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ANTICEDENTS OF INTENTION TO ADOPT WEB-BASED COMPUTER AIDED FACILITY MANAGEMENT (CAFM) BY FACILITY MANAGERS

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ANTICEDENTS OF INTENTION TO ADOPT WEB-BASED COMPUTER AIDED FACILITY MANAGEMENT (CAFM) BY FACILITY MANAGERS

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ABSTRACT

ANTICEDENTS OF INTENTION TO ADOPT WEB-BASED COMPUTER AIDED FACILITY MANAGEMENT (CAFM) BY FACILITY MANAGERS

By

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Computer Aided Facility Management (CAFM) is a computerized network system connects graphic and non-graphic information in a central and comprehensive source of facilities information (Hayman & Ulrich, 1995). This system increases accuracy through data validation, but remains flexible in reporting and inquiry. It is believed that CAFM provides facility manages with the ability to analyze the effective use of space more readily than ever.

Despite the development of Internet, the improvements of the system itself, and the potential benefit and productivity gains from using it, studies have revealed that facility professionals are not so willing to adopt CAFM application (FMLink, 2006). Drawing upon Diffusion of Innovation Theory (DOI) (Rogers, 1995), the researcher has developed a model describing the relationships between intention to adopt CAFM application and five characteristics of an innovation led to the intention. The purpose of this dissertation is to examine what factors that influence individuals FM professionals to adopt CAFM application. To serve the purpose of the study accordingly, the original set of characteristics of an innovation has been re-positioned by grouping perceived trialability, perceived result demonstrability, and perceived visibility together and labeling them as opportunities for experiencing CAFM. Eight hypotheses are proposed to examine the relationships. Specifically, the researcher proposes that opportunities for

experiencing CAFM, consisting of perceived trialability, perceived result demonstrability, and perceived visibility, will positively relate to perceived relative advantage and perceived complexity. It is further proposed that perceived relative advantage will further positively relate to the intention to adopt CAFM, while perceived complexity will negatively relate to the intention to adopt CAFM.

The researcher conducted stepwise regression analysis to test the hypotheses. All hypotheses were supported, suggesting that perceived trialability, perceived visibility, and perceived result demonstrability positively relate to intention to adopt CAFM system indirectly through perceived relative advantage and perceived complexity and that perceived advantage and perceived complexity have significant effects on FM professionals' intention to adopt CAFM application. Implications for future research and FM professionals are discussed.

I dedicate this work to my parents, Ming and Ampha Saengratwatchara. They always encouraged me to do well in school even though they never had opportunity to receive a formal education.

I also would like to dedicate this dissertation to my wife Porngarm and my son Korn, who sympathize, hearten, and help me throughout the learning experiences.

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TABLE OF CONTENTS

LIST OF TABLES ix

LIST OF FIGURES x

CHAPTER ONE
INTRODUCTION 1

CHAPTER TWO
REVIEW OF LITERATURE 8
The Field of Facility Management (FM) 8
The Definition of Facility Management 8
The Roles of Facility Managers 11
Computer Aided Facility Management (CAFM) 14
The Definition of CAFM 14
The Components of CAFM 15
The Evolution of CAFM 16
Generations 1 and 2: Technology Evolution 16
Generation 3: CAFM and CIFM 17
Generation 4: the Explosion of the Internet 18
Generation 5 and beyond: High Speed Internet Computers and Networks 19
Research on CAFM 20
CAFM and its implementation 21
CAFM and its benefits 22
Theories of Adoption 24
Diffusion of Innovation Theory (DOI) 25
Research Model and Hypotheses 29
Research Model 29
Research Hypotheses 32
Opportunities for Experiencing CAFM 32
Perceived Relative Advantage and Perceived Complexity Lead to Intention to Adopt CAFM 33

CHAPTER THREE
RESEARCH METHODOLOGY 36
Pretest 36
Participants and Procedure 36
Statistical Test for the Pretest 37
Results of the Pretest 37
Main Study 42

Population and Sample..... 42
Procedure..... 42
Survey Instrument development..... 44
Dependent Variable..... 45
Independent Variables..... 45
Mediators..... 45
Control Variables..... 46
Descriptive Statistic 46
Validity and Reliability of Scale..... 48

CHAPTER FOUR
DATA ANALYSIS AND RESULTS..... 53
Results of Main Study..... 53
Opportunities for Experiencing CAFM..... 58
Perceived Relative Advantage and Perceived Complexity
Lead to Intention to Adopt CAFM..... 59

CHAPTER FIVE
DISCUSSION AND CONCLUSION..... 62
General Discussion..... ...62
Implications for Future Researchers.....64
Implications for Managers..... 65
Limitations..... 66
Conclusion.....67

APPENDICES
Appendix A: Introduction E-mail & Reminder E-mails
Introduction E-mail for Pretest..... 71
Introduction E-mail for Main Study..... 72
Reminder E-mails for Main Study..... 73
Appendix B: Consent Form and Questionnaire
Web-based Questionnaire 76
Appendix C: Summary of the Results
Summary of the Results 84
Appendix D: Human Subject Committee Approval
Human Subject Committee Approval 104

BIBLIOGRAPHY..... 106

TABLE OF TABLES

Table 1	Descriptive Statistics of Pretest	38
Table 2	Correlations of Pretest	39
Table 3	The Regression Analysis Results for the Pretest	41
Table 4	Descriptive Statistic	47
Table 5	Confirmatory Factor Analysis of Items	49
Table 6	Cronbach's Alpha of the Constructs	52
Table 7	Frequencies and Percentages of Variables	55
Table 8	Means and Standard Deviations of Variables	56
Table 9	Correlations of Variables	57
Table 10	Regression Analysis Results for Opportunities for Experiencing CAFM	59
Table 11	Regression Analysis Results for Intention to Adopt CAFM	60

TABLE OF FIGURES

Figure 1	A three-interrelated element model of People, Process, Place (Developed by Facility Management Institute (FMI), a non-profit education and research organization established by Herman Miller Inc. in the late 1970s)	10
Figure 2	A diagram of the facility management definition provided by the International Facility Management Association (IFMA)	11
Figure 3	Diffusion of Innovations Theory (Rogers, 1983; 1995)	27
Figure 4	Diffusion of Innovations Theory (Moore & Benbasat, 1991)	28
Figure 5	Research Model	31

CHAPTER ONE

Introduction

Coping with rapidly accelerating technological change is one of the most important challenges in today's world, and Facility Management is not insulated from such change. Facility Management (FM) is a discipline defined in the 1970s by the Facilities Management Institute (FMI) to encompass the management of people, process and place. It is known primarily by its effects, principally acquisition, design, construction, maintenance, operation and support services for in-house customers and the physical facilities (Gondeck-Becker, 2006). Effective facilities operations is the responsibility of facilities managers, whose daily tasks may include long and short-term facility planning, financial forecasting, real estate acquisition, interior, architectural and engineering planning, maintenance and operations, telecommunications and security (Thatcher, 2001).

With the influx of information has come a proportionate expansion of the role of the facility manager. A facility manager now must be able to manage facility information as well as technology related to FM work as part of their responsibilities (Brennan, 2002). Information about facilities is used to support a number of other business processes such

as maintenance and operations, real estate/property, human resources, capital planning, inventory services and information services.

Computer Aided Facility Management (CAFM) is a computerized network system connects graphic and non-graphic information in a central and comprehensive source of facilities information (Hayman & Ulrich, 1995). The system delivers a new, robust set of computer-based tools that has automated many of these space, maintenance, and asset tracking functions. Some facility managers have embraced this new technology and begun to find significant benefits to implementing a CAFM system.

With the development of Internet and technology readily allows open databases, some facility managers believe CAFM will become the best source for space, personnel, asset, and maintenance information in the organization. In other words, the initial FM users assert the CAFM system has become more needed, easier to use, and more cost effective for managing facilities than it has been thought to be (FMlink, 2006).

Despite improvements in the system itself and the potential benefit and productivity gains from using it, studies suggest that less than 30% of FM professionals managing facilities less than 250,000 sq.ft. are using CAFM and that those who manage facilities larger than 250,000 sq.ft. have been less likely to add CAFM to their responsibilities than those managing facilities less than 250,000 sq.ft. (FMlink, 2006).

Understanding what motivates individual FM professionals to adopt new technology is the focus of this study. In this case, CAFM is the technology being studied to determine why it has or has not been adopted by FM professionals. Specifically, the research questions are: What influences FM professionals to adopt CAFM? Is it merely the characteristics of the CAFM technology itself or are FM professionals also influenced

by other issues, such as their predisposed tendency to try out a new technology? If these factors are indeed important in the intention to adopt CAFM by FM professionals, are they interrelated? If so, how are they interrelated? And what are the mechanisms through which they achieve their effects on the adoption decisions? These questions will be explored by using Diffusion of Innovations theory (DOI), a theory that explains how the characteristics of innovations, as perceived by individuals, can help to explain the intention of adoption (Rogers, 1995).

Rogers (1983; 1995) identified five characteristics of an innovation: perceived relative advantage, perceived compatibility, perceived complexity, perceived trialability, and perceived observability. Moore and Benbasat (1991) argued that observability is too broad a construct for use in many technology adoption contexts. In its place, they proposed two more specific constructs: visibility and result demonstrability. This argument has been empirically supported (e.g., Agarwal & Prasad, 1997; Plouffe, Vandenbosch, & Hulland, 2001). In this study perceived visibility and perceived result demonstrability will replace perceived observability.

DOI is regarded as an important theory to understand the adoption behavior of potential adopters and to predict the adoption of technological innovations. Based on this theoretical framework, researchers typically considered perceived innovation characteristics of potential adopters as independent variables while the intention to adopt as dependent variable. The explanatory power of those characteristics on the innovation adoption was examined empirically (Adams, Nelson, & Todd, 1992; Agarwal & Prasad, 1997; Chau & Tam, 1997; Davis, 1989). Agarwal and Prasad (1997) found that the innovation characteristics of visibility, compatibility, trialability, and voluntariness were

relevant in explaining current usage, while the only relevant innovation characteristics for future use intention were relative advantage and results demonstrability.

Recent innovation studies have argued that some constructs in the diffusion of innovations theory, such as compatibility, trialability and observability, relate to prior technology experience or opportunities for experiencing the technology under consideration (Oh, Ahn, & Kim, 2003; Agarwal, Sambamurthy, & Stair, 2000; Venkatesh & Davis, 2000). Agarwal and his colleagues (2000) found that relevant prior experience, mediated by general self-efficacy, affected perceived ease of use. Venkatesh and Davis (2000) showed that experience moderated the relationship between subjective norm and perceived usefulness in longitudinal research, and this was consistent with the result of Venkatesh and Morris (2000).

Applying the diffusion of innovations theory and its relevant arguments to the adoption of CAFM application, the researcher establishes a theoretical relationship between the FM professionals' intention to adopt CAFM application and factors that are likely to influence their intention to adopt decisions. Specifically, the researcher has re-positioned the original set of characteristics of an innovation developed by Rogers (1995), proposing that opportunities for experiencing CAFM, consisting of perceived trialability, perceived result demonstrability, and perceived visibility, will positively relate to perceived relative advantage and perceived complexity. It is further proposed that perceived relative advantage will further positively relate to the intention to adopt CAFM, while perceived complexity will negatively relate to the intention to adopt CAFM. By re-positioning the characteristics of an innovation, the research model will be appropriate to better serve the purpose of the dissertation. These perceptions will be

assessed using the questionnaire with items adapted from the Perceived Characteristics of Innovating scale (PCI), a well-established measurement instrument developed by Moore and Benbasat (1991).

By selecting a population that is not confined to one organization or one event, the information gathered through the research should be about the FM professional and not specific to a particular organization in which these professionals are embedded. To reach FM professionals who are expected to be involved in various functions of CAFM application in a range of organizations and industries, members of the International Facility Management Association (IFMA) were the target population of the study. Using the members of IFMA as the population to be studied would provide a broad background of experiences against which the perceptions of characteristics of innovation could be assessed.

An online nation-wide survey was conducted, and the respondents were randomly drawn from the IFMA membership directory. A large sample is necessary to ensure an adequate number of FM professional respondents. The researcher expected to receive approximately a 20-25% response rate, which is the average response rate for online survey methods (Hamilton, 2003). The members were contacted by email survey and asked to complete a short questionnaire, which recorded their perceptions of intention to adopt CAFM.

The researcher used regression analysis for the statistical analysis. After gathering the data an assessment was made as to whether the data meet the criteria necessary to perform regression analysis. The proper assessment and any needed transformation had been conducted before regression analysis was performed on the data

related to the eight hypotheses. Since the hypotheses are exploratory, a two-tail test assessed the statistical significance of the results.

This study opens up new theoretical and empirical domains not yet explored in FM field. Much of research has been conducted in the FM field, none of it, to the researcher's knowledge, has studied or analyzed individual FM professionals' perceptions. Different degrees of perceptions of intention to adopt CAFM across individual FM professionals are critically important for a better understanding of factors that potentially motivate FM professionals when making adoption decisions. The expected benefits from the investments in new technology are realized only when they are adopted by their intended users and subsequently used.

The research study is important because it presents unusual approaches in collecting and analyzing the data compared to other research conducted in the FM field. There has been considerable research to date in FM and on CAFM, but most of it has focused on single-site case studies using benchmarking as a method of collecting data and proposing best practice principles of using CAFM. This study empirically examines the research model using quantitative data collection method to analyze the collected data using statistical approach. By initiating a different approach in doing FM research, this study lays the groundwork for more ambitious empirical investigation designed to clarify the intention to adopt CAFM among FM professionals and identify the factors that determine that intention.

The dissertation consists of five chapters. This chapter is the introduction in which project purpose and contribution are described. The second chapter contains the literature review and the research hypotheses. The review includes definitions and a

discussion of the literature related to FM field and CAFM applications as well as the review on the diffusion of innovations theory and its previous findings. Chapter three presents the research design describing the sampling approach, measurement procedures, and the data collection methods. Chapter four reports the results and data analysis. The dissertation concludes with Chapter five containing a discussion of the results and implications for FM professionals and future research.

CHAPTER TWO

Review of Literature

The first of two sections is the literature review discussing concepts and theories that are important in developing the research study. The second section presents the research model and hypotheses as well as the logic underlying the model.

In the literature review section, two areas of literature were reviewed in developing this research study: 1) facility management (FM) and computer aided facility management (CAFM) and; 2) Diffusion of Innovations Theory (DOI) (Rogers, 1983; 1995) and a brief description of other theories of adoption including the Technology Acceptance Model (TAM) (Davis, 1989) and the Theory of Planned Behavior (Ajzen, 1985; 1991).

The Field of Facility Management (FM)

The Definitions of Facility Management

Facility management is a relatively new business and management discipline. Only in the past 25-30 years has facility management become a recognized and required process practiced by organizations that expend resources on people, their work environment, and the ways they work. Facility management (FM) is a multidisciplinary

or trans-disciplinary profession drawing on theories and principles of engineering, architecture, design, accounting, finance, management, and behavioral science (Springer, 2001). This multidisciplinary approach embraced by facility management professionals has long been practiced by large organizations such as research, educational, health care institutions and government, using different names such as operations and maintenance, public works, facilities engineering, and physical plant administration.

