, Morris, Davis, 2003). In this study, we considered usefulness and ease of use as two factors that would reinforce the perception that an innovation has advantages. If an innovation is easy to use and helps the individual achieve desired outcomes, then that should positively impact relative advantage. Research also supports the distinct relationship between usefulness and relative advantage as depicted within this study (Adams et al., 1992; Davis et al., 1992). In this study support was found for the positive influence of ease of use and usefulness on relative advantage, H2 and H3 respectively.

Another factor from diffusion of innovation that comes into play here is visibility (Rogers 1983; Moore and Benbasat, 1991). Visibility is defined as the user's perception of an innovation through what is seen throughout the organization. Research supports the more visible the innovation is within an organization, and the results are communicated amongst a social network, the individual users will see an advantage to using the innovation (Zaltman et al., 1973). So, if an individual sees other being successful with an innovation, this should reinforce the perception that the innovation is useful. Hence, in this study and consistent with theory, it was found that visibility positively influences usefulness (H5).

Another factor from Moore and Benbasat's (1991) model of diffusion of innovation is results demonstrability. Results demonstrability suggests that the more visible the advantages of an innovation are the more likely it is to be adopted (Moore & Benbasat, 1991). Hence, it follows that if an individual view the advantages of an innovation through others use of that innovation, they will start to gain an appreciation of the relative advantage that innovation has to offer. In

this study we found a positive relationship between results demonstrability and relative advantage (H4).

### **Implications**

This study demonstrates clear evidence of the intent to use an IVA by a biotechnology sales force is determined by the ABMs identifying a relative advantage (hypothesis supported) over the precursor. If the innovation, does not bring tangible advantages, then the likelihood of the ABM using that technology will be reduced. ABMs within the biotechnology corporation must find the IVA useful (hypothesis supported), they must be able to see others being successful using the innovation (hypothesis supported), and positive results need to be demonstrated (hypothesis supported).

This study illustrates that, regardless of corporate mandates, the importance of a biotechnology corporation demonstrating how the interactive visual aid on an iPad platform will provide a relative advantage to its ABMs. In other words, the corporation must be able show the individual how they can be more successful using the innovation than they were using whatever tools they had before.

### **Voluntariness**

This study utilized a modification of Everett Rogers (1983) five attributes contained in the diffusion of innovation theory (Moore & Benbasat, 1991). One of the factors added to Everett Rogers diffusion of innovation theory is the voluntariness construct. Moore and Benbasat (1991), recognized behavior is either voluntary or compulsory and thus the construct of voluntariness needed to be a separate factor in their model. It is this construct that sits in contradiction to Sappington's principal agent model and further illustrates goal incongruence between the sales representative and management. Also, it is important to note the distinction

between an explicit and an implicit mandate. For example, if management is monitoring employee behavior, whether the action is formally mandated or not, this may enforce the perception that an activity is mandated. In this study, support was found for the positive impact of voluntariness on usage intention (H6).

Sappington (1991), identified the moral hazard as the employee's personal goals interfering with the objectives of management resulting in unobserved employee behavior (Bhattacharjee, 1996). Voluntariness addresses the identified conflict between mandated employee behavior and employee behavior determined by free will. This study incorporates three of the constructs found in the principal agent model and uses voluntariness as the mediator between usage intention and monitoring mechanisms.

Behavioral evaluation and monitoring are utilized by management to ensure employee technology utilization is in alignment with management's objective (Sappington, 1991). In this study monitoring is defined as the degree to which their usage is being monitored by management. Sappington's (1991) research illustrates management's use of monitoring mechanisms may have an impact on the employee's volition. If management monitors employee innovation usage, then that reinforces the notion that the action is mandatory. Hence, this study found support for monitoring positively impacting voluntariness (H7).