The term "facility management" has been used since 1979 with the creation of the Facilities Management Institute (FMI), a non-profit education and research organization established by Herman Miller Inc. in Ann Arbor, Michigan. Facility management encompasses the management of people, process, and place (Rondeau, Brown, & Lapides, 1995). Particularly, it is the integration of an organization's *people* with its *process* (work) into its *place* (facilities) where overlapping area represents facility management. Figure 1 represents a three-interrelated element model of people, process, and place developed by Facility Management Institute.

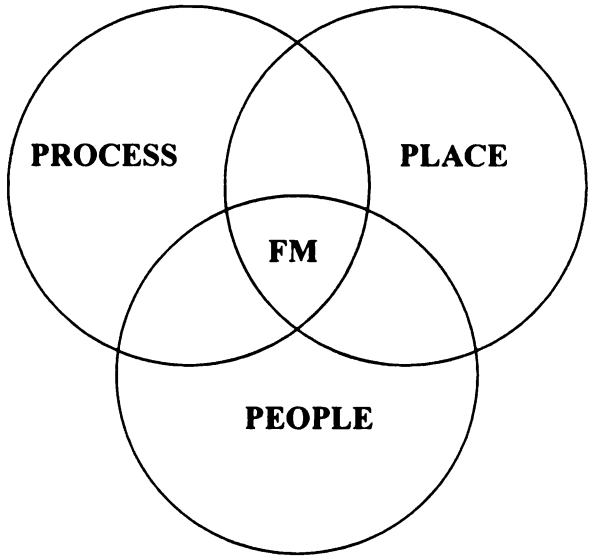

Figure 1. A three-interrelated element model of People, Process, Place (Developed by Facility Management Institute (FMI), a non-profit education and research organization established by Herman Miller Inc. in the late 1970s)

In 1982, the United States Library of Congress defined facility management as: "The practice of coordinating the physical workplace with the people and work of the organization; it integrates the principles of business administration, architecture, and the behavioral and engineering sciences." As FM profession continues to change and evolve, and as the information technology (IT) has became very important in facility professions, the International Facility Management Association (IFMA) then defines Facility Management as a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology (IFMA, retrieved October 29, 2006). The IFMA definition of facility management will be utilized throughout this research study. Figure 2 represents a diagram of the facility management definition provided by the IFMA.

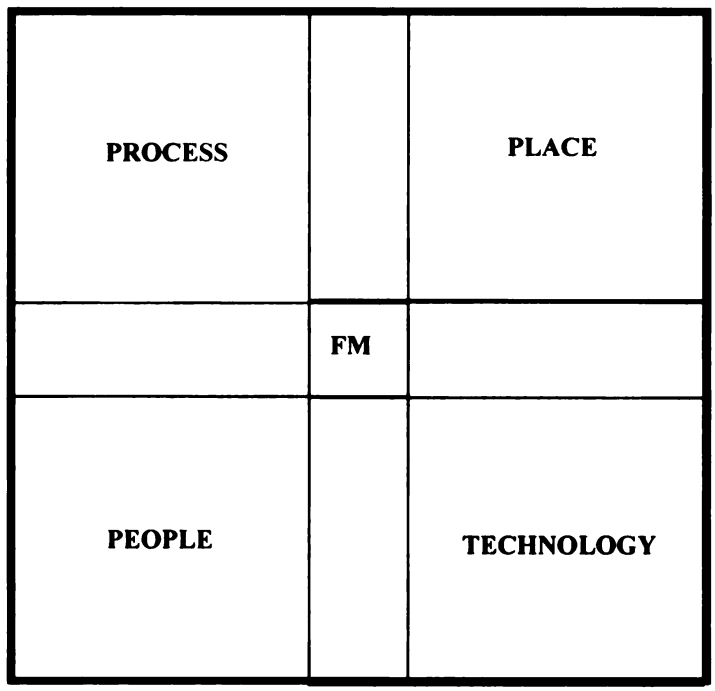

Figure 2. A diagram of the facility management definition provided by the International Facility Management Association (IFMA).

The Roles of Facility Managers

According to the definitions above, the mission of facility managers is to provide quality and cost-effective service to in-house customers in support of the organization business plan (Rondeau et al., 1995). The International Facility Management Association (IFMA) has grouped the facility professions' responsibilities under nine major function areas (Rondeau et al.,1995):

1. Long-range facility planning (Strategic planning).
2. Annual facility planning (tactical planning).
3. Facility financial forecasting and management.
4. Real estate acquisition and/or disposal.

5. Interior space planning, work specifications, and installation and space management.
6. Architectural and engineering planning and design.
7. New construction and/or renovation work.
8. Maintenance and operations maintenance of the physical plant.
9. Telecommunications integration, security, and general administrative services such as food service, records management, reprographics, transportation, mail services, and etc.

A facility manager organizes and oversees budgeting, interviewing and hiring consultants, set design, construction, furnishings, scheduling, space and office furnishing standards, capital purchasing programs, and translates organizational customer facility requirements into a cost-effective, environmentally safe, and aesthetically pleasing workplace. Specifically, their role is to ensure that the customer and the organization have an on-time and on-budget project with the best possible site, space, facilities, furnishings, and support systems to serve their needs today and tomorrow (Rondeau et al., 1995). The facility manager is a person who uses his or her corporate business experience especially "people skills" to manage some or all of the nine job responsibilities listed above and takes additional corporate business responsibilities on occasion.

To survive in today's business world facility management must handle increasingly complex processes as Rondeau et al (1995) mentioned. The facility manager must address diverse technological and economical changes in today's practice.

In addition, Rondeau et al (1995) suggested some of the technological and economical changes and they are:

- Increasing use and reliance on technology including more computers, telecommunications devices, and their support requirements.
- Increasingly complex infrastructure systems such as telecommunication, computer cabling, power, backup power, heating ventilation and air conditioning (HVAC), lighting, human safety , security systems, ergonomic, environmental and sustainability requirements.
- Higher worker expectation for pleasant, comfort, ergonomic, secure, and cost-effective environments with limited time, space, staff, and funds.
- Competitive and economic pressures to reduce expenditures; increase profits; and buy out, merge with, or take over competitor.
- Pressure to mesh personnel and facility requirement with long-range, regional, national, and international business issues, in addition to develop and integrated strategic corporate business and facility plan.
- Requirement to provide quality, integrated, in-house services in a timely, coordinated, and cost-effective manner.

Moreover, Thatcher (2001) states that facility information is extremely important for managing facility, as information has become the key to success in any business. Thus one of the most important tasks for facility managers is to manage facility information properly as well as to think about how to make the information accessible and current when needed.

To ensure that quality FM services will be delivered, in a timely, and cost-effective manner that fits the requirements of corporate culture and politics, including customer and senior management service expectations, computer aided facility management (CAFM) has an opportunity to play a critical role. The detail regarding this software application is discussed subsequently.

Computer Aided Facility Management (CAFM)

The Definition of CAFM

Computer-Aided Facility Management (CAFM) or Computer-Integrated Facility Management (CIFM) refers to a software system that automates several facility management tasks (Keller & Keller, 2004). The International Facility Management Association (IFMA) defines CAFM as a high-tech tool used by facility professionals to track and manage virtually any facility-related asset (Keller & Keller, 2004). This technology is intended to reduce management costs by creating a central and comprehensive resource of facilities information. Both facilities professionals and those seeking facilities-related information can then use this resource. It supports day-to-day facilities operations, from master planning to project design and budgeting; as well as from construction to lease management. Such technology increases accuracy through data validation, but remains flexible in reporting and inquiry. In sum, CAFM provides facility managers with the ability to analyze the effective use of space more readily than ever.

The Components of CAFM

A CAFM system usually includes both a graphic and non-graphic component (Dean, 2004; Gabriel, 2003; Trudeau, 1996; Heyman, Ulrich, 1995; Boes, 1993). At the heart of a CAFM system is a Computer-Aided Design (CAD) package which automates design and drafting tasks. Planning and management software or non-graphic component allows users to combine CAD and other non-graphic data to track information from bulk data in order to perform various facility management-related tasks.

According to Teicholz and Noferi (2002), CAFM system can be described in six primary components as follows:

1. Computer-Aided Design (CAD) for drafting and design tasks
2. Space and Asset Management for space inventory and space planning and analysis, asset inventory, integrated CAD, occupancy information, stacking and blocking, and move management.
3. Capital Planning/Facility Condition Assessment for tracking condition and deficiencies of buildings (e.g., roofs, structural and mechanical systems, etc.) and life cycle costs of renewal.
4. Maintenance and Operations for work order management, preventative maintenance, stock/inventories, and other scheduling works.
5. Real Estate and Property Management for tracking information on property portfolios with tenant and lease administration, transaction management, financial modeling, and work management functions.
6. Support Technologies. This is a miscellaneous grouping for functions that support and integrate the other FM-specific categories. Examples include project

management, document management, web-based applications such as extranets (a private internet over the Internet), reporting tools, IT infrastructure, and office support tools such as email and spreadsheets.

CAFM software applications vary in their complexity and capabilities. Smaller organizations may be satisfied with one or two CAD stations linked to a simple desktop database. Others may wish to link all the graphic and non-graphic information involved in facility management.

A review of the evolution of CAFM and its current context follows in order to understand CAFM more profoundly.

The Evolution of CAFM

Teicholz (1994; 2001) attempted to divide the evolution of CAFM into five distinct phases, covering almost 50 years, from the early 1960s to approximately 2005. However, he made no attempt to go beyond this timeframe, simply because, according to Teicholz, technology changes too rapidly.

Generations 1 and 2: Technology Evolution. Mainframe computers with applications designed for facility managers existed in the early 1960s, before the term facility manager even existed. There were few vendors at this time, but solutions were quite comprehensive and integrated. Moreover, mainframe FM software vendors represented expensive investments for organizations and the integration of graphic and non-graphic databases was complex.

Starting in the mid-1980s, this centralized, integrated model for FM software technology became fragmented with the widespread deployment and acceptance of

personal computers (PCs). PC applications, representing the second generation of FM technology, were initially built around office automation software. However, no standards existed for graphic or non-graphic databases and these "islands of automation" rarely were designed for integration with other applications.

Generation 3: CAFM and CIFM. The third generation of CAFM, starting in the early 1990s, was characterized by robust integration between various FM graphic and non-graphic applications, still using the PC as the primary hardware platform. The earlier computer-aided facility management (CAFM) systems were desktop solutions whereby data was moved over a local area network (LAN) to the desktop PC. The CAFM software then processed the data and returned the results over the LAN to users. This process tended to be slow and restricted their use to mostly inventory management and reporting applications.

The next software improvement came as a result of new database management systems (DBMSs). With the advent of client-server databases from companies such as Oracle and Sybase, enterprise-wide CAFM systems (called computer-integrated facility management or CIFM) significantly reduced the data transmission bottleneck and resulted in increased links to external databases managed by non-FM groups such as information technology, finance, and human resources.

Thus real-time space reports with occupancy information and occupancy cost analyses started to be generated by FM systems. Linking FM data with mainstream corporate databases in the beginning, resulted in making CAFM/CIFM more strategic in nature and elevated the importance of facility managers and their role in managing spatial

and work-related information. For example, organizations started to track costs associated with space, which in turn led to space chargeback to the business units.

Generation 4: the Explosion of the Internet. The Internet represents the largest telecommunications network that currently exists in the world. Any vendor that does not use this network for all aspects of data communication and reporting will find it increasingly difficult to exist. Initially, FM vendors used the Internet to post static information by publishing HTML formatted reports from the client-server applications. Next came some transaction server-based Web queries for functions such as entering or querying the status of a work request or requesting a customized graphic or non-graphic report from the software.

Today CAFM vendors have moved well beyond these simple data collection, querying, and reporting functions. Many of the CAFM vendors seem to be writing their own Java code to get their own "look and feel" to the graphic user interface. And increasingly, entire FM applications have moved onto the Internet. A manifestation of this is collaborative project Web sites which offer functions such as work flow, document management, and redlining. Such software, mostly used for construction project management, is changing how client and design consultants communicate.

The benefits of the Internet are clearly discernible and have been well defined and understood. As process-based tools, such as work flow and technical document management are better incorporated and integrated into CAFM, the benefits increase significantly.

Generation 5 and beyond: High Speed Internet Computers and Networks. This post-PC age refers to the imminent arrival of high speed Internet computers and networks (both through cables and mobile) and the increasing embedding of microchips into assets.

In this generation, communication will be very high speed; it will be wireless as well as on wires, new data formats such as sound and multimedia video will be included, and there will be very high-speed data networks connected to powerful hub computers. The most immediate impact of these networks is expected to be on collaborative project Web sites.

It is not surprising then, that the commercially available computer-aided facility management (CAFM) software companies have eagerly sought to transfer their products to Internet technology. The CAFM software business really began to evolve during the early 1980s with the advent of PCs and the availability of PC-based and database and computer aided design (CAD) systems. A number of companies have evolved to offer integrated solutions to typical facilities information problems. Examples of the application areas included in currently available CAFM system products are:

- Space management
- Asset management
- Maintenance management
- CAD drawing and image management
- Project management
- Project budgeting

The integrated CAFM systems are designed to work with standard database management systems (DMBS) and generally include some method of displaying and

managing associated graphical information that is available from CAD system generated drawings. There are two main areas of functions that must be addressed when the Internet is enabling a CAFM solution. The first is the ability to organize; view, display, and report information included in the backend database or application. The second, and more difficult, is the ability to manipulate, manage, maintain, validate, and update the information contained in that backend database system. The greater value can be obtained by being able to actually collect and manage information on-line.

Technology is difficult to keep up with. It continues to evolve at a rapid pace. Internet technology is considered a required and often a strategic technology (Teicholz, 2001). The facility managers now have a new tool to assist them in solving business problems related to building and property management. Therefore, it is important for facility managers to have a technology plan, which will most likely be built on Internet technology. It will be incumbent on the astute facility managers to continue to study further developments in Internet technology and its uses in FM.

Research on CAFM

Even though the field of facility management and CAFM are fairly new, the prevalent use of CAFM has created a growing body of literature on two major streams: CAFM and its implementation (e.g., Stryker, 1991; Keller & Keller, 2004) and CAFM and its benefits (e.g., Hayman & Ulrich, 1995; Brennan, 2002) However, it is very important to note that, however, the vast majority of research on CAFM has been conducted using single-site case studies involving private corporations as well as public

sector institutions (Gabriel, 2003). Additionally, those research studies usually involve proposing best practice principles of using CAFM and employ benchmarking as a method to collect the data (e.g., Lomas, 1999; McDougall & Hinks, 2000), as opposed to studies in other fields that use a variety of data collection methods and report the results analyzed by different statistical analyses (Gabriel, 2003).

CAFM and its implementation. Teicholz (1995) described an implementation process at Siemens-Pacesetter Inc. in California. The company was already convinced of the benefits of integrated CAFM and was interested in how to implement this technology with a minimum amount of disruption, using existing databases that were in place, and minimizing the disruptive impact of ramp-up and implementation. Teicholz's (1995) paper also included a description of a rigorous cost benefits analysis performed to determine both the quantitative and qualitative impact of CAFM.

Subsequently, Teicholz and Noferi (2002) reported some recent CAFM case studies from universities that have successfully combined CAFM with business processes to arrive at innovative solutions that meet their unique and increasing demands for information. Those universities were, for example, University of Massachusetts at Amherst and Iowa State University. Dean (2004) discussed a list of criteria for the analysis of a CAFM product to establish an appropriate business case analysis. The list featured guidance for CAFM implementation planning, as a good implementation plan is a key to the success of the introduction of a CAFM. Stryker (1991) proposed six steps in implementing CAFM, that begin with defining goals and developing an implementation schedule. Similarly, BOMI Institute presented practical and step-by-step guides for customizing a CAFM system (BOMI Institute, 2002) according to one's specific needs.

These steps were necessary even though not all the issues and problems have been identified and resolved.

In addition to the above studies, Gabriel (2003) reported a case study with the University of Sydney where CAFM was introduced as a way to promote information management on multi-site environments. The study also included a proposal of a more decentralized and web-based CAFM framework as well as the possible application of the proposed framework to a range of CAFM scenarios outside the context of the university environment. Keller & Keller (2004) documented a process of implementing CAFM systems in Dow Jones & Co., and found that the successful solution meant creating balance between corporate business objectives, facility management objectives and technology. A series of articles published in Building Owners and Management International Institute (BOMI) website (BOMI Institute, July – September, 2003) described how to set up and maintain a facility database as a way to successfully implement CAFM systems.

CAFM and its benefits. The other stream of research studies in CAFM focuses on benefits of using CAFM. For example, Hayman and Ulrich (1995) believed that with a CAFM system a company should be able to enhance the value of its properties and increase its profitability through reducing the cost of tenant improvements; lowering architectural costs for space planning; and tracking and controlling operating expenses. Similarly, an article from BOMI Institute (Anonymous, 1999) divided benefits of CAFM into five categories. They are: cost-effective management of inventory, support for individual projects, reporting information to others, budget preparation and justification, and organize benchmarking data. In a more recent article, Watkins (2004) outlined the

business benefits for the implementation of a CAFM system. His list included, for example, leverage customer service levels, centralization and control, asset management and space management, and maintenance scheduling. He concluded that a CAFM system typically represents only one percent of an operating and labor budget but has a disproportionate impact on the 90 percent of the same budget relating to the organization's labor and ongoing operations.

In addition to the articles above, Brennan (2002) reported two major strengths of new web-based CAFM systems. The first was the ability to house facilities data from several sources in one data warehouse, resulting in the best source for space, personnel, asset, and maintenance information in the organization. The other major benefit of web-based CAFM applications is the cost. The current releases of client/server CAFM software are priced according to the traditional "per license" method. This feature has resulted in a new pricing structure wherein the web-based CAFM user can have an unlimited number of people using the system for one set cost. He stated that CAFM systems needed to be able to integrate with other systems in order to exchange data on a real time basis with other departments.

Boes (1993) described how CAFM could be the best cost-cutting tool for a local government. He specifically argued that the system generates cost savings, regardless of its application, by enhancing management decision-making due to the delivery of timely and accurate information. Later on, Boes (1994) expanded his arguments to healthcare service, arguing that one of CAFM's most useful roles is calculating the cost of space that can be charged back to third-party payers. He further claimed that hospitals tended to rely on guesswork and negotiation in calculating and substantiating the reimbursable

portion of their costs. This approach often led to liability for overcharges or to lost revenues resulting from undercharging. Using a CAFM system to capture, document, and display accurate reimbursement numbers would lead to a big improvement over the current chargeback system.

In the following section, the researcher presents reviews of the theory used in the research model, the diffusion of Innovations theory (DOI) (Rogers, 1983; 1995), as well as other important theories in the area of technology adoption. These reviews provide the basis of theorized relationships that are discussed subsequently.

Theories of Adoption

Understanding the behavior of individuals has always been a concern for social psychology researchers. Most studies concerned with the prediction of behavior from attitudinal variables are conducted in the framework of the theory of planned behavior (TPB) (Ajzen 1985; 1991) and, to a lesser extent, its predecessor, the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975). TPB is a general model that has been applied in many diverse domains. The model posits that behavioral intention is a function of, in addition to attitude, subjective norm, referred to the individual's perceptions of general social pressure to perform a given behavior (Ajzen, 1991), and perceived behavioral control, defined as the perception of internal and external resource constraints on performing the behavior (Ajzen, 1991). Along with these theories, the technology acceptance model (TAM) (Davis, 1989) and diffusion of innovations theory (DOI) (Rogers, 1983; 1995) are also widely supported, particularly in discussing the adoption of technology.

Of the various models that information systems researchers have used to explain or predict the motivational factors underlying users' adoption of technology, the technology acceptance model (TAM) of Davis and his colleagues (Davis, 1989; Davis, Bagozzi & Warshaw, 1989) is perhaps the most widely applied (Yi, Jackson, Park & Probst, 2006). Grounded in both TRA and TPB, TAM states that an individual's system usage is determined by behavioral intention, which is, in turn, determined by two particular beliefs, perceived usefulness and perceived ease of use. Perceived usefulness is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context. Perceived ease of use refers to the degree to which the prospective user expects the target system to be effortless (Davis, 1989; Davis et al., 1989). TAM initially included attitude, but this was later dropped due to its weak role as a mediator between the beliefs and behavioral intention.

While TAM has been empirically supported in much previous research (Davis, 1989; Adams et al., 1992; Taylor & Todd, 1995; Agarwal & Prasad, 1999; Lou, Luo, & Strong, 2000), there are alternatives. An alternate theoretical framework for examining technology use comes from Rogers' (1995) diffusion of Innovations Theory (DOI). A brief review of DOI is presented in the following section.

Diffusion of Innovations Theory (DOI)

Originating from sociology, diffusion of innovations theory is concerned with understanding the process by which the use of innovations spread throughout a social system (Rogers, 1995). The theory states that the rate of adoption is partially determined

by the perceived attributes of an innovation, called innovation characteristics. This thinking has been validated in many studies of IT-based innovations (Prescott & Conger, 1995).

Rogers (1983; 1995) identified five characteristics of an innovation: its relative advantage, compatibility, complexity, trialability, and observability (See Figure 3). Perceived relative advantage is the degree to which an innovation is perceived to be superior to its predecessor (Rogers, 1995). This perception has been widely shown to have a positive influence on adoption and use intentions (Prescott & Conger, 1995). Research has found this construct to be one of the best predictors of the adoption of an innovation (Oh et al., 2003; Plouffe, Hulland, & Vandenbosch, 2001; Van Slyke, Lou, & Day, 2002). Perceived complexity, which is the conceptual opposite of perceived ease of use (Moore & Benbasat, 1991), is defined as the degree to which an innovation is viewed as being difficult to use (Rogers, 1995). Empirical research validates the impact of perceived complexity on potential users' intentions to use a variety of IT innovations including groupware (Van Slyky et al., 2002), smart card systems (Plouffe et al., 2001) and information retrieval systems (Venkatesh & Morris, 2000).

Perceived compatibility is the degree to which an innovation fits with a potential adopter's existing values, beliefs and experiences. Perceived compatibility is widely considered to have a positive influence on use intentions (Moore & Benbasat, 1991; Rogers, 1995; Prescott & Conger, 1995). In fact, in some cases, perceived compatibility has been shown to be the best perception-based indicator of use intentions (Van Slyke, Belanger & Comunale, 2004). Finally, perceived trialability is the degree to which an innovation may be experimented with before adoption. Innovations will be adopted and

implemented more often and more quickly if they can be tried prior to making a commitment to purchase.

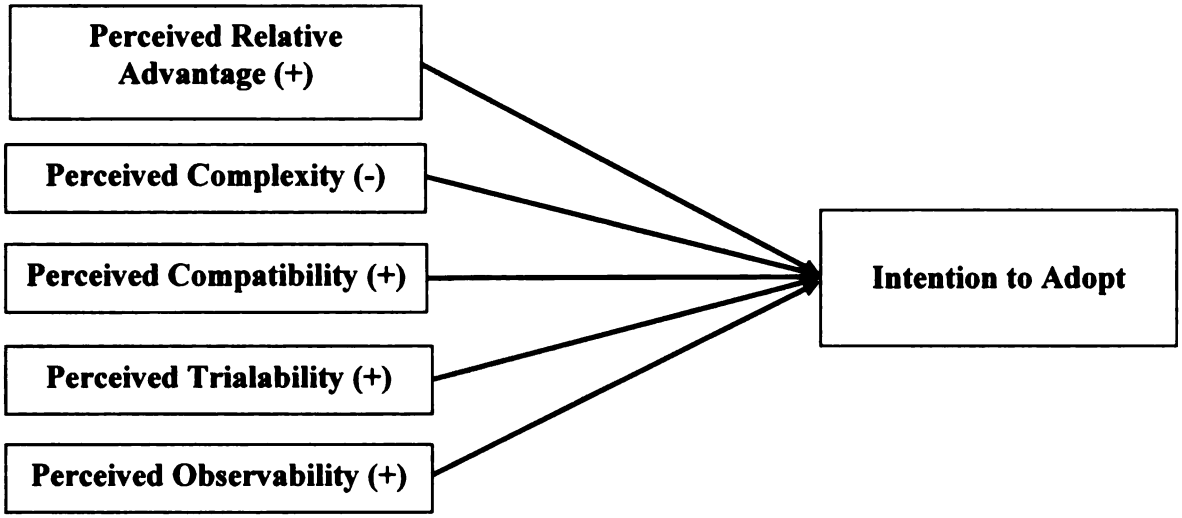

Figure 3. Diffusion of Innovations Theory (Rogers, 1983; 1995)

Rogers' (1995) original conceptualization of the perceived innovation characteristics included perceived observability, which represents perceptions of the degree to which the results of using an innovation are visible (Rogers, 1995). However, perceived observability has received equivocal support in empirical studies. A potential explanation for this is offered by Moore and Benbasat (1991), who propose that observability is better conceptualized as two separate constructs (see Figure 4) – visibility and result demonstrability. Visibility refers to the degree to which the use of an innovation is apparent. In contrast, result demonstrability refers to the degree to which the outcomes of the use of an innovation are apparent (Moore & Benbasat, 1991). This distinction has been supported empirically (Moore & Benbasat, 1991; Agarwal & Prasad, 1997).

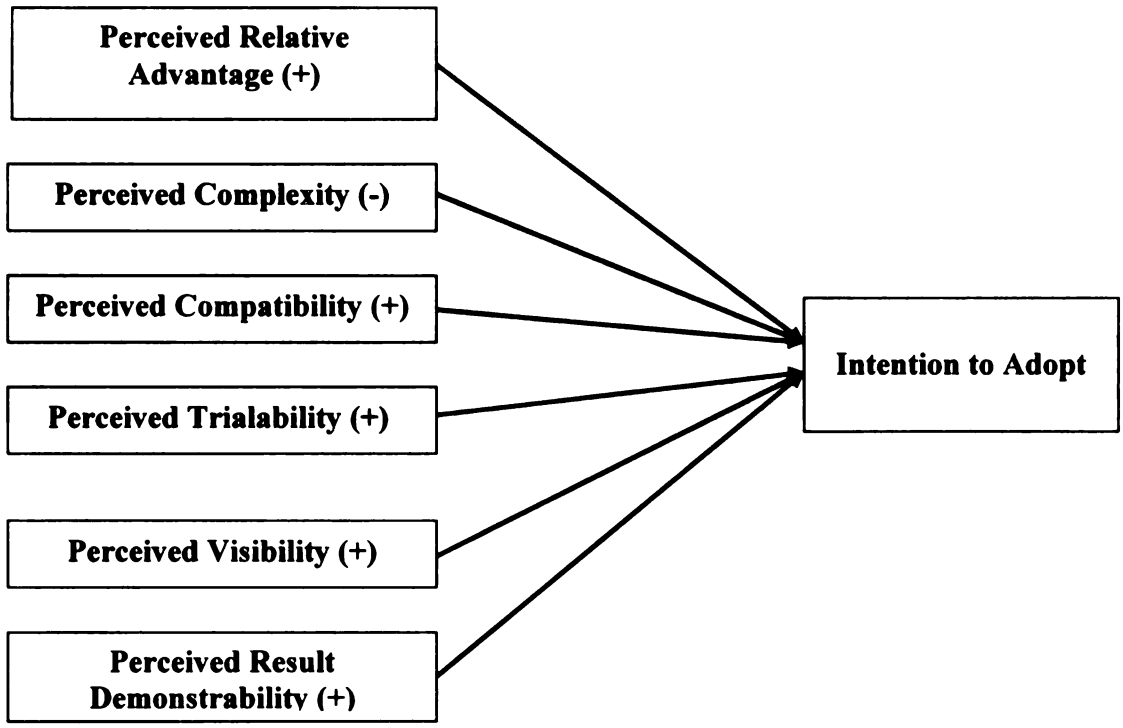

Figure 4. Diffusion of Innovations Theory (Moore & Benbasat, 1991)

Rogers' diffusion of innovations theory has been widely supported for a variety of IT innovations (Van Slyke et al., 2002; Ilie, Van Slyke, Green, & Lou, 2005). It is regarded as an important theory to apply in order to understand the adoption behavior of potential adopters and to predict the adoption of technological innovations. Based on this theoretical framework, researchers typically considered perceived innovation characteristics of potential adopters as independent variables so that the explanatory power of those characteristics on the innovation adoption was examined empirically (Adams et al., 1992; Agarwal & Prasad, 1997; Chau & Tam, 1997; Davis, 1989).

In a study investigating the factors influencing intentions to use a specific groupware application – Lotus Domino discussion databases – Van Slyke, Lou and Day

(2002) found that perceptions of the relative advantage, complexity, compatibility and result demonstrability of Lotus Domino have significant relationships with the adoption intentions. He and colleagues (2006) examined the adoption of online e-payment by business enterprises using diffusion of innovations theory. The findings indicated that only perceived compatibility has significant influence on online e-payment adoption of Chinese companies. Other research into IT innovations offers support for the importance of users' perceptions of the characteristics of an innovation in determining the innovation's subsequent use (Mathieson, 1991; Van Slyke et al., 2002; Yi et al., 2007).

Research Model and Hypotheses

Research Model

The theoretical model for the study is based on the diffusion of innovations theory, as expressed in DOI rather than TAM for the following reasons. Although TAM explains the relationship between perceived usefulness, perceived ease of use and attitude very well, and has been empirically supported in much previous research (Davis, 1989; Adams et al., 1992; Taylor & Todd, 1995; Agarwal & Prasad, 1999; Lou et al., 2000), it has a high degree of generality (Mathieson, 1991). Specifically, TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of use decisions. As a result, it is unlikely to provide richer perspective and detailed information about factors users might consider when deciding to adopt technology in a specific context (Mathieson, 1991).

The model proposed in this study concerns the intention to adopt a specific technology among a specific group of users, thus TAM might not be able to provide the

desired information as needed. Toward this end, DOI appears to provide the underlying structure for the theoretical model of the study as well as a theoretical description of factors that might influence the intention to adopt technology (Ilie et al., 2005).