Repeated contract is another measure that can impact voluntariness and monitoring. Repeated contract is the degree to which the subject believes that they will be rewarded if a task is performed (Bhattacharjee, 1996). Closely related, in a professional environment, is the notion of image. Image is the degree to which use of the innovation is perceived to enhance one's image or status (Moore & Benbasat, 1991). Past studies have exhibited the impact of image on the individual's intent to use an innovation (Ismail, 2012; Rogers, 1983). Image can impact an

employee's use of a new technology if the usage enhances the employee's social standing (Agarwal & Prasad, 1997). Roger's (1983) acknowledged the image construct may have the most significant impact on an individual's intent to use an innovation due to an individual's desire to enhance social status.

These constructs are closely related in that the individual receives some incentive either personal or material for usage of the innovation. The notion of usage of an innovation being incentivized reinforces the notion that the action is required. Hence, in the current study we found support for repeated contract and image positively influencing monitoring, H8 and H9 respectively and thus indirectly impacting the perception of voluntariness.

### **Implications**

This study, consistent with prior research, found evidence that monitoring mechanisms such as repeated contract and behavioral evaluation can impact a sales representatives' usage of an IVA on an iPad in selling discussions with customers. The biotechnology area business managers perceived voluntary use of the IVA also impacts usage intention. Whether implicit or explicit, the notion of mandating usage will impact usage intention. Biotechnology sales management must take an active role in monitoring and incentivizing the area business managers' usage to address the goal incongruence which exists between management and the sales representative, and to prevent moral hazard (Sappington, 1991).

### **Compatibility**

This study, in alignment with prior diffusion of innovation research, demonstrated the construct, compatibility, impacts area business managers' usage intention of the IVA on the iPad during sales discussions. For the IVA to be compatible, the IVA on the iPad would need to fit with the needs, beliefs, and past experiences of the sales representative (Rogers, 1983).



Interestingly, trialability, while a construct of Moore and Benbasat's (1991) modification of Everett Rogers's diffusion of innovation theory, did not exhibit an impact on compatibility. Therefore, in this study while we did find support for compatibilities positive influence on usage intention (H11), the impact of trialability on compatibility was not significant.

### **Implications**

The results from this research demonstrate compatibility had a positive impact on the ABM's intent to use an IVA on an iPad technology platform. However, it appears that having a trial period would exhibit no impact on either compatibility or usage intention. These results indicate that having such a trial period with the IVA may be a waste of resources and time. And, more attention needs to be paid to the compatibility between innovation usage and the way ABM's conduct business.

### **Study Limitations**

One limitation this study had to address was desirability bias. Social desirability bias, introduced when respondents want to please the designer, may cause respondents to have a greater adoption and utilization of digital promotion (Fisher, 1993). Several steps were taken to minimize the effect of this specific bias. The corporation's senior vice president met with all regional managers and explained the survey was for purely academic purposes, responses would be anonymous, no geographic data would be collected, and results from the research would not be shared with senior leadership. Other objectives of this meeting were to increase response rates, garner support from regional sales management, and to ensure regional managers did not unnecessarily bias their direct reports. An email with survey link was created by the researcher which the regional managers forwarded to their ABMs. The email, as well as the survey introduction and protection of human subject's survey section, emphasized the anonymity of the

respondents. Hence, together with the high response rate, it is believed that the impact of desirability bias was minimized.

The sample size may have proven to be a limitation of this study. While this study achieved an over 70% response rate, due to data cleaning procedures, the sample declined from 172 to a total of 163 respondents. Partial least squares structural equation modeling is appropriate for smaller sample sizes ( $n = 100 - 150$ ) often found in exploratory studies such as the one described here (Anderson & Gerbing, 1988). Also, as an a priori test a power analysis was performed. The a priori analysis indicated that a sample size of 123 was desired to achieve  $\alpha = 0.05$  and power = 0.90. The final sample size of this study well exceeded the 123 target.

Finally, due to the protection of human subjects' statement at the beginning of the survey, some respondents may be influenced (positively or negatively) by seeing the name of the researcher requesting their voluntary participation in the study. While the statement is necessary to ensure the protection of human subjects, response bias may have been introduced if the survey participants were aware of the researcher's identity.