TAM and DOI share similarities in theoretical constructs. If new technology can be thought of as a specific innovation, both theories share the view that the adoption of a particular technology is determined by its perceived attributes. Furthermore, the constructs employed in TAM are fundamentally a subset of the perceived innovation characteristics; specifically perceived usefulness and perceived ease of use are conceptually similar to relative advantage and complexity of DOI, respectively. Relative advantage and perceived usefulness both encapsulate the degree to which a user feels that the innovative but marginally improved technology (sometimes referred to as gadget technology) is better than the current practice. Complexity is the opposite of perceived ease of use. In this respect, DOI and TAM partially reconfirm each other's findings.

The diffusion of innovations theory provides such constructs as compatibility, trialability, result demonstrability, and visibility. These constructs are related to experiences and/or opportunities for experiencing new technology before adoption. While relative advantage is one of the best predictors of an innovation's rate of adoption, compatibility is of relatively little importance in predicting the same outcome (Rogers, 1995). Moreover, perceived compatibility might be difficult to measure since it involves personal beliefs values. Therefore the researcher proposes that compatibility will be excluded from the model. It is reasonable to think that these experience-related constructs, which are perceived trialability, perceived result demonstrability, and perceived visibility, will have a positive relationship to perceived relative advantage and

perceived complexity, and that perceived relative advantage will have a positive relationship with the intention to adopt CAFM while perceived complexity will have a negative relationship. The research model in Figure 5 demonstrates this perspective.

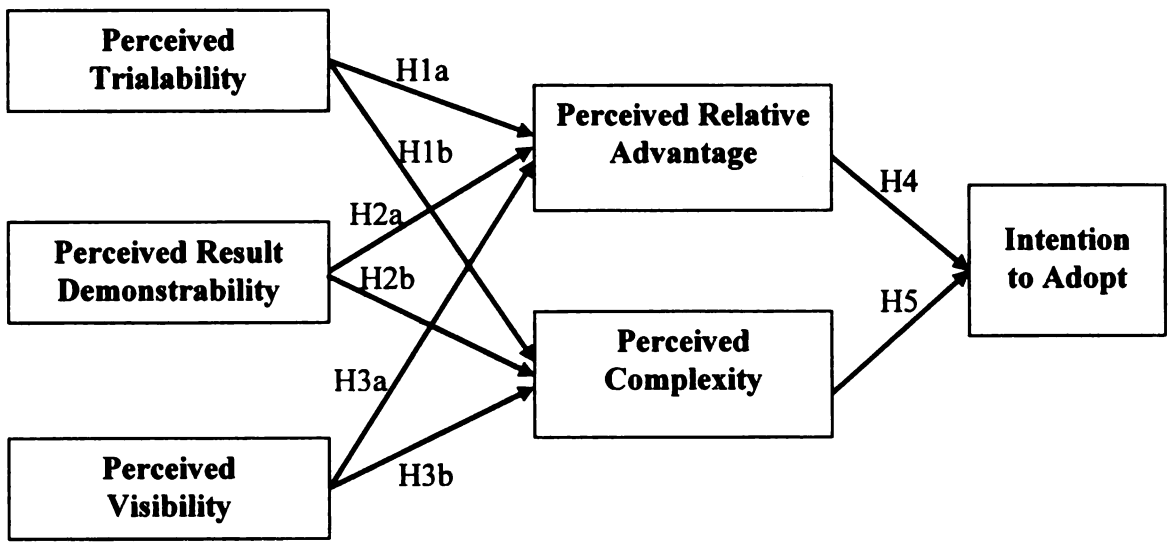

Figure 5. Research Model

Behavioral intention to adopt, defined as a person's subjective probability to perform a specified behavior (Yi et al., 2006), is the dependent variable for theoretical and practical reasons. According to Ajzen and Fishbein (1975), intention has a major influence in mediating the effect of other determinants on behavior. Also, given that the study utilized a survey-based cross sectional design, using intention instead of "actual system usage" avoids the potential problem of retrospective analysis (Fichman, 1992). Finally, even though the target technology in the study, CAFM, is now more commonly recognized among FM managers, it is still considered an emerging technology. Thus, the choice of intention to adopt over actual system usage as a dependent variable is desirable,

allowing a timely investigation of FM managers' adoption intention even though there is a growing number of organizations are adopting and using CAFM.

Research Hypotheses

Opportunities for Experiencing CAFM. Trialabiltiy is the degree to which an individual may experiment with an innovation on a limited and low-risk basis (Rogers, 1995). New ideas that are tried incrementally, on an installment plan or through "pilot tests," are more likely to be adopted because experimentation can reduce anxiety and uncertainty (Bender & Good, 2003). As mentioned earlier, observability consists of both visibility and result demonstrability, with visibility defined as the degree to which the innovation is visible and result demonstrability defined as the degree to which the results of adopting/using the innovation are observable and communicable to others (Moore & Benbasat, 1991). Trialability, result demonstrability, and visibility are related to the opportunities for experiencing CAFM before adoption and use. If FM managers have opportunities to be exposed to CAFM before adoption, then they have a better chance of understanding its usefulness and its implications for their job, especially when tangible results of CAFM are directly apparent, observable, and communicable to others. Furthermore, the extents to which an individual has a chance to be exposed to the system and perceives the results of using an innovation to be demonstrable help, he or she will be able to determine whether the system is easy or difficult to understand and use.

By experiencing CAFM applications or by being exposed to CAFM before its subscription, FM managers can build positive perceptions that may lead to the intention to adopt the applications. Positive exploratory experiences before the adoption of CAFM

also help FM managers to obtain knowledge on how to use it and adopt it with less effort and time. Therefore, the researcher suggests the following hypotheses:

Hypothesis 1a: Perceived trialability will have a positive relationship with perceived relative advantage

Hypothesis 1b: Perceived trialability will have a negative relationship with perceived complexity

Hypothesis 2a: Perceived result demonstrability will have a positive relationship with perceived relative advantage

Hypothesis 2b: Perceived result demonstrability will have a negative relationship with perceived complexity

Hypothesis 3a: Perceived visibility will have a positive relationship with perceived relative advantage

Hypothesis 3b: Perceived visibility will have a negative relationship with perceived complexity

Perceived Relative Advantage and Perceived Complexity Lead to Intention to Adopt CAFM. Relative advantage is the degree to which an innovation is perceived as better than the innovation that it may replace. The greater the recognized advantages of the new innovation, the quicker the innovation will be adopted. Little perceived relative advantage may decrease interest in an innovation and reduce the speed with which it is adopted. That is, if FM managers perceive that CAFM applications can help them

significantly improve their quality of work and the services provided for in-house employees, they would be willing to adopt CAFM more quickly.

Previous research with other innovations has found relative advantage to be the most important characteristic leading to adoption of an innovation among users (e.g., Plouffe et al., 2001; Landstrom, 1995; Charp, 2000). As such, the researcher expects the same result in the context of CAFM adoption among FM managers. This leads to the following hypothesis:

Hypothesis 4: Perceived relative advantage will have a positive relationship with intention to adopt CAFM.

Complexity is the degree of difficulty in using and understanding an innovation. New ideas that are simple to understand are adopted more rapidly than ideas that require an individual to seek new skills and methods of understanding (Rogers, 1995). CAFM applications consist of a high degree and great diversity of technology, affecting the way FM professionals do their work and interact with other employees in organizations. As noted earlier, CAFM applications have moved onto the Internet and may be very complex. Its ability to organize, view, and report and update information contained in the backend database requires FM professionals who currently use or want to use CAFM applications to have some knowledge of the Internet and database management to be able to collect and manage FM related information on-line. FM professionals might be discouraged and less inclined to adopt CAFM applications due to the above complexity. This leads to the final hypothesis.

Hypothesis 5: Perceived complexity will have a negative relationship with intention to adopt CAFM.

CHAPTER THREE

Research Methodology

This chapter details the research methodology that was used to empirically test the research hypotheses stated in the previous chapter. Included in this chapter are descriptions of the pretest as well as the instrument used for the main survey of Facilities Management (FM) professionals who are referred to as participants. Within both the pretest and the posttest description are discussion about sample selection, data collection process, variable operationalization, and scale description and validation. This chapter concludes by discussing the statistical test selected for the survey.

Pretest

Participants and Procedure

A pretest was conducted in order to assess the probable response rates and check face validity and content validity of the questionnaire. In addition, the pretest was to ensure that respondents' expertise with browsers and web-based materials matches or exceeds the sophistication and complexity of the research instrument (Staton & Rogelberg, 2001). Sixty-nine of IFMA members in Canada were randomly selected for

participation in the pretest. These individuals received an e-mail explaining the study and a link to go to the pretest survey attached with the e-mail. The first and second e-mail reminders were sent out to the same group of people one week and two weeks respectively, after the initial e-mail contact.

Statistical Test for the Pretest

The researcher conducted a regression analysis to examine the effect of perception of characteristics of innovation on the intention to adopt CAFM applications. If the statistical regression coefficient for the dependent variable is significant, this indicates that the pretest participants indicated that they would support the adoption of the CAFM applications. In addition, they indicated that they used the perceived characteristics of innovation in deciding whether they will adopt CAFM applications. The results of the pretest are reported in the subsequent chapter.

Results of the Pretest

The purposes of the pretest were to check face validity and content validity of the questionnaire as well as to eliminate potential problems areas in the survey instrument. The researcher used stepwise regression analysis to examine whether FM professionals would be influenced by the perception of characteristics of innovation when making adoption decisions. Cases were excluded listwise.

From the 69 selected participants, there were 25 responses, yielding 19 usable questionnaires, for a response rate of 27.53%. The average age of the 19 respondents in the final pretest data set was 47.4 years, and seventy-four percent were male. Most of

them were department managers who managed 1,000,000 – 2,500,000 sq. ft. facilities. One completed high school, 4 went to some college, 3 had associate's degrees, 7 had bachelor's degrees, and 5 had master's degrees.

The tables 1 and 2 below present descriptive statistics including the means, standard deviations, and correlations of variables used in the pretest.

Table 1.

Descriptive Statistics of Pretest

Variables	*Mean*	*SD*	*α*
1. Trialability	4.79	1.562	.658
2. Result Demonstrability	5.12	1.132	.809
3. Visibility	4.03	1.426	.532
4. Relative Advantage	5.47	1.168	.971
5. Complexity	3.32	1.212	.899
6. Intention to Adopt CAFM	5.28	1.143	.941

Table 2.

Correlations of Pretest

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Trialability	1.000									
2. Result Demonstrability	0.817**	1.000								
3. Visibility	0.659**	0.760**	1.000							
4. Relative Advantage	0.419	0.715**	0.496*	1.000						
5. Complexity	-0.697**	-0.789**	-0.564*	-0.412	1.000					
6. Intention to Adopt CAFM	0.589**	0.841**	0.616**	0.904**	-0.557*	1.000				
7. Age	-0.132	-0.117	-0.083	-0.345	-0.097	-0.292	1.000			
8. Gender	-0.240	-0.126	0.184	-0.136	0.160	-0.225	0.130	1.000		
9. Important Responsibility	-0.247	-0.181	0.124	-0.097	0.131	-0.109	-0.383	0.558*	1.000	
10. Size of Facilities	0.173	0.007	-0.004	-0.176	-0.072	-0.132	0.289	0.170	0.085	1.000

** Significant at the 0.01 level (2-talied)
* Significant at the 0.05 level (2-tailed)
Listwise N=19

Table 3 shows the regression results for the pretest. Looking across this table, result demonstrability appears to have a direct influence on both perceived relative advantage and perceived complexity as the regression coefficients are statistically significant (B = 1.201, Beta = 1.163, $p < .05$ for perceived relative advantage; B = -0.775, Beta = -0.724, $p < .05$ for perceived complexity) while the other two perceptions, trialability and visibility, do not.

As predicted, results indicate significant effects of perceived relative advantage and perceived complexity on the intention to adopt CAFM, with perceived relative advantage being the most significant determinant of FM professionals' intention to adopt the system (B = 0.795, Beta = 0.812, $p < .001$ for perceived relative advantage and B = -0.209, Beta = -0.222, $p < .05$ for perceived complexity). These results indicate that FM professionals' intention to adopt CAFM is influenced by the apparent results of using the system, which further leads to the importance of relative advantage and how complicated it is to operate the system.

Table 3.

Regression Analysis Results for the Pretest

Variables	*Relative Advantage*			
	B	***Beta***	***Standard Error***	***t***
1. Trialability	-0.364	-0.486	0.214	-1.699
2. Result Demonstrability	1.201*	1.163*	0.342	3.512
3. Visibility	-0.054	-0.066	0.208	-0.261
R^2	.595			
F	(3,15) = 7.335			
Valid N (listwise)	19			

Variables	*Complexity*			
	B	***Beta***	***Standard Error***	***t***
1. Trialability	-0.132	-0.170	0.211	-0.626
2. Result Demonstrability	-0.775*	-0.724*	0.337	-2.300
3. Visibility	0.083	0.097	0.205	0.403
R^2	.634			
F	(3,15) = 8.670			
Valid N (listwise)	19			

Variables	*Intention to Adopt CAFM*			
	B	***Beta***	***Standard Error***	***t***
1. Relative Advantage	0.795**	0.812**	0.101	7.860
2. Complexity	-0.209*	-0.222*	0.097	-2.148
R^2	.858			
F	(2,16) = 48.394			
Valid N (listwise)	19			

*Significant at 0.05 level

** Significant at 0.001 level

Main Study

Population and Sample

The population of interest was FM professionals in managerial level positions. The sample was drawn from the directory of members of the International Facility Management Association (IFMA). The population contained approximately 187,500 names along with email and work address information worldwide. Only the members from the US or approximately 15,725 names were used in this study. The unit of analysis was the individual. The selection of this population provided for the gathering of information from a diverse group based on position in FM field. Additionally the population may also feel some connection to the survey because of the IFMA organization and therefore produce a higher response rate (Rea & Parker, 1997).

Procedure

The method of data collection was through web-based survey. Despite some limitations of web-based surveys, they are considered a viable alternative to traditional surveys (Dillman, 2000; Schonlau, Fricker, & Elloitt, 2002). Web-based surveys are generally less expensive, faster, more convenient and provide higher data quality than do mail surveys (Schonlau et al., 2002: Smith, 1997). A survey approach also gives respondents an opportunity to think before completing the questions thus potentially enhancing the reliability of data.

In attempting to reach a large sample, the web-based questionnaire is the most economical approach (Sapsford, 1999). Noncompliance is expected to be higher with this method, but the researcher is attempting to overcome that by choosing a sample that may connect to the study because of the institute affiliation. Rea and Parker (1997) suggest that selecting a "specialized" sample may result in a higher response rate.

The sampling and data collection techniques utilized were designed to guard against the standard problems associated with web-based surveys. Web-based surveys have been criticized for lack of control over the number of times the same individual can take the survey (e.g., Schonlau et al., 2002). In this study, the researcher used a survey application service provider (surveymonkey) that would screen respondents' IP address range and thus restricted them from responding to the survey multiple times. Another criticism of web-based surveys has been the fact that users can skip questions. To ensure high data quality, respondents would be required by the software to answer all survey questions except the open-ended ones.

There are 15,725 IFMA members in the United States. By randomly selected every 7th members from the list, the researcher was able to send an e-mail invitation along with a cover letter indicating the nature and purpose of the study (See appendix) to 2,246 IFMA members in the United States. The message accompanying each email survey assured respondents that their answers would be kept confidential and provided a link to the online survey.

One week after the initial contact, a follow up e-mail was sent to the same group of contacted people. Another e-mail was sent one week later as an attempt to achieve a 20-25 % response rate or approximately 360-400 completed surveys. The responses from

the survey were coded into a data file for statistical analyses. Invalid and incomplete responses were removed. In addition, the demographic data from the participants including e-commerce experience would be used to determine whether the sample was representative of the target population.

Survey Instrument development

All items used in a survey questionnaire were from the measurement scale developed and extensively tested by Moore and Benbasat (1991) and modified by Plouffe et al (2001). The scale has long been used in previous research (e.g., Bender & Good, 2003; Oh et al., 2003; He et al., 2006) and shows high reliability and validity (Oh et al., 2003). As the instrument of Moore and Benbasat (1991) was not designed for the CAFM adoption, their instrument was modified by this researcher to be more closely applied to the purpose of this study.

Respondents indicated their opinions by rating the items through the use of a Likert scale. A seven-point scale with anchors ranging from "1 = Strongly disagree" to "7 = Strongly agree" was used to answer the scale items with higher numbers indicating high perception of trialability, result demonstrability, visibility, relative advantage, complexity and a high intention to adopt CAFM.

In addition to the study variables, the survey included questions about whether the respondents currently use CAFM applications and plan to use the applications in the future. Also, the respondents were asked to provide reason(s) why they do or do not use CAFM and why they do or do not plan to use CAFM. Finally, the survey includes

demographic questions about age, gender, educational background, size of the respondents' facilities managed, and respondents' top responsibilities.

Dependent Variable

The dependent variable in this study is intention to adopt Computer Aided Facility Management (CAFM). Intention to adopt CAFM is defined as a person's subjective probability to perform a specified behavior (Yi et al., 2006). Intention to adopt CAFM will be measured by the respondent's level of agreement or disagreement with six items.

Independent Variables

There are three independent variables in this study. They are perceived trialability, defined as the degree to which an innovation may be experimented with before adoption (Rogers, 1995), perceived result demonstrability, defined as the degree to which the outcomes of the use of an innovation are apparent (Moore & Benbasat, 1991), and perceived visibility, the degree to which the benefit of an innovation is apparent (Moore & Benbasat, 1991).

Perceived trialability, perceived result demonstrability, and perceived visibility were measured by the respondent's level of agreement or disagreement with four items for each construct.

Mediators

The mediators in this study are perceived relative advantage and perceived complexity. Perceived relative advantage is the degree to which an innovation is perceived to be superior to its predecessor (Rogers, 1995). Perceived complexity is

defined as the degree to which an innovation is viewed as being difficult to use (Rogers, 1995).

Perceived relative advantage and perceived complexity were measured by the respondent's level of agreement or disagreement with six and five items, respectively.

Control Variables

A number of control variables were included to try to control for items which were believed to impact the dependent variables but were not the subjects of interest (Neter, Kutner, Nachtsheim, & Wasserman, 1996). The researcher controlled for respondent's age, educational level (14 = some college; 16 = bachelors degree; 18 = master's degree; 22 = doctoral degree; codes reflect approximate years of education), gender (male or female), size of managed facilities (measured in square feet), and priority responsibilities (e.g., budget management, contract administration, and construction management).

Descriptive Statistic

Table 4 presents descriptive statistic and item-total correlation of the 29 items. Some items with low item-total correlation were excluded. These items were TR3, RD4, and CO1. However, even though RD3 has relatively low item-total correlation, its content is reasonable to measure result demonstrability. Thus, this item is retained for statistical analysis.

Table 4.

Descriptive Statistic

Item Statement	*Descriptive Statistic*		
	Mean	*Standard Deviation*	*Item-Total Correlation*
Trialability (TR)			
1. I have had a great deal of opportunity to try the web-based CAFM software application.	4.00	2.13	0.63
2. I know where I can go to satisfactorily try out various uses of CAFM software.	4.28	2.09	0.66
*3. Before deciding whether to use web-based CAFM software application, I would be able to properly try it out.	5.57	1.58	**0.36**
4. I was permitted to use web-based CAFM on a trial basis long enough to see what it can do.	3.75	2.01	0.65
Result Demonstrability (RD)			
1. I would have no difficulty telling others about my experience using web-based CAFM.	5.28	1.69	0.41
2. I believe I could communicate to others the consequences of using the web-based CAFM.	5.20	1.68	0.41
3. The results of using web-based CAFM are apparent to me.	5.19	4.13	0.29
*4. I would have difficulty explaining why using web-based CAFM may or may not be beneficial.	3.17	1.79	**-0.15**
Visibility (V)			
1. I have seen what others do using web-based CAFM.	4.24	1.99	0.75
2. I have seen many people using web-based CAFM.	3.61	1.88	0.85
3. I have not seen many others using web-based CAFM.	3.64	1.96	0.59
4. I have seen web-based CAFM in use outside my organization.	4.26	2.09	0.67
Relative Advantage (RA)			
1. Using web-based CAFM would enable me to accomplish tasks more quickly	5.18	1.41	0.86
2. Using web-based CAFM would improve the quality of my work.	5.21	1.39	0.92
3. Using web-based CAFM would make it easier for me and may staff to do our jobs.	5.41	1.34	0.90
4. Using web-based CAFM would enable me to work more effectively	5.42	1.35	0.94

(Table continues)

Table 4.

Descriptive Statistic *(continued)*

Item Statement	***Descriptive Statistic***		
	Mean	***Standard Deviation***	***Item-Total Correlation***
Relative Advantage (RA) *(cont')*			
5. Using web-based CAFM would give me greater control over my work.	5.16	1.36	0.88
6. Using web-based CAFM would improve my job performance	5.04	1.38	0.84
Complexity (CO)			
*1. Using web-based CAFM is often frustrating.	4.02	1.29	**0.17**
2. I would find it easy to get web-based CAFM to do what I want it to do.	3.59	1.26	0.60
3. I would find web-based CAFM easy to use.	3.27	1.24	0.81
4. Learning to use web-based CAFM would be easy for me.	2.95	1.31	0.76
5. Overall, I believe that using web-based CAFM is easy for me.	3.00	1.31	0.80
Intention to Adopt CAFM (IA)			
1. I intend to use web-based CAFM when they are available	5.21	1.46	0.86
2. To the extent possible, I would use web-based CAFM to do various facility management tasks.	5.53	1.39	0.90
3. To the extent possible, I would use web-based CAFM frequently.	5.47	1.40	0.90
4. It would be much better for me to use web-based CAFM for facility management activities in addition to traditional methods.	5.31	1.41	0.76
5. Overall, I like using web-based CAFM for facility management.	5.07	1.33	0.75
6. I intent to use web-based CAFM in my job in the future.	5.32	1.48	0.83

Validity and Reliability of Scale

Although the instrument developed by Moore and Benbasat (1991) has established good validity and reliability, the validity and reliability needed to be

established with the instrument used in this study as the researcher has revised it and to contribute further psychometric data for the instrument. The researcher conducted a confirmatory factor analysis (CFA) by allowing the components to be correlated and examining whether the items are significantly correlated with the component's dimension in which those items are supposed to measure. Confirmatory factor analysis is appropriate for analyzing the structure of data items based on preconceived theory because it identifies separate dimensions based on the degree to which the model fits to the data by investigating goodness-of-fit statistics (Hair, Anderson, Tatham, & Black, 1995).

Table 5.

Confirmatory Factor Analysis of Items

Item Statement	*Factor Loading*					
	F1	*F2*	*F3*	*F4*	*F5*	*F6*
Trialability (TR)—F1						
1. I have had a great deal of opportunity to try the web-based CAFM software application.	**0.79**					
2. I know where I can go to satisfactorily try out various uses of CAFM software.	**0.78**					
4. I was permitted to use web-based CAFM on a trial basis long enough to see what it can do.	**0.71**					
Result Demonstrability (RD)—F2						
1. I would have no difficulty telling others about my experience using web-based CAFM.		**0.85**				
2. I believe I could communicate to others the consequences of using the web-based CAFM.		**0.89**				
3. The results of using web-based CAFM are apparent to me.		**0.36**				

(Table continues)

Table 5.

Confirmatory Factor Analysis of Items *(continued)*

Item Statement	*Factor Loading*					
	F1	*F2*	*F3*	*F4*	*F5*	*F6*
Visibility (V)—F3						
1. I have seen what others do using web-based CAFM.			**0.81**			
2. I have seen many people using web-based CAFM.			**0.93**			
3. I have not seen many others using web-based CAFM.			**0.68**			
4. I have seen web-based CAFM in use outside my organization.			**0.74**			
Relative Advantage (RA)—F4						
1. Using web-based CAFM would enable me to accomplish tasks more quickly				**0.88**		
2. Using web-based CAFM would improve the quality of my work.				**0.93**		
3. Using web-based CAFM would make it easier for me and may staff to do our jobs.				**0.93**		
4. Using web-based CAFM would enable me to work more effectively				**0.97**		
5. Using web-based CAFM would give me greater control over my work.				**0.89**		
6. Using web-based CAFM would improve my job performance				**0.85**		
Complexity (CO)—F5						
2. I would find it easy to get web-based CAFM to do what I want it to do.					**0.69**	
3. I would find web-based CAFM easy to use.					**0.94**	
4. Learning to use web-based CAFM would be easy for me.					**0.82**	
5. Overall, I believe that using web-based CAFM is easy for me.					**0.43**	
Intention to Adopt CAFM (IA)—F6						
1. I intend to use web-based CAFM when they are available						**0.88**
2. To the extent possible, I would use web-based CAFM to do various facility management tasks.						**0.97**

(Table continues)

Table 5.

Confirmatory Factor Analysis of Items *(continued)*

Item Statement	*Factor Loading*					
	F1	*F2*	*F3*	*F4*	*F5*	*F6*
Intention to Adopt CAFM (IA)—F6 *(cont')*						
3. To the extent possible, I would use web-based CAFM frequently.						**0.96**
4. It would be much better for me to use web-based CAFM for facility management activities in addition to traditional methods.						**0.78**
5. Overall, I like using web-based CAFM for facility management.						**0.72**
6. I intent to use web-based CAFM in my job in the future.						**0.83**

F=Factor

The final scale (Table 5) consists of twenty-six items loading on six factors with factor loading ranging from .36 to .97. The coefficient alpha was .871 indicating strong reliability for the scale. For each respondent, the corresponding scale items were averaged resulting in a single measure to be used in the regression analysis testing the hypotheses. Larger numbers on the scale, except for the complexity, reflect higher intention to adopt CAFM applications.

Individual Cronbach's Alpha for each construct is presented in the Table 6 below:

Table 6.

Cronbach's Alpha of the Constructs

Constructs	*α*
1. Trialability	.807
2. Result Demonstrability	.529
3. Visibility	.862
4. Relative Advantage	.966
5. Complexity	.901
6. Intention to Adopt CAFM	.945

CHAPTER FOUR

Data Analysis and Results

In this chapter, the researcher describes the data analysis procedures and presents the results of the hypotheses tests. The chapter begins with the results from the pretest, followed by the results from the main survey. The hypotheses that FM professionals' perception of characteristics of innovation would relate to the intention to adopt CAFM application were tested using data collected from the main survey described in the previous chapter.

Results of the Main Study

Stepwise regression analyses were performed in order to determine the significance and strength of each proposed effect. First, stepwise regression was conducted for perceived trialability, perceived visibility, and perceived result demonstrability against perceived relative advantage. Secondly, perceived trialability, perceived visibility, and perceived result demonstrability were regressed against perceived complexity. Thirdly, perceived relative advantage and perceived complexity were regressed against intention to adopt CAFM. Cases were excluded listwise. All three stepwise regression equations are shown below.

$$PRA = B_0 + B_1 PT + B_2 PD + B_3 PV$$

PRA = Perceived relative advantage
B_0 = Constant
B_{1-3} = Unstandardized Coefficients
PT = Perceived trialability
PD = Perceived result demonstrability
PV = Perceived visibility

$$PC = B_0 + B_1 PT + B_2 PD + B_3 PV$$

PC = Perceived Complexity
B_0 = Constant
B_{1-3} = Unstandardized Coefficients
PT = Perceived trialability
PD = Perceived result demonstrability
PV = Perceived visibility

$$IA = B_0 + B_1 PRA + B_2 PC + B_3 Size + B_4 ImptRes + B_5 Age$$

IA = Intention to adopt
B_0 = Constant
B_{1-5} = Unstandardized Coefficients
PRA = Perceived relative advantage
PC = Perceived Complexity
Size = Size of facility managed
ImptRes = Important responsibility
Age = Age

Table 7 is a descriptive summary of the respondents including frequencies and percentages of the non-metric variables used in the regression analysis. Two thousand two hundreds and forty-six e-mails invitation were sent out with attached link to the questionnaire. Four hundred and eighty-two e-mails were rejected by server, leaving a total number of contacted e-mails of 1,764. Of 1,764 valid e-mails, a total of 514 questionnaires were returned, yielding a response rate of approximately 29.14%. One hundred and ninety-one questionnaires were discarded from the analyses because of missing values or incomplete surveys, leaving a total of 323 questionnaires (18.31% effective response rate) to be used in this study.

Characteristics of the respondents indicate that 70.8 percent were male and 29.2 percent were females. The average age of the 323 respondents in the final data set was 43.7 years. Approximately twenty-eight percent of them were department managers who managed facilities larger than 2,500,000 sq. ft. Six completed high school, 49 went to some college, 34 had associate's degrees, 137 had bachelor's degrees, 83 had master's degrees, 6 had doctoral degrees, and 8 had professional degrees. Moreover, the results of demographic in this study are relatively close to the 2003 research profile done by IFMA (IFMA, 2003).

Table 7.

Frequencies and Percentages of Variables

Variables	*Class*	*Frequency*	*Percentage*
Age	40-49	122	37.9
	50-59	112	34.8
Gender	Male	228	70.8
	Female	94	29.2
Education	High School	6	1.9
	Some College	49	15.2
	Associate Degree	34	10.6
	Bachelor Degree	136	42.2
	Master Degree	83	25.8
	Doctoral Degree	6	1.9
	Professional Degree	8	2.5
Important Responsibility	Maintenance and Operation Management	147	45.7
	Strategic Planning	55	17.1
	Space Planning	36	11.2
Size of Facilities	Greater than 2,500,000 sq. ft.	64	19.9
	1,000,000 – 2,500,000 sq. ft.	58	18.0
	100,000 – 250,000 sq. ft.	47	16.4

Further descriptive information including means and standard deviations and correlation matrix for the variables are given in the Table 8 and 9. Listwise deletion of

cases was used in the correlations and caused the differing n sizes and correlation significance levels among the variables.

Table 8.