## **Conclusions**

This study aimed to apply Moore and Benbasat's (1991) modified diffusion of innovation theory, Sappington's (1991) principal agent model, and Davis' technology adoption model (1983) to determine usage intention of an interactive visual aid on a tablet PC platform by a biotechnology sales force. Consistent with prior research, the study found that factors pertaining to diffusion of innovation, agency theory, and technology adoption do affect ABMs' IVA usage intention. Through mediation, three variables became more prominent in the alternative model's prediction of user intention: relative advantage, compatibility and voluntariness. In this study, the ABMs intent to use an IVA on an iPad platform during selling discussions with HCPs were

impacted by the perceived advantages the IVA has over its predecessor, the compatibility the IVA had with the current work environment, and the ABMs' voluntary use of the IVA.

### **Implications for Future Research**

This study demonstrated how diffusion of innovation and the principal agent model can be applied to better understand technology adoption in a professional selling environment. In this context, this study further illustrated how relative advantage, voluntariness, and compatibility have a direct impact on area business managers' usage intention of the IVA on a tablet PC platform. While other constructs from the principal agent model and diffusion of innovation theory do not directly impact usage intention, this study demonstrated an indirect impact through mediating constructs.

One construct, relative advantage, is reinforced by perceived ease of use, usefulness, and results demonstrability. This relationship, supported by existing theory, between perceived ease of use and usefulness of an innovation is key in determining the relative advantage of the innovation. This study also demonstrates how results demonstrability has a direct impact on relative advantage. Thus, in a corporate selling environment, this study supports the need for area business managers to see others succeed as an important factor in creating the perception of relative advantage.

Although beyond the scope of this study, these results may provide insights into the stages of adoption in a professional selling environment. It could be argued that the population of high-end sales professionals may not contain many "early adopters". These individuals are typically driven to adopt new technology if it provides a competitive advantage. As a result, it appears that this study did not contain a lot of early adopters and the results appear to suggest,

like late adopters in the diffusion of innovation process model, they want to see others succeed before taking the step to adopt.

This study demonstrated voluntariness was influenced by monitoring and behavioral evaluation. These results suggest that external factors do have an impact on the individual's perception of whether using an innovation is voluntary. Thus, the results of this study suggest that monitoring the actions of an employee may create a perception that an action is mandatory.

Finally, it is important to note that trialability had no impact on usage intention in either model. This result may suggest that the opportunity to "try before you commit" is not adequate to trigger an intention to use the innovation. This suggests that the sales force may weigh outcome risk and reward over the innovation itself. Therefore, if the sales force does consist largely of late adopters, the sales representatives may be more focused on sales achievement than the technical features of the innovation itself.

### **Implications for Practice**

Due to the significant impact relative advantage, voluntariness, and compatibility exhibited on ABMs' usage intention, biotechnology corporations need to explore how IVAs on a tablet PC platform are differentiated over print promotional literature. Biotechnology management can accomplish this through sales leadership's technology paradigm shift, investment in training, implementation of behavioral observation and incentive tools, and the reallocation of resources.

To achieve sales force adoption, biotechnology sales leadership must embrace the IVA on a tablet PC platform as an innovative, technological advancement, which will drive sales results more effectively than traditional promotional literature. This paradigm shift must be effectively communicated and adopted by the sales force if the innovation, in this case the IVA,

is going to be used in the selling environment. The sales force must also perceive the innovation to be easy to use and useful in their daily sales interactions with healthcare providers. As a result, a biotechnology sales organization's training department must be able to train and demonstrate how the technology will be a measurable improvement over current promotional literature.

Also, the study suggests that ABMs need to see others be successful before they are willing to adopt. As such, management must try to develop ways to highlight successes within the broader salesforce. If an individual ABM sees others increasing sales or landing larger sales due at least in part to the usage of the new platform, then they will be motivated to follow suit.