Means and Standard Deviations of Variables

Variables	*Mean*	*SD*	*α*
1. Trialability	4.55	1.479	.681
2. Result Demonstrability	5.24	1.984	.530
3. Visibility	3.95	1.661	.860
4. Relative Advantage	5.25	1.275	.966
5. Complexity	4.83	1.250	.706
6. Intention to Adopt CAFM	5.33	1.259	.945

Table 9.

Correlations of Variables

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Trialability	1.000									
2. Result Demonstrability	0.475**	1.000								
3. Visibility	0.598**	0.319**	1.000							
4. Relative Advantage	0.381**	0.371**	0.406**	1.000						
5. Complexity	-0.465**	-0.402**	-0.402**	-0.560**	1.000					
6. Intention to Adopt CAFM	0.430**	0.406**	0.448**	0.770**	-0.653**	1.000				
7. Age	-0.088	-0.011	0.000	-0.100	0.161**	-0.139	1.000			
8. Gender	-0.030	0.026	0.029	-0.007	0.065	-0.044*	0.165**	1.000		
9. Important Responsibility	0.185**	0.111*	0.107	0.151**	-0.183**	0.169**	0.046	0.016	1.000	
10. Size of Facilities	0.153**	0.076	0.164**	0.066	-0.085	0.152**	0.022	0.200**	0.019	1.000

** Significant at the 0.01 level (2-talied)
* Significant at the 0.05 level (2-tailed)
Listwise N = 321

Opportunities for Experiencing CAFM

Hypotheses 1, 2, and 3 stated that perceived trialability, perceived visibility, and perceived result demonstrability would positively relate to perceived relative advantage and perceived complexity. Table 10 displays results of the stepwise regression analyses.

The results were in the predicted directions. All three perceptions showed significant effects on both perceived relative advantage and perceived complexity. Specifically, perceived result demonstrability was highly significant (B = 0.147, Beta = 0.228, $p < .001$ for perceived relative advantage; B = -0.128, Beta = -0.225, $p < .001$ for perceived complexity). Perceived visibility was also highly significant (B = 0.201, Beta = 0.264, $p < 001$ for relative advantage; B = -0.126, Beta = -0.186, $p < .001$). Finally, perceived trialability has no significant effect on perceived relative advantage (B = .081, Beta = .113, $p > .05$) and had a significant effect on a perceived complexity (B = -.158, Beta = -.247, $p < .001$). These results indicated that all three perceptions or opportunities for experiencing CAFM were important predictors in determining whether CAFM system would provide job-related benefits for FM managers and whether it was too complicated for them to adopt or not. Thus Hypotheses 1, 2, and 3 were supported.

The regression equations are presented below:

$$\mathbf{PRA = B_0 + B_1\,PT + B_2\,PD + B_3\,PV}$$

$$PRA\text{^} = 3.214 + .105\ PT^{*} + .147\ PD^{***} + .199\ PV^{***}$$

$$\mathbf{PC = B_0 + B_1\,PT + B_2\,PD + B_3\,PV}$$

$$PC\text{^} = 2.746 + .192\ PT^{***} + .127\ PD^{***} + .137\ PV^{**}$$

Table 10.

Regression Analysis Results for Opportunities for Experiencing CAFM

Variables	*Relative Advantage*			
	B	***Beta***	***Standard Error***	***t***
1. Trialability	0.081	0.113	0.047	1.708
2. Visibility	0.201**	0.264**	0.047	4.318
3. Result Demonstrability	0.147**	0.228**	0.036	4.119
R2	.234			
F	(5, 317) = 32.901			
Valid N (listwise)	327			
Variables	*Complexity*			
	B	***Beta***	***Standard Error***	***t***
1. Trialability	-0.158***	-0.247***	0.041	-3.869
2. Visibility	-0.126***	-0.186***	0.040	-3.141
3. Result Demonstrability	-0.128***	-0.225***	0.031	-4.189
R2	.282			
F	(5, 317) = 42.239			
Valid N (listwise)	326			

*Approached significant at 0.10 level
** Significant at 0.05 level
***Significant at 0.01 level

Perceived Relative Advantage and Perceived Complexity Lead to Intention to Adopt CAFM

According to Hypotheses 4 and 5, the researcher predicted that perceived relative advantage and perceived complexity were significantly important factors for FM professionals' intention to adopt CAFM. In other words, respondents with high perceived relative advantage and low perceived complexity toward CAFM should show stronger intention to adopt CAFM. Similar expectation has been found in the DOI literature (Agarwal &Prasad, 1997; Moore & Benbasat, 1991).

In addition to the variables used in the regression equation described earlier, the researcher added age, important responsibility, and size of facilities managed as control variables to test these two hypotheses. Table 11 contains regression results related to Hypotheses 4 and 5.

$$\mathbf{IA = B_0 + B_1\,PRA + B_2\,PC + B_3\,Size + B_4\,ImptRes + B_5\,Age}$$

$$IA\hat{} = .692 + .619\ PRA^{***} + .267\ PC^{***} + .057\ Size^{**} + .014\ ImptRes - .052\ Age$$

Table 11.

Regression Analysis Results for Intention to Adopt CAFM

Variables	*Intention to Adopt CAFM*			
	B	***Beta***	***Standard Error***	***t***
1. Relative Advantage	0.578***	0.585***	0.038	15.027
2. Complexity	-0.343***	-0.307***	0.044	-7.764
3. Size	0.052**	0.087**	0.019	2.692
4. ImptRes	0.012	0.024	0.017	0.728
5. Age	-0.044	-0.034	0.042	-1.043
R2	.673			
F	(5, 317) = 129.939			
Valid N (listwise)	321			

*Significant at 0.10 level
** Significant at 0.05 level
***Significant at 0.01 level

As hypothesized and consistent with previous research (Agarwal &Prasad, 1997; Moore & Benbasat, 1991; Roger, 1995), the results indicated that both perceived relative advantage and perceived complexity of the system had significant effect on FM professionals' intention to adopt CAFM (B = 0.578, Beta = 0.585, $p < .001$ for perceived

relative advantage; B = -0.343, Beta = -0.307, $p < .001$ for perceived complexity). Hypotheses 4 and 5 were supported.

Additionally, it is interesting to learn from these results that size of facilities managed by a FM manager showed a significant influence on FM professionals' intention to adopt CAFM (B = 0.052, Beta = 0.087, $p < .05$). Specifically, the larger the facility, the more likely FM professionals adopt the system. However, age and important responsibility of a FM manager were not significant.

CHAPTER FIVE

Discussion and Conclusion

In the final chapter, the researcher discusses the results of the study that aims to explain factors affecting individual FM professionals' intention to adopt CAFM applications. The implications of the findings for both future researchers and FM managers are also presented. The chapter concludes with limitations of the study.

General Discussion

This research analyzed a modified diffusion of innovations theory (DOI) model with a sample of 323 IFMA members. All hypotheses were supported. The re-positioned model was proven to be relevant and applicable to the intention to adopt CAFM application.

The findings show that perceived trialability, perceived visibility, and perceived result demonstrability positively relate to intention to adopt CAFM system indirectly through perceived relative advantage and perceived complexity. This suggests that when an innovation generates job relevant results that are readily discernable and visible and when people are given opportunities to try an innovation, perceptions of relative advantage are enhanced and the potential disadvantages of the complexity are considerably reduced. Specifically, perceived trialability appears to have stronger

influence on perceived complexity than it does on perceived relative advantage. Being able to try CAFM application before actual adoption appears to be helpful so potential users to learn whether the application is easy or difficult to operate. However, having a chance to try out the system might not be so important for them to realize its advantages, for they can learn from other sources such as seeing other people using it or discussing with others how they use it and its advantages and disadvantages.

Consistent with other studies (Plouffe et al., 2001; Landstrom, 1995; Charp, 2000; Oh et al., 2003), perceived relative advantage and perceived complexity were found to have significant effects on FM professionals' intention to adopt CAFM application. If FM professionals discover that CAFM application is easy to use and provides job-related advantages, they are more willing to adopt CAFM application quickly.

Taking the results together, opportunities should be provided for allowing potential users to understand CAFM system so that they would discover its work-related advantages as well as be able to understand whether the system is easy or difficult to use. While experiencing CAFM application, potential users then can make themselves open to and ready for adoption of CAFM when they have new software under consideration.

Overall, the findings from this study significantly support the hypotheses that opportunities for experiencing CAFM application affect perceived relative advantage and perceived complexity, and that these two latter perceptions further affect intention to adopt CAFM application by making potential users feel comfortable and ready to adopt it.

Implications for Future Researchers

One major implication for FM researchers is the initial attempt to study individual FM professionals' perceptions using quantitative method and statistical analysis approach. The researcher suggests that using different approaches, such as an online survey as it was initiated in this study, to do FM research should be continued in order to establish more ambitious empirical research in FM field.

The findings of this study make contributions to DOI theory. By re-arranging the existing variables of the theory, the researcher felt that it would provide a more appropriate and meaningful model for the purposes of the study as well as to FM environment. Moreover, the re-arranged model empirically supported the idea that opportunities for experiencing CAFM affect the information of positive perceptions towards CAFM applications by making FM professionals feel comfortable and ready to adopt it. Since this study was conducted to examine a particular technology involving a specific user group, more research is needed to further explore whether or not the model proposed in this study would be valid with different technologies and user groups. More studies are also needed to collect data from multiple FM associations to reach higher generalizability.

It is important to note that despite this study's finding of significance, its predictive power of perceived complexity is likely to be decreasing as this research stream continues. Assuming that CAFM applications are likely to be more widely used, their design and user interfaces would be created to improve and simplify user's interaction. As a result, many users expect the systems to be easy to use and simple in design and function. If this assumption proves to be the case in the future, perceived

complexity then is a less effective predictor of users' intention to adopt new technology. Thus DOI theory might need to be adapted and/or re-examined accordingly.

The preliminary finding of the relationship FM professional's perceptions of the characteristics of an innovation and their intentions to adopt CAFM create many possibilities for future researchers. Future research should also continue to examine the external factors that impact a FM professional's decision process to adopt CAFM applications. For example, the findings from this study suggest that cost of implementation process and size of facilities managed by a FM professional have influence on their intention to adopt CAFM applications. A more complete model can be developed by incorporating those factors as moderators to explore whether cost of implementation and size of facilities would enhance or lessen the relationship.

Another possible stream for possible future research is to study the impact of changes in perception and intention to adopt CAFM over a long period of time. This can be accomplished by initially assessing intention to adopt CAFM, using a scale similar to the one used in this study, and taking subsequent measurements at pre-specified time intervals. Additional variables such as age and size of facilities managed can be included to determine whether a change in those variables correlate with any change in the relationship between the perceptions of characteristics of an innovation and intention to adopt CAFM.

Implications for Managers

The findings provide important managerial implications. One key advantage of understanding the determinants of user intention is the opportunity that it presents for

organizational intervention. It is important to develop training interventions and implementation strategies that illustrate and disseminate the potential advantages associated with the target technology as evident by the significant effect of relative advantage on intention to adopt the applications. Further, the findings suggest that CAFM applications can be more successfully implemented if its tangible results are readily apparent or if users have a chance to try them before making adoption decision.

Another implication for FM managers is that understanding the limitations and causes of reluctance within the information system component (i.e., people, processes, business policies and strategies, management) may better explain current limitations with the use of CAFM systems than user's familiarity with CAFM applications themselves. Several comments from the open-ended questions indicate that CAFM application is a cultural change for an organization and that most implementations fail because IT component (i.e., hardware, software, and backbone infrastructure) leads the process, rather than IS (i.e., people, processes, business rules, policies, etc) leads initiatives. Therefore it is crucial to have active participation from top management as well as to prepare people in other levels for the implementation and related processes.

Limitations

The study has some limitations that should be considered when interpreting the results. First, the sample of the study was drawn from a single association. Given that other FM associations might have different perceptions toward intention to adopt CAFM, the findings may not generalizable to all FM professionals. Second, because the data were collected at a single point in time and not longitudinally, measuring intention to

adopt CAFM would unavoidably involve retrospective analysis for some of the managers who responded. In addition, the regression analyses were conducted in order to determine the effects of each construct. Structural equation modeling, which shows the effects of each construct from the perspective of the entire model, may also be used in further research, along with a refinement of the research model. Finally, the questionnaire attempted to receive insight information regarding FM professionals' experience of using CAFM but its questions might be too general to ask FM professionals' experience of using CAFM. Richer information could be obtained by posing more specific questions (e.g., for what type of tasks do you use CAFM?). However, open-ended questions might take time to complete, thus could further discourage respondents to answer them accordingly. Future researchers may need to modify those open-ended questions to encourage the willingness of participants to seriously answer them. This can be done by, for example, providing choice of reasons rather than leaving blank space to fill out.

Conclusion

This study carries out an on-line questionnaire survey to explore how the characteristics of innovation would affect FM professionals' intention to adopt CAFM systems. Research in FM field as well as Rogers' (1995) and other prior scholars' research on the characteristics of innovation have been reviewed, and a research model based on DOI theory was modified to better assess its empirical applicability to individual FM professionals. Exploratory factor analysis and Cronbach's alpha were

used to refine the survey instrument and to assess its validity and reliability, while stepwise regression analyses were conducted to test the hypotheses.

The findings from this study show that trialability, visibility, and result demonstrability, grouped as opportunities for experiencing CAFM, are antecedents to relative advantage and complexity and that relative advantage further positively relates to while complexity negatively relate to intention to adopt CAFM system. In addition, the results from the open-ended questions suggest that cost of implementation and difficulty in preparing people for change might cause limitations with the use of CAFM application.

By taking an integrative approach, the researcher was able to develop a rich understanding of the mechanisms underlying intention to adopt CAFM application among FM professionals. The factors that have been identified as important here should be actively managed and manipulated to fully realize the expected benefits from the investment in CAFM systems.

APPENDICES

APPENDIX A

INTRODUCTION E-MAIL & REMINDER E-MAILS

INTRODUCTION E-MAIL FOR THE PRETEST

Dear fellow IFMA members,

My name is Supornchai Saengratwatchara, an IFMA Michigan at Large member. I am a PhD candidate in Human Environment Design and Management at Michigan State University. I am writing this email to seek your help to do the pilot test for my dissertation.

My dissertation title is "Antecedents of Intention to Adopt Web-based Computer Aided Facility Management (CAFM) by Facility Managers." The purpose of this study is to examine factors that motivate FM professionals to adopt new technology, which in this case is Computer Aided Facility Management (CAFM). The questionnaire will ask your perceptions of intention to adopt CAFM, your background and/or experience of using CAFM, and some demographic questions. It will take approximately 15 minutes to complete the questionnaire.

Since the purpose of the study focuses on FM professionals, your response is critically important and I truly appreciate your help.

If you agree to fill out the questionnaire, please go to the following link:

http://www.surveymonkey.com/s.asp?u=731243602357

Thank you very much for your help. You response will certainly strengthen my research study.

Sincerely,

Supornchai Saengratwatchara

INTRODUCTION E-MAIL FOR THE MAIN STUDY

Dear fellow IFMA members,

My name is Supornchai Saengratwatchara, an IFMA Michigan at Large member. I am a PhD candidate in Human Environment Design and Management at Michigan State University. I am writing this email to seek your help to do the survey for my dissertation.

My dissertation title is "Antecedents of Intention to Adopt Web-based Computer Aided Facility Management (CAFM) by Facility Managers." The purpose of this study is to examine factors that motivate FM professionals to adopt new technology, which in this case is Computer Aided Facility Management (CAFM). The questionnaire will ask your perceptions of intention to adopt CAFM, your background and/or experience of using CAFM, and some demographic questions. It will take approximately 10-15 minutes to complete the questionnaire.

Since the purpose of the study focuses on FM professionals, your response is critically important and I truly appreciate your help.

If you agree to fill out the questionnaire, please go to the following link:

http://www.surveymonkey.com/s.aspx?sm=CkBK9SALd2kQ1DsU5tms6w_3d_3d

Thank you very much for your help. You response will certainly strengthen my research study.

Sincerely,

Supornchai Saengratwatchara (Artee)
PhD. Candidate in Human Environment: Design and Management
Department of Human Environment: Design and Management
College of Communication Arts & Sciences
Michigan State University

E-Mail: saengrat@msu.edu
Tel: 765.749.5147

REMINDER E-MAIL FOR THE MAIN STUDY

Dear fellow IFMA members,

This is the first reminder for the FM research on CAFM applications adoption. If you have already done the survey, please discard this e-mail and **THANK YOU VERY MUCH**. If you have not taken the survey, please take a moment to complete the survey. I CANNOT MOVE ON WITHOUT YOUR VALUABLE INPUT.

My name is Supornchai Saengratwatchara, an IFMA Michigan at Large member. I am a PhD candidate in Human Environment Design and Management at Michigan State University. I am writing this email to seek your help to do CAFM application adoption survey for my dissertation.

Since the purpose of the study focuses on IFMA members and FM professionals, your response is critically important and will certainly strengthen my research study. If you agree to complete the questionnaire, please go to the following link:

http://www.surveymonkey.com/s.aspx?sm=CkBK9SALd2kQ1DsU5tms6w%3d%3d

However, if you feel uncomfortable to participate in the study, you can OPT OUT by using the following link:

http://www.surveymonkey.com/OptOut.aspx

Thank you very much for your time. I truly appreciated.

Sincerely,

Supornchai Saengratwatchara (Artee)
PhD. Candidate in Human Environment: Design and Management
Department of Human Environment: Design and Management
College of Communication Arts & Sciences
Michigan State University

E-Mail: saengrat@msu.edu
Tel: 765.749.5147

Dear fellow IFMA members,

This is the second reminder for the FM research on CAFM applications adoption. If you have already done the survey, please discard this e-mail and **THANK YOU VERY MUCH**. If you have not taken the survey, please take a moment to complete the survey. I CANNOT MOVE ON WITHOUT YOUR VALUABLE INPUT.

My name is Supornchai Saengratwatchara, an IFMA Michigan at Large member. I am a PhD candidate in Human Environment Design and Management at Michigan State University. I am writing this email to seek your help to do CAFM application adoption survey for my dissertation.

Since the purpose of the study focuses on IFMA members and FM professionals, your response is critically important and will certainly strengthen my research study. If you agree to complete the questionnaire, please go to the following link:

http://www.surveymonkey.com/s.aspx?sm=CkBK9SALd2kQ1DsU5tms6w%3d%3d

However, if you feel uncomfortable to participate in the study, you can OPT OUT by using the following link:

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Thank you very much for your time. I truly appreciated.

Sincerely,

Supornchai Saengratwatchara (Artee)
PhD. Candidate in Human Environment: Design and Management
Department of Human Environment: Design and Management
College of Communication Arts & Sciences
Michigan State University

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Tel: 765.749.5147

APPENDIX B

CONSENT FORM AND QUESTIONNAIRE

CAFM Technology Adoption by IFMA Members and FM Professionals

1. INTRODUCTION

Dear fellow IFMA members:

My name is Supornchai Saengratwatchara. I am a Ph.D candidate in a Human Environment: Design and Management at Michigan State University. I am also a member of IFMA member, Michigan at-large. I am writing this email to ask for your help in research concerning facility management professionals' intention to adopt web-based computer aided facility management (CAFM).

This study seeks to learn what factors will encourage facility managers to utilize a Computer Aided Facility Management (CAFM) application in their work. Results from this study will be used to answer the following questions: What influences FM professionals to adopt CAFM? Is it merely the characteristics of the CAFM technology itself or are FM professionals also influenced by other issues, such as their predisposed tendency to try out a new technology?

A better understanding of factors that potentially motivate FM professionals when making adoption decisions is important because the expected benefits from the investments in new technology are realized only when they are adopted by their intended users and subsequently used. Moreover, by knowing more about facility managers' needs and backgrounds, the researcher will be able to work with application developers in creating the right application for the right task, which will further assist facility managers to work more effectively and with less effort.

This study assesses FM managers' intention to adopt web-based computer-aided facility management (CAFM). Participation in this study usually takes between 10-20 minutes and includes: (1) completing a questionnaire assessing your experience with CAFM (2) completing a questionnaire assessing your intention to adopt web-based CAFM, (3) answering some demographic questions.

This research is voluntary, that the participants can withdraw, or refuse to answer any particular questions. If you agree to take a few minutes of your valuable time to share your experiences and your opinions, please answer the informed consent below then click NEXT to enter the questionnaire. Your answers are completely confidential and will be released only as summaries in the form of study's results. No individual's answers will be identified. If you would like to have the results of this study, please include your contact information at the end of the questionnaire.

If you have any questions about this study, please contact the investigators:

Supornchai Saengratwatchara
PhD. Candidate
Department of Human Environments Design & Management
Michigan State University
East Lansing, MI 48824
Telephone: 765 -749 -5147
E-mail: saengrat@msu.edu

Jeffery Elsworth, Ph.D.
Assistant Professor
The School of Hospitality Business
Eli Broad College of Business
Michigan State University
243 Eppley Center
East Lansing, MI 48824-1121
Telephone: 517-353-9211
Fax: 517-432-1170
E-mail: elsworth@bus.msu.edu

If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any respect of this study, you may contact- anonymously, if you wish – Peter Vasilenko, Chair of Behavioral, Social Science Institutional Review Board by phone: (517) 355-2180, fax: (517) 432-4503, e-mail: irb@msu.edu., or regular mail: 202 Olds Hall, East Lansing, MI 48824-1047.

Thank you very much for helping this important research.

Sincerely,

Supornchai Saengratwatchara
Doctoral Student in Human Environments Design and Management

1. Please check one of these boxes to proceed:

- ◯ I have read the above and would like to participate.
- ◯ I would prefer not to participate at this time.

2. PART ONE

CAFM usage background

2. Have you heard about computer-aided facility management (CAFM)?

- ◯ YES
- ◯ NO

3. Part I (Continue): Have heard about CAFM

3. Do you currently use CAFM in your facility management work?

- ◯ YES
- ◯ NO

CAFM Technology Adoption by IFMA Members and FM Professionals

4. Part I (Continue)

4. How long have you been using CAFM or Web-based CAFM?

5. Please select one CAFM application from the list your company currently uses.

6. I use

- ◯ CAFM (including DataBASE, Spread sheet and, etc.)
- ◯ Web-based CAFM

5. Currently use CAFM not web-based CAFM

7. If you currently use CAFM, do you plan to upgrade to use web-based CAFM in the near future?

8. Please specify why you DO or DO NOT plan to upgrade to use web-based CAFM

6. Currently do not use CAFM or Web-based CAFM

9. If you currently do not use CAFM, do you plan to use either CAFM or web-based CAFM in the near future?

10. Please specify why you do or do not plan to use either CAFM or web-based CAFM

7. PART TWO

The following questions will help us to understand how you feel about using a web-based CAFM software application.

EVEN IF YOU HAVE NEVER USED A WEB-BASED CAFM SOFTWARE APPLICATION, PLEASE ANSWER THE QUESTIONS BASED ON HOW YOU THINK YOU WOULD USE ONE.

11. Please rate the following question by using scale 1 to 7 where 1= Strongly Disagree and 7 = Strongly Agree

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Moderately Agree	Strongly Agree
1. I have had a great deal of opportunity to try the web-based CAFM software application.	◯	◯	◯	◯	◯	◯	◯
2. I know where I can go to satisfactorily try out various uses of CAFM software.	◯	◯	◯	◯	◯	◯	◯
3. Before deciding whether to use web-based CAFM software application, I would be able to properly try it out.	◯	◯	◯	◯	◯	◯	◯
4. I was permitted to use web-based CAFM on a trial basis long enough to see what it can do.	◯	◯	◯	◯	◯	◯	◯
5. I would have no difficulty telling others about my experience using web-based CAFM.	◯	◯	◯	◯	◯	◯	◯
6. I believe I could communicate to others the consequences of using the web-based CAFM.	◯	◯	◯	◯	◯	◯	◯
7. The results of using web-based CAFM are apparent to me.	◯	◯	◯	◯	◯	◯	◯
8. I would have difficulty explaining why using web-based CAFM may or may not be beneficial.	◯	◯	◯	◯	◯	◯	◯

9. I have seen what others do using web-based CAFM.	○	○	○	○	○	○	○
10. I have seen many people using web-based CAFM.	○	○	○	○	○	○	○
11. I have not seen many others using web-based CAFM.	○	○	○	○	○	○	○
12. I have seen web-based CAFM in use outside my organization.	○	○	○	○	○	○	○

12. Please rate the following question by using scale 1 to 7 where 1= Strongly Disagree and 7 = Strongly Agree

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Moderately Agree	Strongly Agree
13. Using web-based CAFM would enable me to accomplish tasks more quickly.	○	○	○	○	○	○	○
14. Using web-based CAFM would improve the quality of my work.	○	○	○	○	○	○	○
15. Using web-based CAFM would make it easier for me and my staff to do our jobs.	○	○	○	○	○	○	○
16. Using web-based CAFM would enable me to work more effectively.	○	○	○	○	○	○	○
17. Using web-based CAFM would give me greater control over my work.	○	○	○	○	○	○	○
18 . Using web-based CAFM would improve my job performance.	○	○	○	○	○	○	○
19. Using web-based CAFM is often frustrating.	○	○	○	○	○	○	○
20. I would find it easy to get web-based CAFM to do what I want it to do.	○	○	○	○	○	○	○
21. I would find web-based CAFM easy to use.	○	○	○	○	○	○	○
22. Learning to use web-based CAFM would be easy for me.	○	○	○	○	○	○	○
23. Overall, I believe that using web-based CAFM is easy for me.	○	○	○	○	○	○	○

13. Please rate the following question by using scale 1 to 7 where 1= Strongly Disagree and 7 = Strongly Agree

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Moderately Agree	Strongly Agree
24. I intend to use web-based CAFM when they are available.	○	○	○	○	○	○	○
25. To the extent possible, I would use web-based CAFM to do various facility management tasks.	○	○	○	○	○	○	○
26. To the extent possible, I would use web-based CAFM frequently.	○	○	○	○	○	○	○

27. It would be much better for me to use web-based CAFM for facility management activities in addition to traditional methods.	○	○	○	○	○	○	○
28. Overall, I like using web-based CAFM for facility management.	○	○	○	○	○	○	○
29. I intent to use web-based CAFM in my job in the future	○	○	○	○	○	○	○

8. PART THREE

Please provide the following information about yourself. Please note that the information will be kept completely confidential, will never be linked to your name, and will be reported only in aggregate form.

14. Your Gender?

15. Your age category?

16. The highest level of education you have completed is

17. What is your job function?

18. Type of facility manage

19. What is the size of your facility?

20. Please use the list below to indicate your most important responsibility as a FM manager

21. To which IFMA chapter do you belong?

STATE

ZIP CODE

22. Comments:

9. THANK YOU

THANK YOU VERY MUCH FOR YOUR PARTICIPATION

23. If you would like to have the results of this study, please provide your e-mail address below:

APPENDIX C

SUMMARY OF THE RESULTS

CAFM Technology Adoption by IFMA Members and FM Professionals

1. Please check one of these boxes to proceed:

	Response Percent	Response Count
I have read the above and would like to participate.	**85.3%**	453
I would prefer not to participate at this time.	14.7%	78
	answered question	**531**
	skipped question	**0**

2. Have you heard about computer-aided facility management (CAFM)?

	Response Percent	Response Count
YES	**92.5%**	417
NO	7.5%	34
	answered question	**451**
	skipped question	**80**

3. Do you currently use CAFM in your facility management work?

	Response Percent	Response Count
YES	**55.9%**	233
NO	44.1%	184
	answered question	**417**
	skipped question	**114**

4. How long have you been using CAFM or Web-based CAFM?

	Response Percent	Response Count
Less than 1 Year	6.8%	15
More than 1 - 3 Years	18.1%	40
More than 3 - 5 Years	15.4%	34
More than 5 - 10 Years	**36.7%**	81
More than 10 - 15 Years	13.6%	30
More than 15- 20 Years	7.2%	16
More than 20 Years	2.7%	6
	answered question	**221**
	skipped question	**310**

5. Please select one CAFM application from the list your company currently uses.

	Response Percent	Response Count
ABBOTT SPACE System	0.0%	0
Aperture	6.3%	14
Archibus/FM	22.6%	50
Autodesk FMDesktop	3.6%	8
CAFM EXPLORER	0.5%	1
CAFMTools & PlanSecure	0.5%	1
CenterStone	2.7%	6
Concept SQL	0.0%	0
Drawbase & DecisionBase Professional	0.0%	0
Facility Information Systems (FIS/FM)	2.7%	6
FM: Systems	8.1%	18
fmWEB	0.0%	0
HP OpenView	0.0%	0
MaintenanceFirst	0.0%	0
MicroMain FM	1.4%	3

Peregrine Systems	0.9%	2
Planet FM Enterprise	0.0%	0
QFM Facility Management	0.0%	0
SD-I	0.0%	0
TRIRIGA	12.7%	28
VisionFM	0.9%	2
Other (please specify)	**37.6%**	83
	answered question	**221**
	skipped question	**310**

6. I use

	Response Percent	Response Count
CAFM (including DataBASE, Spread sheet and, etc.)	**53.4%**	118
Web-based CAFM	47.1%	104
	answered question	**221**
	skipped question	**310**

7. If you currently use CAFM, do you plan to upgrade to use web-based CAFM in the near future?

	Response Percent	Response Count
YES	**65.5%**	74
NO	34.5%	39
	answered question	**113**
	skipped question	**418**

8. Please specify why you DO or DO NOT plan to upgrade to use web-based CAFM

	Response Count
	113
answered question	**113**
skipped question	**418**

9. If you currently do not use CAFM, do you plan to use either CAFM or web-based CAFM in the near future?

	Response Percent	Response Count
YES	**54.3%**	94
NO	45.7%	79
	answered question	**173**
	skipped question	**358**