The study also suggests sales leadership must not waste time and resources by allowing the sales force to use the innovation during a trial period. This study implies the sooner sales leadership implements and incorporates the technology innovation into the daily life of the sales representative, the sooner the sales force will see the visible use of the innovation – supporting perceived voluntary use.

Finally, a sales force will only “respect what we inspect” if sales management is monitoring the use of the technology innovation and rewarding correct usage with reinforcement through behavioral incentives.

## **Summary**

This study was able to demonstrate the factors that impact the intent to use an IVA on a tablet PC platform by a biotechnology sales force. Through mediation, this study further illustrated how relative advantage, voluntariness, and compatibility have a direct impact on the usage of a technology innovation by a biotechnology sales force. Finally, this study demonstrated how diffusion of innovation and the principal agent model can be applied, in a professional selling environment, to better understand technology adoption.

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## Appendices



## Appendix A

### Prospective Research Participant:

You are asked to take part in a research study regarding factors that affect the utilization of an Interactive Visual Aid (IVA) on an iPad by a biotechnology sales force. You are being asked to take part in this study because you are an Area Business Manager in a biotechnology firm. The survey should take 5 minutes or less to complete.

If you decide to take part, please respond yes to the following question. This will take you to the survey questions. If you do not wish to take part in the study, choose no, and you will be exited from the survey. Participation in the survey is voluntary. The survey will not cause you discomfort or inconvenience, and poses no risk to you as an individual. No identifying information is being requested, and your IP address is not being retained as part of your response to this survey. Complete anonymity will be maintained. Names will not appear in any data collected, and participants cannot be identified from what demographic data is collected.

This study may be of benefit in establishing an academic basis for the utilization of future technology platforms in the corporate setting.

Everything we learn about you in the study will be confidential. The survey is password protected in Survey Monkey and the data is encrypted on a single laptop device.

Your decision to take part in the study is voluntary. You are free to choose not to take part in the study or to stop taking part at any time. Prior to the research study being implemented, approval will be obtained from the UIW Institutional Review Board. IRB approval number 17-09-008. Participation is strictly voluntary. You may refuse to participate or withdraw from the research at any time. A decision not to participate will not adversely prejudice future interactions with the institution.

If you have any questions or you wish to report a problem that may be related to this study, contact Thomas A. Dotter, MBA at [dotter@student.uiwtx.edu](mailto:dotter@student.uiwtx.edu) or (210) 872-5482.

The University of the Incarnate Word committee that reviews research on human subjects, the Institutional Review Board, approved this research. The UIW IRB is available to answer any questions about your rights as a research subject (210) 829-3157 – (Dean of graduate Studies and Research).

Thanks in advance for your participation.

Thomas A. Dotter, MBA  
HEB School of Business & Administration

- ☐ Yes, I would like to participate
- ☐ No, I would not like to participate

## Appendix B

Question	Scale	Citation
Relative Advantage*	SA A N A/D D SD	
1. Using the Interactive Visual Aid (IVA) enables me to accomplish my job. 2. Using the IVA in selling discussions with customers improves the quality of work I do. 3. Using the IVA in selling discussions makes it easier to do my job. 7. Using the IVA enhances my effectiveness at work. 8. Using the IVA in selling discussions gives me greater control over my work.		Adapted from Moore and Benbasat, (1991).
Ease of Use*	SA A N A/D D SD	
1. I believe the Interactive Visual Aid (IVA) is cumbersome to use. 2. It is easy for me to remember how to perform tasks using the IVA. 3. My using the IVA requires a lot of mental effort. 4. Using the IVA is often frustrating. 5. My interaction with the IVA is clear and understandable. 6. I believe that it is easy to get the IVA to do what I want it to do. 7. Overall, I believe that the IVA is easy to use. 8. Learning to operate the IVA is easy for me.		
Results Demonstrability*	SA A N A/D D SD	
1. I would have no difficulty telling others about the results of using the IVA. 2. I believe I could communicate to others the consequences of using the IVA. 3. The results of using the IVA are apparent to me. 4. I would have difficulty explaining why the IVA may or may not be beneficial.		
Visibility*	SA A N A/D D SD	
1. I have seen what others do using the IVA. 2. At my work, one sees the IVA on many iPads. 3. I have seen the IVA in use outside my company. 4. The IVA is <i>not</i> very visible in my company. 5. It is easy for me to observe others using the IVA at my company.		
Trialability*	SA A N A/D D SD	
1. I have had a great deal of opportunity to try various IVA tools. 2. I know where I can go to satisfactorily try out various uses of the IVA. 3. IVA was available to me to adequately test run various applications. 4. Before deciding whether to use the IVA, I was able to properly try it out. 5. I was permitted to use the IVA on a trial basis long enough to see what it could do.		
Compatibility*	SA A N A/D D SD	
1. Using the IVA is compatible with all aspects of my work. 2. Using the IVA is completely compatible with my current situation.		

3. I think that using the IVA fits well with the way I like to work. 4. Using IVA fits into my work style.		
<b>Voluntariness*</b>	<b>SA A N A/D D SD</b>	
1. My supervisors expect me to use the IVA during selling discussions with customers. 2. My use of the IVA is voluntary (as opposed to required by management). 3. My direct supervisor does not require me to use the IVA in selling discussions with customers. 4. Although it might be helpful, using the IVA is certainly not compulsory in my work.		
<b>Image*</b>	<b>SA A N A/D SD</b>	
1. Using the IVA improves my image within the organization. 2. People in my company who use the IVA have more prestige than those who do not. 3. People in my company who use the IVA have a high profile. 4. Having the IVA on an iPad is a status symbol in my company.		
<b>Perceived Usefulness*</b>	<b>SA A N A/D D SD</b>	
1. Using the IVA would improve my job performance. 2. Using the IVA in my job would increase my productivity. 3. Using the IVA would enhance my effectiveness on the job. 4. I would find the IVA useful in my job.		Adapted from (Davis, F. D., Bagozzi, R. P., & Warshaw, 1989)
<b>Behavioral Evaluation**</b>	<b>SA A N A/D D SD</b>	
1. The bonus I receive depends on how well I use the IVA in selling discussions with customers compared to others in my division. 2. The bonus I receive depends on my individual use of the IVA in selling discussions with customers, irrespective of others' use or non-use of the IVA. 3. My use of the IVA in selling discussions with customers will be evaluated relative to others in my group.		Adapted from Bhattacharjee, (1996)
<b>Monitoring**</b>	<b>SA A N A/D D SD</b>	
1. I believe my IVA use is being monitored. 2. Some network software is monitoring my use or non-use of the IVA. 3. I think I am not being monitored. *	.	Adapted from Bhattacharjee, (1996)
<b>Repeated Contract**</b>	<b>SA A N A/D D SD</b>	
1. If I do well using the IVA in selling discussions, I will receive some type of additional bonus. 2. I can possibly get extra bonus using the IVA during selling discussions. 3. My performance in my current position will determine whether I can get additional bonus.		
<b>Intent to Use***</b>	<b>SA A N A/D D SD</b>	

1. I use the Interactive Visual Aid on the iPad a lot during my selling discussions with healthcare providers (HCPs). 2. I use the IVA whenever possible during my selling discussions with healthcare providers (HCPs). 3. I use the IVA frequently during my selling discussions with healthcare providers (HCPs). 4. I use the IVA whenever appropriate during my selling discussions with healthcare providers (HCPs).		Adapted from Agarwal & Prasad, (1997).
Are You Male or Female?		
1. Male 2. Female		
What is your age?		
1. 25 – 34 2. 35 – 44 3. 45 – 54 4. 55 – 64 5. 65 – 74		

*Note:* Each of the items was constructed using a Likert scale with five response categories (grounded by Strongly Agree – Strongly Disagree). A Likert scale is appropriate when the research measures the respondent's attitudes toward the constructs (McDaniels & Gates, 2005).