10. Please specify why you do or do not plan to use either CAFM or web-based CAFM

	Response Count
	173
answered question	**173**
skipped question	**358**

11. Please rate the following question by using scale 1 to 7 where 1= Strongly Disagree and 7 = Strongly Agree

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Moderately Agree	Strongly Agree	**Rating Average**	**Response Count**
1. I have had a great deal of opportunity to try the web-based CAFM software application.	**20.8% (71)**	10.3% (35)	8.8% (30)	10.9% (37)	17.0% (58)	18.8% (64)	13.5% (46)	4.03	341
2. I know where I can go to satisfactorily try out various uses of CAFM software.	15.2% (52)	12.9% (44)	9.1% (31)	7.9% (27)	17.6% (60)	**21.1% (72)**	16.1% (55)	4.28	341
3. Before deciding whether to use web-based CAFM software application, I would be able to properly try it out.	3.5% (12)	3.5% (12)	3.8% (13)	10.0% (34)	15.5% (53)	27.3% (93)	**36.4% (124)**	5.58	341
4. I was permitted to use web-based CAFM on a trial basis long enough to see what it can do.	22.9% (78)	9.7% (33)	5.6% (19)	**27.9% (95)**	9.1% (31)	14.1% (48)	10.9% (37)	3.76	341
5. I would have no difficulty telling others about my experience using web-based CAFM.	6.5% (22)	2.3% (8)	2.9% (10)	17.9% (61)	14.1% (48)	**28.7% (98)**	27.6% (94)	5.27	341

6. I believe I could communicate to others the consequences of using the web-based CAFM.	5.9% (20)	3.8% (13)	2.3% (8)	19.9% (68)	12.9% (44)	**32.3% (110)**	22.9% (78)	5.18	341
7. The results of using web-based CAFM are apparent to me.	8.5% (29)	4.4% (15)	2.9% (10)	17.0% (58)	17.6% (60)	**26.4% (90)**	23.2% (79)	5.03	341
8. I would have difficulty explaining why using web-based CAFM may or may not be beneficial.	**22.3% (76)**	21.1% (72)	16.1% (55)	19.1% (65)	8.8% (30)	8.8% (30)	3.8% (13)	3.13	341
9. I have seen what others do using web-based CAFM.	15.5% (53)	7.6% (26)	9.1% (31)	18.2% (62)	16.4% (56)	**18.5% (63)**	14.7% (50)	4.26	341
10. I have seen many people using web-based CAFM.	19.6% (67)	13.2% (45)	11.7% (40)	**21.1% (72)**	15.0% (51)	12.0% (41)	7.3% (25)	3.64	341
11. I have not seen many others using web-based CAFM.	9.7% (33)	14.1% (48)	11.1% (38)	17.3% (59)	13.8% (47)	15.8% (54)	**18.2% (62)**	4.32	341
12. I have seen web-based CAFM in use outside my organization.	19.4% (66)	7.9% (27)	5.9% (20)	9.7% (33)	**22.6% (77)**	19.1% (65)	15.5% (53)	4.28	341
							answered question		**341**
							skipped question		**190**

12. Please rate the following question by using scale 1 to 7 where 1= Strongly Disagree and 7 = Strongly Agree

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Moderately Agree	Strongly Agree	**Rating Average**	**Response Count**
13. Using web-based CAFM would enable me to accomplish tasks more quickly.	1.8% (6)	2.6% (9)	3.5% (12)	24.6% (84)	21.1% (72)	**26.4% (90)**	19.9% (68)	5.20	341
14. Using web-based CAFM would improve the quality of my work.	1.8% (6)	2.9% (10)	2.3% (8)	23.2% (79)	22.9% (78)	**27.6% (94)**	19.4% (66)	5.23	341
15. Using web-based CAFM would make it easier for me and my staff to do our jobs.	1.2% (4)	2.3% (8)	2.3% (8)	19.6% (67)	20.2% (69)	**31.1% (106)**	23.2% (79)	5.41	341
16. Using web-based CAFM would enable me to work more effectively.	1.5% (5)	1.8% (6)	2.6% (9)	19.1% (65)	21.4% (73)	**29.6% (101)**	24.0% (82)	5.42	341
17. Using web-based CAFM would give me greater control over my work.	1.8% (6)	2.6% (9)	2.6% (9)	24.0% (82)	**25.8% (88)**	24.9% (85)	18.2% (62)	5.17	341
18 . Using web-based CAFM would improve my job performance.	2.3% (8)	2.1% (7)	4.1% (14)	26.1% (89)	23.2% (79)	**27.0% (92)**	15.2% (52)	5.08	341
19. Using web-based CAFM is often frustrating.	4.7% (16)	8.8% (30)	11.4% (39)	**48.1% (164)**	16.4% (56)	7.9% (27)	2.6% (9)	3.97	341

20. I would find it easy to get web-based CAFM to do what I want it to do.	1.8% (6)	5.0% (17)	11.1% (38)	**41.6% (142)**	19.1% (65)	16.7% (57)	4.7% (16)	4.40	341
21. I would find web-based CAFM easy to use.	1.2% (4)	2.1% (7)	8.2% (28)	**39.0% (133)**	20.2% (69)	21.1% (72)	8.2% (28)	4.71	341
22. Learning to use web-based CAFM would be easy for me.	0.6% (2)	3.2% (11)	6.2% (21)	26.4% (90)	22.0% (75)	**28.4% (97)**	13.2% (45)	5.04	341
23. Overall, I believe that using web-based CAFM is easy for me.	1.5% (5)	1.8% (6)	5.0% (17)	**32.6% (111)**	20.2% (69)	26.1% (89)	12.9% (44)	4.98	341
							answered question		**341**
							skipped question		**190**

13. Please rate the following question by using scale 1 to 7 where 1= Strongly Disagree and 7 = Strongly Agree

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Moderately Agree	Strongly Agree	**Rating Average**	**Response Count**
24. I intend to use web-based CAFM when they are available.	2.6% (9)	2.1% (7)	3.2% (11)	**25.8% (88)**	18.8% (64)	24.9% (85)	22.6% (77)	5.21	341
25. To the extent possible, I would use web-based CAFM to do various facility management tasks.	2.3% (8)	1.8% (6)	1.5% (5)	16.1% (55)	18.5% (63)	**32.6% (111)**	27.3% (93)	5.53	341

26. To the extent possible, I would use web-based CAFM frequently.	2.3% (8)	1.8% (6)	1.8% (6)	18.2% (62)	19.1% (65)	**30.8% (105)**	26.1% (89)	5.47	341
27. It would be much better for me to use web-based CAFM for facility management activities in addition to traditional methods.	1.8% (6)	2.6% (9)	2.3% (8)	23.8% (81)	17.0% (58)	**29.9% (102)**	22.6% (77)	5.32	341
28. Overall, I like using web-based CAFM for facility management.	1.5% (5)	0.6% (2)	2.1% (7)	**40.2% (137)**	14.1% (48)	23.2% (79)	18.5% (63)	5.08	341
29. I intent to use web-based CAFM in my job in the future	2.6% (9)	2.3% (8)	1.5% (5)	24.9% (85)	16.1% (55)	26.1% (89)	**26.4% (90)**	5.33	341
							answered question		**341**
							skipped question		**190**

14. Your Gender?

	Response Percent	**Response Count**
Male	**71.1%**	239
Female	28.9%	97
	answered question	**336**
	skipped question	**195**

15. Your age category?

	Response Percent	Response Count
Less than 20 years	0.3%	1
20 - 29 years	3.0%	10
30 - 39 years	14.3%	48
40 - 49 years	**38.7%**	130
50 - 59 years	33.3%	112
60 - 69 years	9.2%	31
70 + years	1.2%	4
answered question		**336**
skipped question		**195**

16. The highest level of education you have completed is

	Response Percent	Response Count
High school/GED	2.1%	7
Some college	15.5%	52
2-Year college degree (Associates)	11.3%	38
4-Year college degree (BA, BS, BFA)	**42.0%**	141
Master's degree (MA, MS, MBA, MFA)	25.3%	85
Doctoral Degree	1.5%	5
Professional Degree (MD, JD)	2.4%	8
	answered question	**336**
	skipped question	**195**

17. What is your job function?

	Response Percent	Response Count
Non-supervisory Staff	4.5%	15
Supervisor	7.1%	24
Functional Manager	18.2%	61
Department Manager	**27.7%**	93
Senior Management/Director/Vice President	25.9%	87
Senior Executive/Chief Executive Officer/Executive Vice President	3.6%	12
Other (please specify)	13.1%	44
	answered question	**336**
	skipped question	**195**

18. Type of facility manage

	Response Percent	Response Count
Oil Industry	0.3%	1
Telecommunication	3.3%	11
Academic Facilities	6.9%	23
Aerospace/Airport Facilities	1.8%	6
Banking/Finance/Accounting	8.6%	29
Business Services/Consultant	4.2%	14
Communications Carrier	0.9%	3
Computer Manufacturer (Hardware, software, peripherals)	5.1%	17
Computer/Network Services/Consultant	0.6%	2
Computer Related Retailer/Wholesaler/Distributor	0.3%	1
Construction/Architecture/Engineering	2.4%	8
Data Processing Services	0.6%	2
Government Federal Government (including military)	5.4%	18
Government State/Local	9.8%	33
Healthcare Facilities	3.6%	12

Insurance/Real Estate/Legal	5.7%	19
Internet Service Provider (ISP) or Application Service Provider (ASP)	0.6%	2
Manufacturing and Process Industries (Noncomputer)	2.7%	9
Marketing/Advertising/Entertainment	0.3%	1
Online Retailer	0.0%	0
Research/Development Lab	4.2%	14
Transportation/Utilities	3.0%	10
Wholesale/Retail/Distribution	1.2%	4
Other (please specify)	**28.9%**	97
	answered question	**336**
	skipped question	**195**

19. What is the size of your facility?

	Response Percent	Response Count
Less than 100,000 sq.ft (9,000 sq.meters)	12.5%	42
100,000 – 250,000 sq.ft (23,000 sq. meters)	15.5%	52
250,001 – 500,000 sq.ft (46,000 sq. meters)	12.5%	42
500,001 – 750,000 sq.ft (70,000 sq. meters)	11.6%	39
750,001 – 1,000,000 sq.ft (93,000 sq. meters)	10.1%	34
1,000,000 – 2,500,000 sq.ft (232,000 sq. meters)	18.5%	62
Greater than 2,500,000 sq.ft (232,000 sq. meters)	**19.4%**	65
	answered question	**336**
	skipped question	**195**

20. Please use the list below to indicate your most important responsibility as a FM manager

	Response Percent	Response Count
Contract administration	3.9%	13
Construction management	7.7%	26
Energy management	1.2%	4
Move management	1.8%	6
Space planning	11.0%	37
Operation and maintenance management	**44.9%**	151
Disaster planning and recovery	1.2%	4
Furniture management	1.5%	5
Strategic planning	17.6%	59
Security planning	0.0%	0
Budgeting management	9.2%	31
	answered question	**336**
	skipped question	**195**

21. To which IFMA chapter do you belong?

	Response Percent	Response Count
STATE	**100.0%**	336
ZIP CODE	**100.0%**	336
	answered question	**336**
	skipped question	**195**

22. Comments:

	Response Count
	75
answered question	**75**
skipped question	**456**

23. If you would like to have the results of this study, please provide your e-mail address below:

	Response Count
	207
answered question	**207**
skipped question	**324**

APPENDIX D

HUMAN SUBJECT COMMITTEE APPROVAL

MICHIGAN STATE
UNIVERSITY

Initial IRB Application Determination *Exempt*

June 6, 2007

To: Jeffrey D. ELSWORTH
243 Eppley Center

Re: **IRB # X07-521** Category: EXEMPT 2
Approval Date: June 4, 2007

Title: ANTECEDENTS OF INTENTION TO ADOPT WEB-BASED COMPUTER AIDED FACILITY MANAGEMENT (CAFM) BY FACILITY MANAGER

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been deemed as exempt** in accordance with federal regulations.

The IRB has found that your research project meets the criteria for exempt status and the criteria for the protection of human subjects in exempt research. **Under our exempt policy the Principal Investigator assumes the responsibilities for the protection of human subjects** in this project as outlined in the assurance letter and exempt educational material. The IRB office has received your signed assurance for exempt research. A copy of this signed agreement is appended for your information and records.

Renewals: Exempt protocols do not need to be renewed. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: Exempt protocols do not require revisions. However, if changes are made to a protocol that may no longer meet the exempt criteria, a new initial application will be required.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants regarding the risk and benefits of the project must be reported to the IRB.

Follow-up: If your exempt project is not completed and closed after three years, the IRB office will contact you regarding the status of the project and to verify that no changes have occurred that may affect exempt status.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Peter Vasilenko, Ph.D.
SIRB Chair

c: Supornchai Saengratwatchara
405 S Morrison Rd Apt#81
Muncie, IN 47304

Principal Investigator Assurance of An Exempt Protocol

Name of Principal Investigator: Jeffrey D. Elsworth

JUN 04 2007

Title of Project: Antecedents of Intention to Adopt Web-based Computer Aided Facility Management (CAFM) by Facility Manager

IRB #: X07-521

The Human Research Protection Program (HRPP) has deemed this project as exempt, in accord in federal regulations of projects exempt from Institutional Review Board (IRB) review. As an exempt protocol, the appropriate IRB will not be further involved with the review or continued review of the projects, as long as the project maintains the properties that make it exempt.

- Since the HRPP is no longer involved in the review and continued review of this project, it is the Principal Investigator who assumes the responsibilities of protection human subjects in this project and ensures that the project is performed with integrity and within accepted ethical standards, particularly as outlined by the Belmont Report (see exempt educational materials).

- The Principal Investigator assumes responsibility for ensuring that the research subjects be informed of the research through a documented or undocumented consent process, if appropriate.

- The Principal Investigator assumes the responsibility to maintain confidentiality of the subjects and the data, and maintain the privacy of the subjects and protection of the data through appropriate means. If data is anonymous, the investigators will make no attempt to identify any individuals.

- The Principal Investigator assumes the responsibility that co-investigators and other members of the research team adhere to the appropriate policies to protection human subjects, maintain confidentiality and privacy, and adhere to accepted ethical standards.

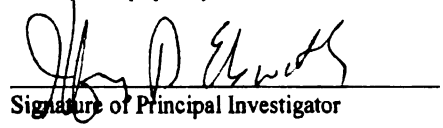
- If the Principal Investigator adds additional investigators to an exempt protocol, he/she may inform the HRPP of the additions. This may be of particular importance to graduate students if the Graduate School requires proof of IRB approval.

- Any complaints from participants regarding the risk and benefits of the project must be reported to the HRPP.

- Since the Principal Investigator and co-investigators are charged with human subject protection and adhering to ethical principles in exempt research, it is appropriate that investigators be trained in human subject principles. The Principal Investigator and all members of the research team are required to complete MSU IRB educational requirements or equivalent.

- Any change in the protocol which may raise the project from exempt to an expedited or full review category must be presented to the HRPP. If there is any question about a change in protocol the Principal Investigator should consult the Director of the HRPP. Failure to submit changes which raise the protocol out of the exempt category will be considered non-compliance and will be subject to investigation and action by the HRPP.

By signing below, the Principal Investigator assures that he/she will abide by the terms of this assurance and the HRPP exempt policy.



Signature of Principal Investigator

5/30/07

Date

05/05/05

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